ROBOTICS

Product manual

IRB 14050

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Product manual

IRB 14050-0.5/0.5

OmniCore

Document ID: 3HAC064625-001

Revision: Q

Original instructions.

Table of contents

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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.

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

A 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.

Product manual scope

The manual covers covers all variants and designs of the IRB 14050. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

Organization of chapters

The manual is organized in the following chapters:

Chapter	Contents
Safety, service	Safety information that must be read through before performing any installation or service work on 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.

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Chapter	Contents
Calibration information	Procedures that do not require specific calibration equipment. General information about calibration.
Decommissioning	Environmental information about the robot and its components.
Reference information	Useful information when performing installation, maintenance or repair work. Includes lists of necessary tools, additional documents, safety standards, etc.

References

Documentation referred to in the manual, is listed in the table below.

Document name	Document ID
Product manual, spare parts - IRB 14050	*3HAC064628-001*
Product specification - IRB 14050	*3HAC064627-001*
Product manual - Grippers for IRB 14050	*3HAC064626-001*
Circuit diagram - IRB 14050	*3HAC064375-009*
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*
Product manual - OmniCore C30	*3HAC060860-001*
Technical reference manual - Event logs for RobotWare 7	*3HAC066553-001*
Technical reference manual - System parameters	*3HAC065041-001*
Application manual - Scalable I/O	*3HAC070208-001*
Application manual - Conveyor tracking	*3HAC066561-001*
Application manual - Functional safety and SafeMove	*3HAC066559-001*

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

Revisions

Revision	Description
A	First edition.
B	Published in release 19C. The following updates are done in this revision: • Updated the safety functions. • Updated the UL label figure. • Updated dimension figure and base hole configuration figure.
C	Published in release 20A. The following updates are done in this revision: • Added information about SafeMove. • Added new section about installation of ABB grippers. • Added information about Type A which has a reinforced design. • Updated robot arm dimension figure. • FlexPendant terminology updated for calibration procedures.
D	Published in release 20B. The following updates are done in this revision: • Corrected the quantity of washers for securing robot to the foundation. • Updated robot arm dimension.
E	Published in release 20C. The following updates are done in this revision: • Added note to revolution counter update procedure.

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Revision	Description
F	Published in release 20D. The following updates are done in this revision: • Added note about default configuration of emergency stop. • Added software version requirement for selecting arm configuration of Type A during system installation. • Updated the calibration procedure using the **Calibration** method.
G	Published in release 21A. The following updates are done in this revision: • Added note about dropping axes, see *Manually releasing the brakes on page 56*.
H	Published in release 21B. The following updates are done in this revision: • Added information about joint torques, see *Joint torques on page 42*. • Text regarding diameter of air hoses is updated, see *Connection points on page 60*. • Added delivery information about the attachment screws, see *Specification, attachment screws and pins on page 54*. • Removed maintenance activity of inspecting oil seepage and updated troubleshooting description about oil and grease stains on motors and gearboxes.
J	Published in release 21D. The following updates are done in this revision: • Added information about how to set the system parameters for a suspended/inverted or a tilted robot.
K	Published in release 22A. The following updates are made in this revision: • Clean Room option added. • Updated information about Gleitmo treated screws, see *Screw joints on page 363*.
L	Published in release 22C. The following updates are done in this revision: • Updated information label figure.
M	Published in release 22D. The following updates are done in this revision: • Added information about Wrist Optimization in calibration chapter.
N	Published in release 23A. The following updates are done in this revision: • Added information about maintenance activity of robot overhaul.
P	Published in release 23B. The following updates are done in this revision: • Updated the information about revolution counter update. • Updated figure showing the hole configuration on the base.
Q	Published in release 23C. The following updates are done in this revision: • Updated article number of robot signal cable from 3HAC067446-00*X* to 3HAC084767-00*X*.

Product documentation

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.

Tip

All documents can be found via myABB Business Portal, *www.abb.com/myABB*.

Product manuals

Manipulators, controllers, DressPack, 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.
- Troubleshooting.
- Decommissioning.
- Reference information (safety standards, unit conversions, screw joints, lists of tools).
- Spare parts list with corresponding figures (or references to separate spare parts lists).
- References to circuit diagrams.

Technical reference manuals

The technical reference manuals describe reference information for robotics products, for example lubrication, the RAPID language, and system parameters.

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, software).
- How to install included or required hardware.
- How to use the application.

Continues on next page

- 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 troubleshooters.

How to read the product manual

Reading the procedures

The procedures contain all information required for the installation or service activity and can be printed out separately when needed for a certain service procedure.

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 15*.

Illustrations

The product 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 product models, can be illustrated with illustrations that show a different product model than the one that is described in the current manual.

1 Safety

1.1 Safety information

1.1.1 Limitation of liability

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.

The information does not cover how to design, install and operate a robot system, nor does it cover all peripheral equipment that can influence the safety of the robot system.

In particular, liability cannot be accepted if injury or damage has been caused for any of the following reasons:

- Use of the robot in other ways than intended.
- Incorrect operation or maintenance.
- Operation of the robot when the safety devices are defective, not in their intended location or in any other way not working.
- When instructions for operation and maintenance are not followed as intended.
- Non-authorized design modifications of the robot.
- Repairs on the robot and its spare parts carried out by in-experienced or non-qualified personnel.
- Foreign objects.
- Force majeure.

Spare parts and equipment

ABB supplies original spare parts and equipment which have been tested and approved for their intended use. The installation and/or use of non-original spare parts and equipment can negatively affect the safety, function, performance, and structural properties of the robot. ABB is not liable for damages caused by the use of non-original spare parts and equipment.

1.1.2 Requirements on personnel

General

Only personnel with appropriate training are allowed to install, maintain, service, repair, and use the robot. This includes electrical, mechanical, hydraulics, pneumatics, and other hazards identified in the risk assessment.

Persons who are under the influence of alcohol, drugs or any other intoxicating substances are not allowed to install, maintain, service, repair, or use the robot.

The plant liable must make sure that the personnel is trained on the robot, and on responding to emergency or abnormal situations.

Personal protective equipment

Use personal protective equipment, as stated in the instructions.

1.2 Safety signals and symbols

1.2.1 Safety signals in the manual

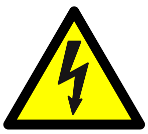
Introduction to safety signals

This section specifies all safety signals used in the user manuals. Each signal consists of:

- A caption specifying the hazard level (DANGER, WARNING, or CAUTION) and the type of hazard.
- Instruction about how to reduce the hazard to an acceptable level.
- A brief description of remaining hazards, if not adequately reduced.

Hazard levels

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

Symbol	Designation	Significance
	DANGER	Signal word used to indicate an imminently hazardous situation which, if not avoided, will result in serious injury.
	WARNING	Signal word used to indicate a potentially hazardous situation which, if not avoided, could result in serious injury.
	ELECTRICAL SHOCK	Signal word used to indicate a potentially hazardous situation related to electrical hazards which, if not avoided, could result in serious injury.
	CAUTION	Signal word used to indicate a potentially hazardous situation which, if not avoided, could result in slight injury.
	ELECTROSTATIC DISCHARGE (ESD)	Signal word used to indicate a potentially hazardous situation which, if not avoided, could result in severe damage to the product.
	NOTE	Signal word used to indicate important facts and conditions.

Continues on next page

Symbol	Designation	Significance
	TIP	Signal word used to indicate where to find additional information or how to do an operation in an easier way.

1.2.2 Safety symbols on manipulator labels

Introduction to symbols

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

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 symbols on the labels on the product must be observed. Additional symbols added by the integrator must also be observed.

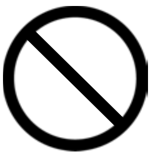
Types of symbols

Both the manipulator and the controller are marked with symbols, containing important information about the product. This is important for all personnel handling the robot, for example during installation, service, or operation.

The safety labels are language independent, they only use graphics. See *Symbols on safety labels on page 19*.

The information labels can contain information in text.

Symbols on safety labels

Symbol	Description
 xx0900000812	**Warning!** Warns that an accident *may* 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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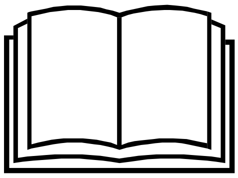
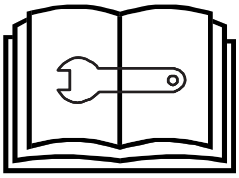
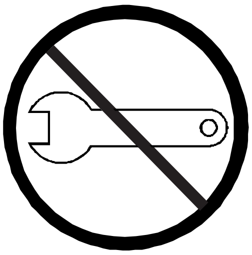
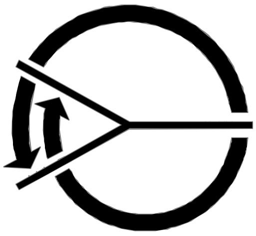
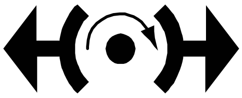
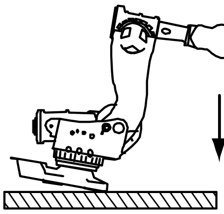
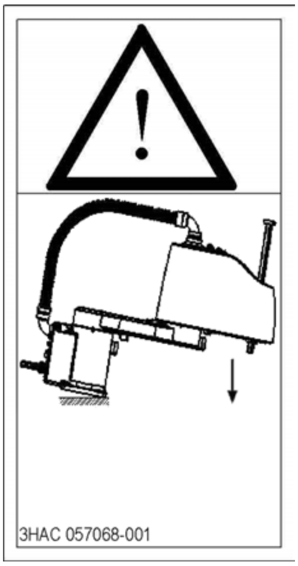
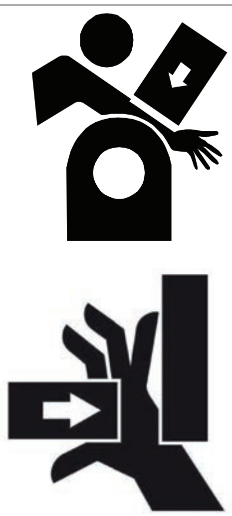
Symbol	Description
 xx0900000813	**See user documentation** Read user documentation for details. Which manual to read is defined by the symbol: • No text: *Product manual*.
 xx0900000816	**Before disassembly, see product manual**
 xx0900000815	**Do not disassemble** Disassembling this part can cause 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.

Continues on next page

Symbol	Description
 xx0900000810  xx1500002402	**Tip risk when loosening bolts** The robot can tip over if the bolts are not securely fastened.
 xx0900000817	**Crush** Risk of crush injuries.

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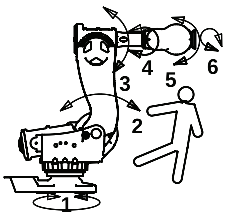
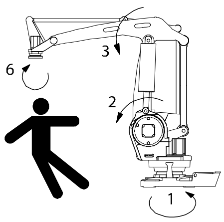
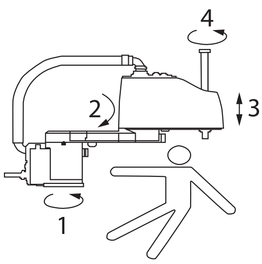
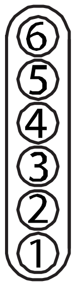
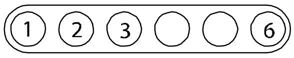
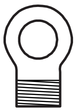
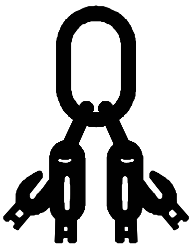
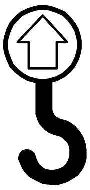
Symbol	Description
 xx0900000818  xx1300001087	**Heat** Risk of heat that can cause burns. (Both signs are used)
 xx0900000819  xx1000001141  xx1500002616	**Moving robot** The robot can move unexpectedly.

Continues on next page

Symbol	Description
 xx0900000820  xx1000001140	**Brake release buttons**
 xx0900000821	**Lifting bolt**
 xx1000001242	**Adjustable 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**

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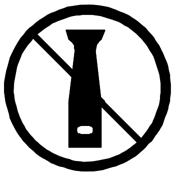
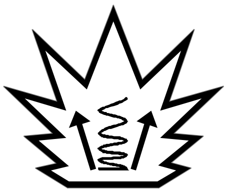
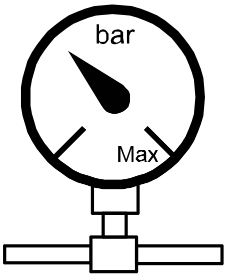
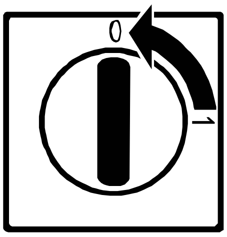
Symbol	Description
 xx1000001144	**No mechanical stop**
 xx0900000825	**Stored energy** Warns that this part contains stored energy. Used in combination with *Do not disassemble* symbol.
 xx0900000826	**Pressure** Warns that this part is pressurized. Usually contains additional text with the pressure 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.

1.3 Robot stopping functions

Protective stop and emergency stop

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

For more information see:

- *Product manual - OmniCore C30*

1.4 Safety during installation and commissioning

National or regional regulations

The integrator of the robot system is responsible for the safety of the robot system.

The integrator is responsible that the robot system is designed and installed in accordance with the safety requirements set forth in the applicable national and regional standards and regulations.

The integrator of the robot system is required to perform a risk assessment.

Layout

The robot integrated to a robot system shall be designed to allow safe access to all spaces during installation, operation, maintenance, and repair.

If robot movement can be initiated from an external control panel then an emergency stop must also be available.

Consider exposure to hazards, such as slipping, tripping, and falling.

Hazards due to the working position and posture for a person working with or near the robot shall be considered.

Hazards due to noise emission from the robot needs to be considered.

Allergenic material

See *Environmental information on page 354* for specification of allergenic materials in the product, if any.

Securing the robot to the foundation

The robot must be properly fixed to its foundation/support, as described in the respective product manual.

When the robot is installed at a height, hanging, or other than mounted directly on the floor, there will be additional hazards.

Electrical safety

Incoming mains must be installed to fulfill national regulations.

The power supply wiring to the robot must be sufficiently fused and if necessary, it must be possible to disconnect it manually from the mains power.

The power to the robot must be turned off with the main switch and the mains power disconnected when performing work inside the controller cabinet. Lock and tag shall be considered.

Harnesses between controller and manipulator shall be fixed and protected to avoid tripping and wear.

Wherever possible, power on/off or rebooting the robot controller shall be performed with all persons outside the safeguarded space.

Note

Use a CARBON DIOXIDE (CO_2) extinguisher in the event of a fire in the robot.

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Safety devices

The integrator is responsible for that the safety devices necessary to protect people working with the robot system are designed and installed correctly.

When integrating the robot with external devices to a robot system:

- The integrator of the robot system must ensure that emergency stop functions are interlocked in accordance with applicable standards.
- The integrator of the robot system must ensure that safety functions are interlocked in accordance with applicable standards.

Other hazards

The risk assessment should also consider other hazards arising from the application, such as, but not limited to:

- Water
- Compressed air
- Hydraulics

End-effector hazards require particular attention for applications which involve close human collaboration with the robot.

Specific information for YuMi robots

General

The YuMi robot is intended for collaborative applications where contact between robot and the operator is harmless. The robot is designed to comply with ISO 10218-1, §5.10.5. Power and force limiting by inherent design or control. This is achieved by inherent design measures in the robot arm and control system.

Details are given in the following sections.[1]

Mechanical design measures

The power and force of the robot is limited mechanically by:

- Light weight
- Low payload (500 gram)
- Weak drivetrain that can be stopped and overridden by hand
- Soft and round outer shell (Regular inspection of the outer shell is required. See *Inspecting, plastic and padding on page 84*)
- No sharp edges or pinch points

Grippers, end effectors and work pieces

The YuMi gripper from ABB is designed to allow manual release and removal of gripped work pieces. Both servo and vacuum modules can be overridden by manual force.

End tools, such as fingers and suction tools, as well as work pieces handled by the robot, must be designed and chosen so that such contact does not introduce safety hazards.

The integrator shall include grippers, end effectors and work pieces in the risk assessment. See also ISO/TS15066.

1 See also technote_150918.

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Personal protective equipment

Sensitive body parts, such as the eyes and the larynx, must be protected by personal protective equipment (PPE).

Safety function

The following safety function is an inherent design measure in the control system, contributing to power and force limiting. The safety function is category B, performance level b, according to EN ISO 13849-1.

Safety function	Description
Cartesian speed supervision	The Cartesian speed of the elbow (arm check point, ACP) and the wrist (wrist center point, WCP) are supervised. If a limit is exceeded, the robot motion is stopped and a message displayed to the user. The default speed limit can be modified based on the risk assessment of the robot installation. The function is active in both manual and automatic mode. The speed limits are set by system parameters, in the topic *Motion*, type *Robot*.

Safety hazards in collaborative application

The arm and gripper must be inspected at frequent intervals to make sure that there are no damages to plastic, padding, or other components.

The arm must not be used without reducing the hazards related to the tool flange.

Pneumatic related hazards

The compressed air used in the robot system must not exceed the rated limit for the manipulator. Use pressure relief valves.

All pipes, hoses and connections within the robot shall be inspected regularly for leaks and damage. Damages must be repaired immediately.

The compressed air used in the robot system might remain after robot main power has been switched off. Compressed air shall be considered in the risk assessment.

Pressure relief valves

The pressure relief valve prevents too much air pressure being built up inside the robot. The air pressure must not exceed the rated limit for the manipulator, or there is a risk of personal injury and mechanical damage.

Pressure relief valves must be kept clean.

Verify the safety functions

Before the robot system is put into operation, verify that the safety functions are working as intended and that any remaining hazards identified in the risk assessment are mitigated to an acceptable level.

1.5 Safety during operation

Automatic operation

Verify the application in the operating mode manual reduced speed, before changing mode to automatic and initiating automatic operation.

Manually stopping or overriding the arm

The movement of the IRB 14050 arm can be manually be stopped or overridden because the arm is light and the drivetrain power is limited. If the arm is in motion, collision detection can be used help to stop the the arm. If the arm is at standstill, motors or brakes can be manually overridden.

CAUTION

The normal stopping functions of the control system should be used to stop movement, to avoid unnecessary damage and wear to the arm. Push the brake release buttons before manually moving the arm.

Unexpected movement of robot arm

WARNING

Hazards due to the use of brake release devices and/or gravity beneath the manipulator shall be considered.

1.6 Safety during maintenance and repair

1.6.1 Safety during maintenance and repair

General

Corrective maintenance must only be carried out by personnel trained on the robot.

Maintenance or repair must be done with all electrical, pneumatic, and hydraulic power switched off, that is, no remaining hazards.

Make sure that there are no tools, loose screws, turnings, or other unexpected parts remaining after maintenance or repair work.

When the work is completed, verify that the safety functions are working as intended.

Hot surfaces

Surfaces can be hot after running the robot, and touching these may result in burns. Allow the surfaces to cool down before maintenance or repair.

Allergic reaction

Warning	Description	Elimination/Action
Allergic reaction	When working with lubricants there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.

Gearbox lubricants (oil or grease)

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

Note

Take special care when handling hot lubricants.

Warning	Description	Elimination/Action
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.
Allergic reaction	When working with lubricants there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.

Continues on next page

Warning	Description	Elimination/Action
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.
Do not overfill	Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may: • damage seals and gaskets • completely press out seals and gaskets • prevent the robot from moving freely.	Make sure not to overfill the gearbox when filling it with oil or grease. After filling, verify that the level is correct.
Specified amount depends on drained volume	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.	After filling, verify that the level is correct.

Hazards related to batteries

Under rated conditions, the electrode materials and liquid electrolyte in the batteries are sealed and not exposed to the outside.

There is a hazard in case of abuse (mechanical, thermal, electrical) which leads to the activation of safety valves and/or the rupture of the battery container. As a result under certain circumstances, electrolyte leakage, electrode materials reaction with moisture/water or battery vent/explosion/fire may follow.

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 *Operating conditions, robot on page 42*.

See safety instructions for the batteries in *Material/product safety data sheet - Battery pack* (*3HAC043118-001*).

Related information

See also the safety information related to installation and operation.

1.6.2 Emergency release of the robot axes

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 described in the section:

- *Manually releasing the brakes on page 56*.

1.6.3 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 axis to a position where the combined weight of the manipulator 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 manipulator does not change position as the motors are switched off, then the brake function is adequate.

Note

It is recommended to run the service routine *BrakeCheck* as part of the regular maintenance, see the operating manual for the robot controller.

For robots with the option SafeMove, the *Cyclic Brake Check* routine is recommended. See the manual for SafeMove in *References on page 10*.

1.7 Safety during troubleshooting

General

When troubleshooting requires work with power switched on, special considerations must be taken:

- Safety circuits might be muted or disconnected.
- Electrical parts must be considered as *live*.
- The manipulator can move unexpectedly at any time.

DANGER

Troubleshooting on the controller while powered on must be performed by personnel trained by ABB or by ABB field engineers.

A risk assessment must be done to address both robot and robot system specific hazards.

Related information

See also the safety information related to installation, operation, maintenance, and repair.

1.8 Safety during decommissioning

General

See section *Decommissioning on page 353*.

If the robot is decommissioned for storage, take extra precaution to reset safety devices to delivery status.

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2 Installation and commissioning

2.1 Introduction to installation and commissioning

General

This chapter contains assembly instructions and information for installing the IRB 14050 at the working site.

See also the product manual for the robot controller.

The installation must be done by qualified installation personnel in accordance with the safety requirements set forth in the applicable national and regional standards and regulations.

The technical data is detailed in section *Technical data on page 39*.

Safety information

Before any installation work is commenced, all safety information must be 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 15* before performing any installation work.

Note

Always connect the IRB 14050 and the robot to protective earth and residual current device (RCD) before connecting to power and starting any installation work.

For more information see:

- *Product manual - OmniCore C30*

2.2 Unpacking

2.2.1 Pre-installation procedure

Introduction

This section is 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.

Prerequisites for installation personnel

Installation personnel working with an ABB product must:

- be trained by ABB and have the required knowledge of mechanical and electrical installation/maintenance/repair work
- conform to all national and local codes.

Checking the pre-requisites for installation

	Action
1	Make a visual inspection of the packaging and make sure that nothing is damaged.
2	Remove the packaging.
3	Check for any visible transport damage. **Note** Stop unpacking and contact ABB if transport damages are found.
4	Clean the unit with a lint-free cloth, if necessary.
5	Make sure that the lifting accessory used (if required) is suitable to handle the weight of the robot as specified in: *Weight, robot on page 39*
6	If the robot is not installed directly, it must be stored as described in: *Storage conditions, robot on page 42*
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: *Operating conditions, robot on page 42*
8	Before taking the robot to its installation site, make sure that the site conforms to: • *Loads on foundation, robot on page 40* • *Protection classes, robot on page 42* • *Requirements, foundation on page 41*
9	Before moving the robot, please observe the stability of the robot: *Risk of tipping/stability on page 50*
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: *On-site installation on page 52*
11	Install required equipment, if any.

2.2.2 Technical data

Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 14050	9.48 kg (without gripper)

Note

The weight does not include tools and other equipment fitted on the robot.

Mounting positions

The table shows valid mounting options for the manipulator.

Mounting option	Installation angle	Note
Table mounted	Any angle	

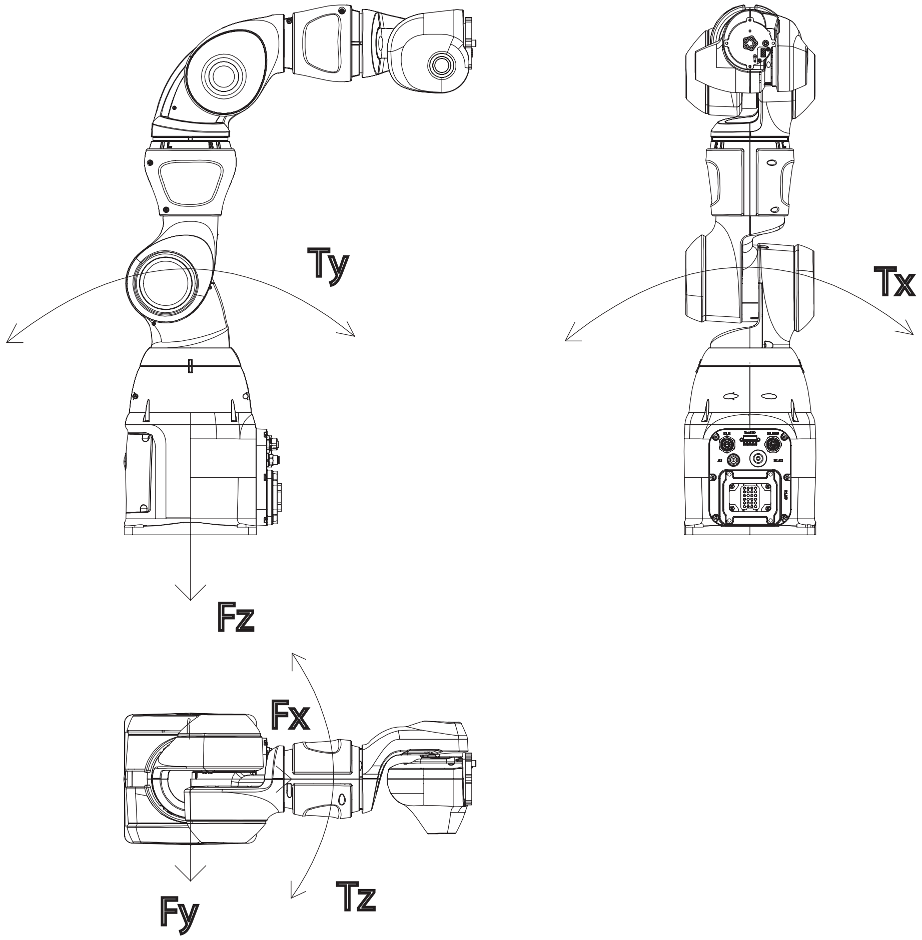
Note

The actual mounting angle must always be configured in the system parameters, otherwise the performance and lifetime is affected.

Continues on next page

Loads on foundation, robot

The illustration shows the directions of the robots stress forces.



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F_x	Force in the X plane
F_y	Force in the Y plane
F_z	Force in the Z plane
T_y	Bending torque the Y plane
T_x	Bending torque the X plane
T_z	Bending torque in the Z plane

The table shows the various forces and torques working on the robot during different kinds of operation.

Note

These forces and torques are extreme values that are rarely encountered during operation. The values also never reach their maximum at the same time!

Continues on next page

WARNING

The robot installation is restricted to the mounting options given in following load table(s).

Table mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force x	±42.7 N	±158.6 N
Force y	±42.03 N	±153.19 N
Force z	75.65±36 N	75.65±87.34 N
Torque x	±30.52 Nm	±91.47 Nm
Torque y	±30 Nm	±95.07 Nm
Torque z	±12.32 Nm	±14.83 Nm

Requirements, foundation

The table shows the requirements for the foundation where the weight of the installed robot is included:

Requirement	Value	Note
Flatness of foundation surface	0.1/500 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy.
Minimum resonance frequency	22Hz **Note** It may affect the manipulator lifetime to have a lower resonance frequency than recommended.	The value is recommended for optimal performance. Due to foundation stiffness, consider robot mass including equipment.[i] For information about compensating for foundation flexibility, see the application manual of the controller software, section *Motion Process Mode*.

i The minimum resonance frequency given should be interpreted as the frequency of the robot mass/inertia, robot assumed stiff, when a foundation translational/torsional elasticity is added, i.e., the stiffness of the pedestal where the robot is mounted. The minimum resonance frequency should not be interpreted as the resonance frequency of the building, floor etc. For example, if the equivalent mass of the floor is very high, it will not affect robot movement, even if the frequency is well below the stated frequency. The robot should be mounted as rigid as possibly to the floor.

Disturbances from other machinery will affect the robot and the tool accuracy. The robot has resonance frequencies in the region 10 – 20 Hz and disturbances in this region will be amplified, although somewhat damped by the servo control. This might be a problem, depending on the requirements from the applications. If this is a problem, the robot needs to be isolated from the environment.

Continues on next page

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

Parameter	Value
Minimum ambient temperature	-10°C
Maximum ambient temperature	+55°C
Maximum ambient temperature (less than 24 hrs)	+55°C
Maximum ambient humidity	85% at constant temperature (gaseous only)

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	+5°C [i]
Maximum ambient temperature	+40°C
Maximum ambient humidity	85% at constant temperature

i At low environmental temperature < 10ºC is, as with any other machine, a warm-up phase recommended to be run with the robot. Otherwise there is a risk that the robot stops or run with lower performance due to temperature dependent oil and grease viscosity.

Protection classes, robot

The table shows the available protection types of the robot, with the corresponding protection class.

Protection type	Protection class [i]
Manipulator, protection type Standard	IP30
Manipulator, protection type Clean Room	ISO 6

i According to IEC 60529.

Joint torques

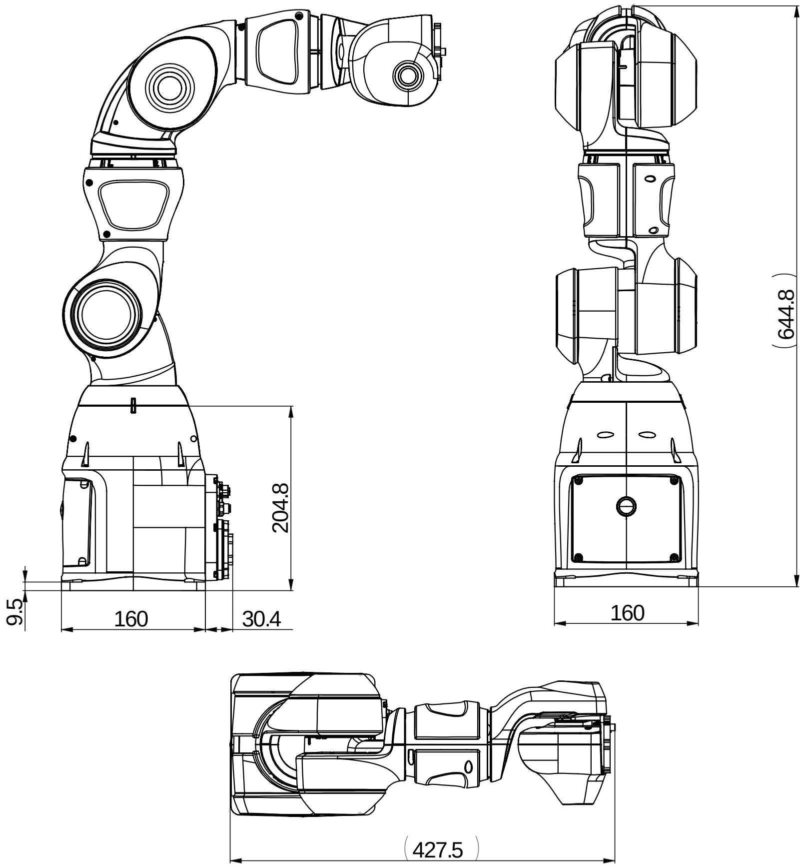
The following table shows the maximum torque for each joint. The maximum value can be achieved on one axis at a time.

Axis	Maximum joint torque
1	14.6 Nm
2	14.62 Nm
3	6.21 Nm
4	1.0 Nm
5	0.8 Nm
6	0.43 Nm
7	6.25 Nm

2.2.3 Dimensions

Dimensions IRB 14050

Manipulator with rear connector interface



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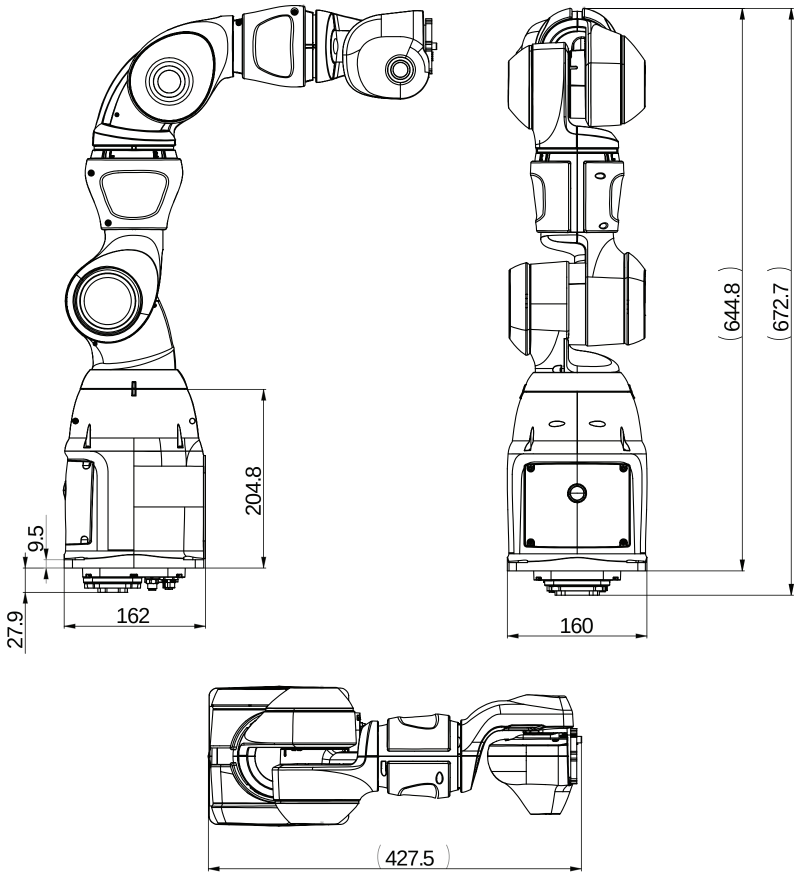
Manipulator with bottom connector interface (option 3309-1)



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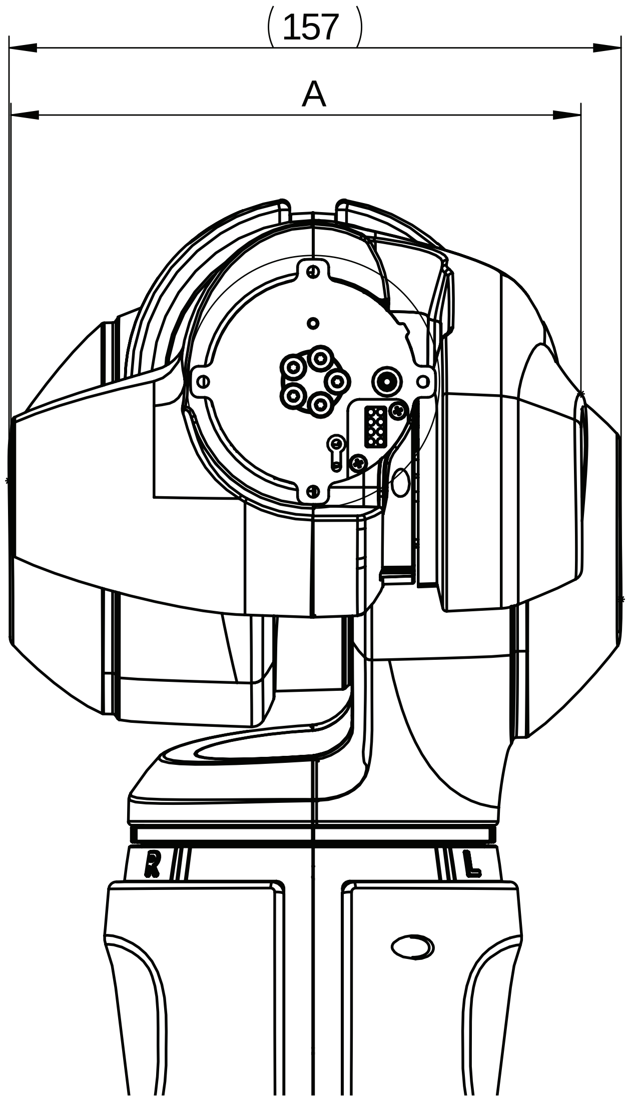
Robot arms



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	IRB 14050 (no-type-specified)	IRB 14050 Type A
A	137 mm	146 mm

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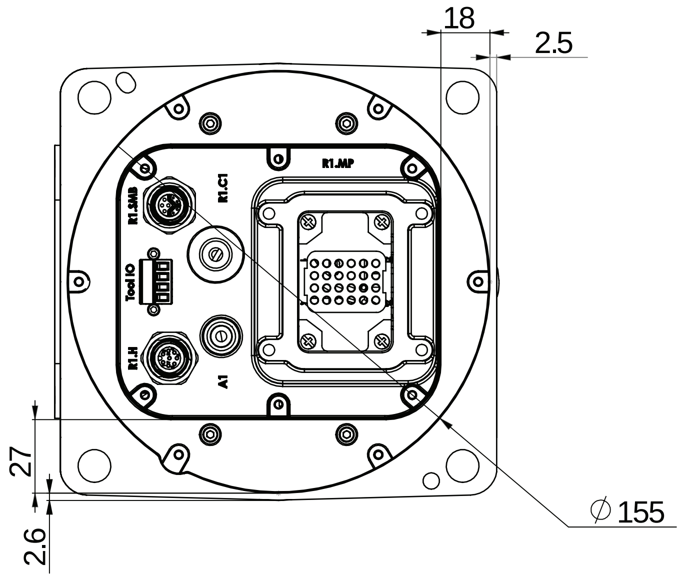
Robot base



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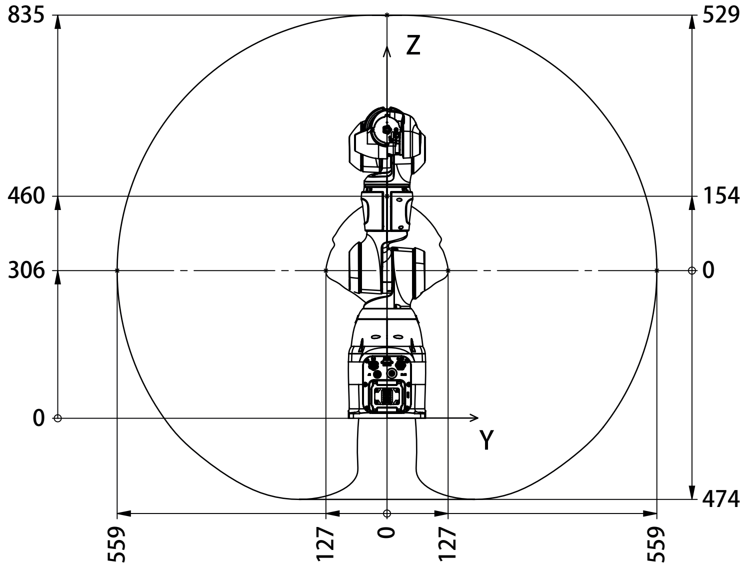
2.2.4 Working range

Illustration, working range IRB 14050

The illustrations show the unrestricted working range of the robot.

Front view



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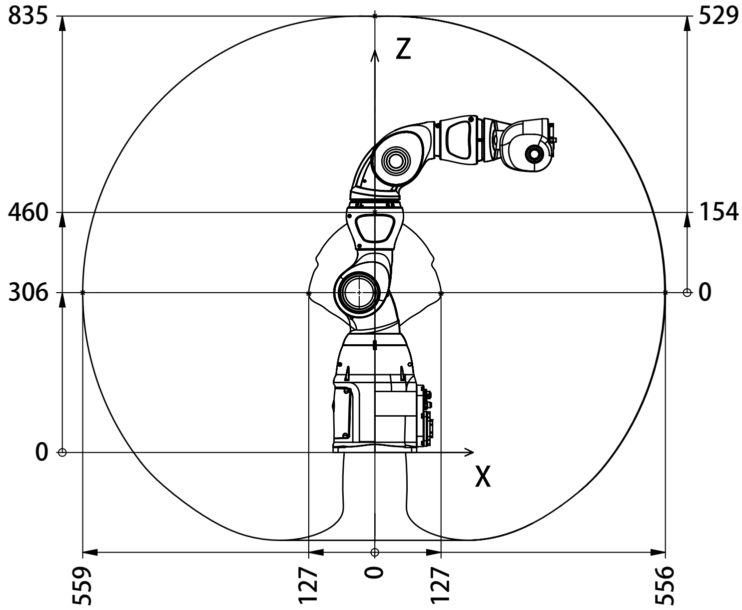
Side view



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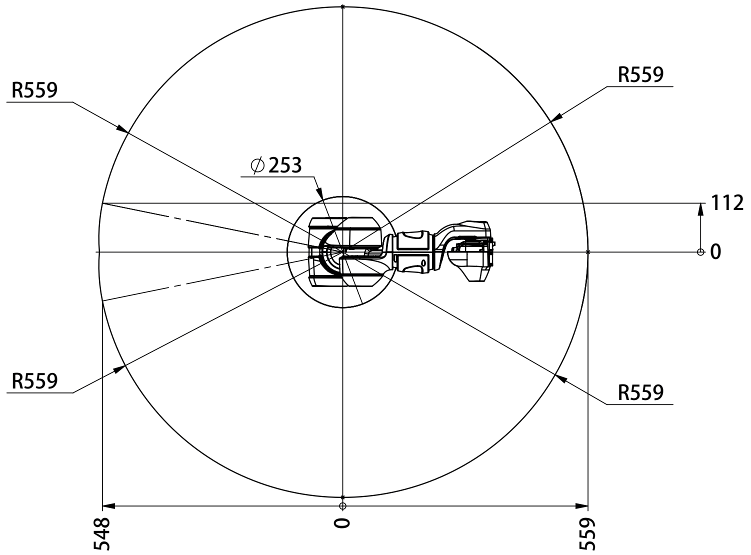
Top view



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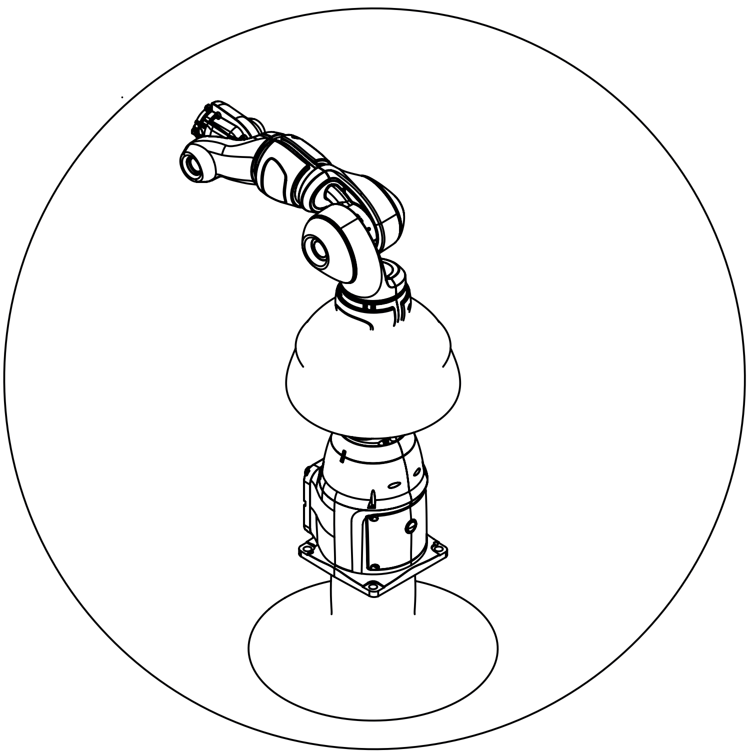
Isometric view



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Robot motion

Axis	Type of motion	Degree of motion
Axis 1	Arm - Rotation motion	-168.5° to +168.5°
Axis 2	Arm - Bend motion	-143.5° to +43.5°

Continues on next page

Axis	Type of motion	Degree of motion
Axis 7	Arm - Rotation motion	-168.5° to +168.5°
Axis 3	Arm - Bend motion	-123.5° to +80°
Axis 4	Wrist - Rotation motion	-290° to +290°
Axis 5	Wrist - Bend motion	-88° to +138°
Axis 6	Flange - Rotation motion	-229° to +229°

2.2.5 Risk of tipping/stability

Risk of tipping

If the robot is not fastened to the foundation while moving the arm, the robot is not stable in the whole working area. Moving the arm will displace the center of gravity, which may cause the robot to tip over.

The transportation position is the most stable position.

Do not change the robot position before securing it to the foundation!

Transportation position

This figure shows the robot in its transportation position.

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Note

The robot might be positioned in a different position at delivery, due to actual configurations and options (for example DressPack).

WARNING

The robot will be mechanically unstable if not properly secured to the foundation.

2.2.6 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.

Safe handling

Use one of the following alternatives:

- Use a wrist strap.

  Wrist straps must be tested frequently to ensure that they are not damaged and are operating correctly.
- Use an ESD protective floor mat.

  The mat must be grounded through a current-limiting resistor.
- Use a dissipative table mat.

  The mat should provide a controlled discharge of static voltages and must be grounded.

2.3 On-site installation

2.3.1 Lifting the robot without lifting accessories

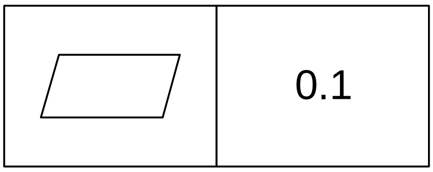
General

This section describes how to lift the robot and move it manually.

	Amount	Note
Persons required for lifting robot	1	

Attachment screws and pins

All hardware is enclosed in the robot delivery.

Suitable screws	M10x25
Quantity	4 pcs
Quality	8.8
Washer	4 pcs, 10.5x20x2
Guide pins	2 pcs, article number 3HNP00449-1
Tightening torque	40 Nm
Level surface requirements	 xx1500000627

Lifting and transporting the robot

Use this procedure to lift the robot.

	Action	Note
1	Grasp the base and clasp the arm.	
2	Move the robot to desired position. **CAUTION** Be careful not to hit the arm into something while lifting and transporting the robot. This could damage the mechanical structure of the arm.	
3	Secure the robot on a workbench according to section *Orienting and securing the robot on page 53*.	Screws: 4 pcs M10x25 Washers: 4 pcs, 10.5x20x2

2.3.2 Orienting and securing the robot

Introduction

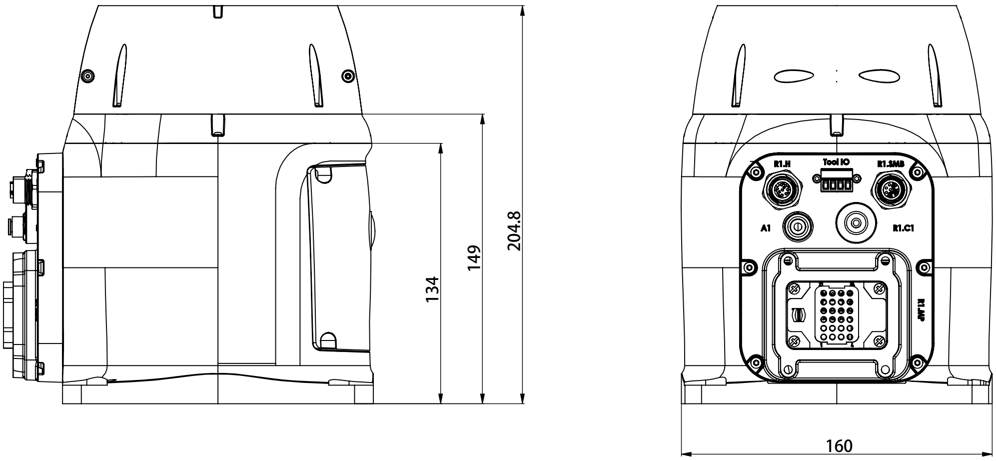
This section details how to orient and secure the robot to the working bench in order to run the robot safely. The requirements made on the workbench are shown in sections:

- *Requirements, foundation on page 41*
- *Loads on foundation, robot on page 40*

Hole configuration, base

There are four holes on the bottom of the robot body.

The illustration shows the hole configuration used when securing the robot.



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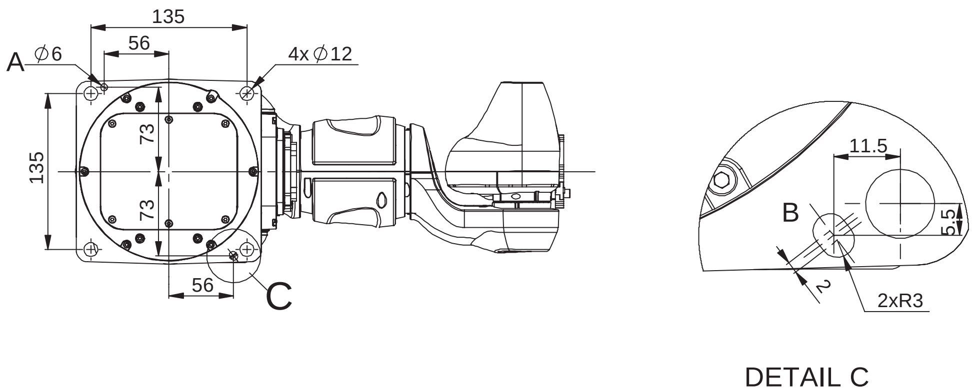

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A	Master hole (round)
B	Alignment hole (slot)

Note

The illustration is in top view and the arrow points the front of the robot.

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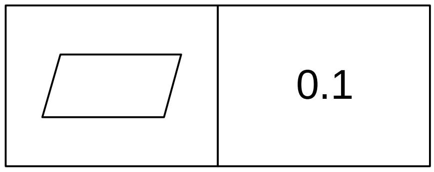
Specification, attachment screws and pins

The table specifies the type of securing screws to be used to secure the robot directly to the foundation. It also specifies the type of pins to be used.

All hardware is enclosed in the robot delivery.

Screws	M10x25
Quantity	4 pcs
Quality	8.8
Washer	4 pcs, 10.5x20x2
Guide pins	2 pcs, article number 3HNP00449-1
Tightening torque	40 Nm
Level surface requirements	 xx1500000627

Orienting and securing the robot

Use this procedure to orient and secure the robot to a table.

	Action	Information
1	Make sure the installation site for the robot conforms to the specifications in section: • *Pre-installation procedure on page 38*	
2	Prepare the installation site with attachment holes.	The hole configuration of the base is shown in the figure in: • *Hole configuration, base on page 53*
3	**CAUTION** The robot weighs 9.48 kg (without gripper). All lifting equipment must be sized accordingly.	
4	**CAUTION** When the robot is put down after being lifted or transported, there is a risk of tipping if not properly secured.	
5	Lift the robot to its installation site. **CAUTION** Be careful not to hit the arms into something while lifting and transporting the robot. This could damage the mechanical structure of the arm.	How to lift the robot is described in section: • *Lifting the robot without lifting accessories on page 52*
6	Make sure there are two pins in the holes in the base.	2 pcs, article number 3HNP00449-1

Continues on next page

	Action	Information
7	Guide the robot using the pins, while lowering it to mounting position.	Make sure the robot base is correctly fitted onto the pins.
8	Fit the securing screws in the attachment holes of the base.	Screws: M10x25, (4 pcs), quality:8.8. Washers: 4 pcs, 10.5x20x2.
9	Tighten the bolts crosswise to ensure that the base is not distorted.	Tightening torque: 40 Nm

2.3.3 Manually releasing the brakes

Introduction to manually releasing the brakes

This section describes how to release the holding brakes for the motors of axis 1, axis 2, axis 3, and axis 7.

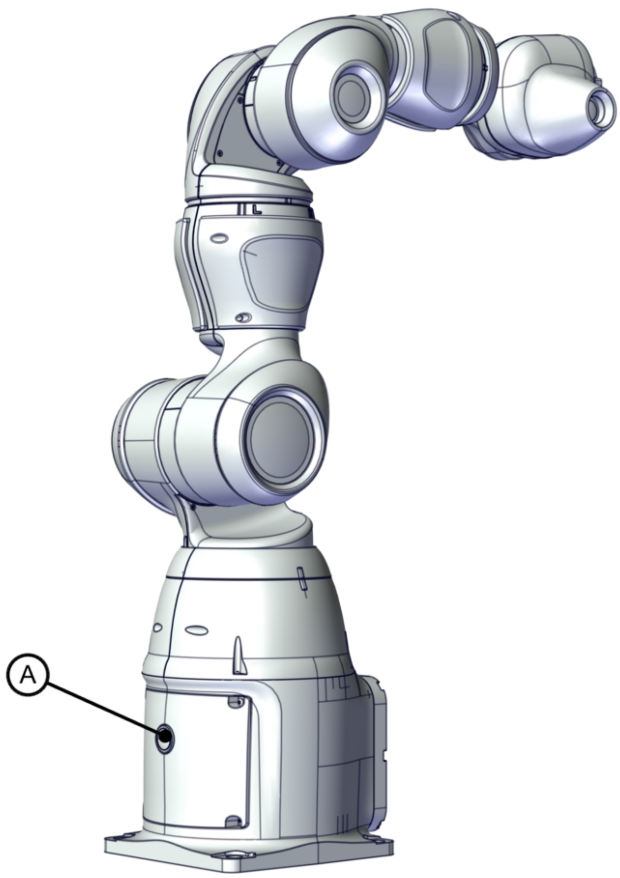
Note

There is no holding brake for axis 4, axis 5, or axis 6.

When a protective stop or emergency stop is triggered, the axes 4-5-6 will drop as there are no holding brakes.

Location of brake release button

There is one brake release button located as shown in the figure.



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A	Brake release button

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Releasing the brakes

This procedure details how to release the holding brakes when the robot is equipped with an internal brake release unit.

	Action	Note
1	Releasing the brakes with the brake release buttons require that power is supplied to the robot, see *Connecting power and the FlexPendant*.	
2	**CAUTION** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways.	
3	Release the holding brake on the arm axes by pressing the button. The brake will function again as soon as the button is released.	

2.3.4 Electrical connections

2.3.4.1 Robot cabling and connection points

Introduction

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

> **DANGER**
>
> Turn off the main power before connecting any cables.

Main cable categories

All cables connected to the robot are divided into the following categories:

Cable category	Description
Robot cables	Handles power supply to and control of the robot's motors as well as feedback from the serial measurement board. Specified in the table *Robot cables on page 58*.
Customer cables (option)	Handles communication with equipment fitted on the robot by the customer, low voltage signals and high voltage power supply + protective ground. The customer cables also handle databus communication. The customer cables also include the air hose. See the product manual for the controller, see document number in *References on page 10*.
Air hoses	The hose for compressed air is integrated with the manipulator cable harness.

Robot cables

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 cables, power	Transfers drive power from the drive units in the control cabinet to the robot motors.	XS1	R1.MP
Robot cable, signals	Transfers resolver data from and power supply to the serial measurement board.	XS2	R1.SMB
Hybrid cables - Ethernet and 24DC power floor cable	Transfers Ethernet bus and 24DC power supply from the controller cabinet to the robot.	X1-X5 X19	R1.MP

Robot cable, power

Power cable length	Article number
Robot cable, power, 3 m	3HAC061139-001
Robot cable, power, 7 m	3HAC061139-002

Continues on next page

Robot cable, signals

Signal cable length	Article number
Robot cable, signals, 3 m	3HAC084767-001
Robot cable, signals, 7 m	3HAC084767-002

Hybrid cables - Ethernet and 24DC power floor cable

Ethernet floor cable length	Article number
Hybrid cables - Ethernet and 24DC power floor cable, 3 m	3HAC063855-001
Hybrid cables - Ethernet and 24DC power floor cable, 7 m	3HAC063855-002

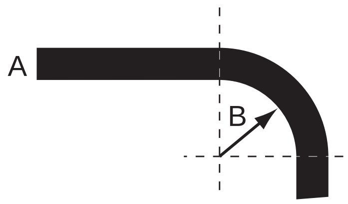
Note

The peak current for this hybrid cable is less than 2A. The RMS current for this hybrid cable is less than 1A.

The 24V DC power must be connected to X19 customer I/O power from OmniCore C30 from panel.

Bending radius for static floor cables

The minimum bending radius is 10 times the cable diameter for static floor cables.



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A	Diameter
B	Diameter x10

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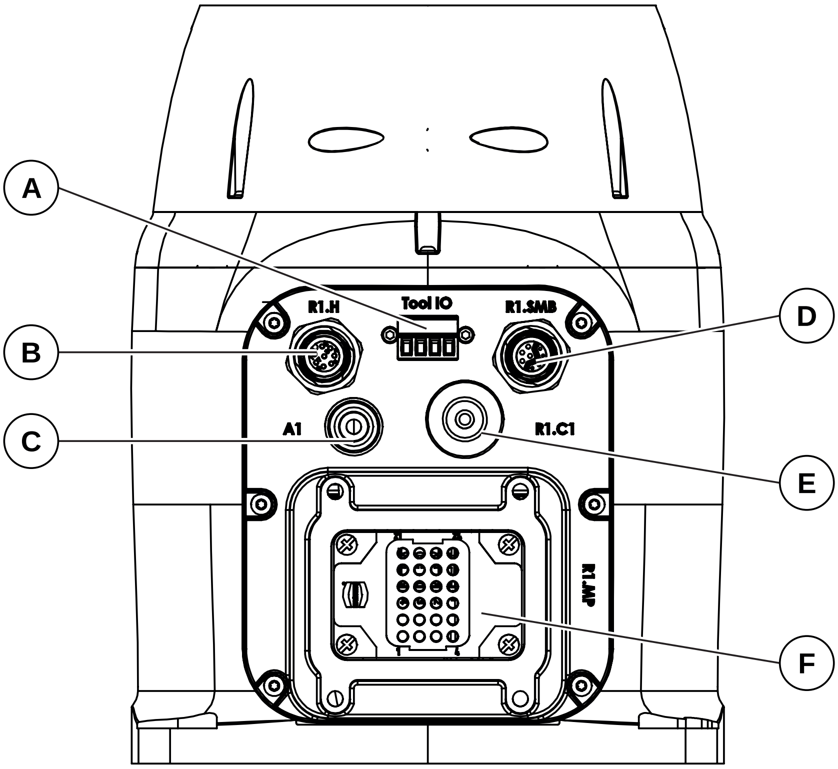
Connection points

These figures show the location of the connection points.



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	Name	Note
A	Tool I/O	4x digital I/O signals to the tool flanges, to be cross connected with M12.X3. This is alternative to Ethernet on the tool flange.
B	R1.H	Hybrid connector to provide Ethernet and 24VDC power to Ethernet I/O module, hall sensor and gripper.
C	A1	Outer diameter of air hose 4 mm; 0.5 MPa air pressure
D	R1.SMB	Transfers resolver data from and power supply to the serial measurement board.
E	R1.C1	Cable inlet reserved for customer signals which is connected from the I/O module inside base.
F	R1.MP	Transfers drive power from the drive units in the control cabinet to the robot motors.

2.3.5 Risk of mechanical damage

General

IRB 14050 motors and gears are designed to exert limited power to be safe for the operator. Improper handling might cause mechanical damage to the robot, as the drivetrain and motors are smaller. Axis 5 (wrist) is the smallest and most sensitive.

Use lead-through jogging to manually move the arm without risk of mechanical damage, see *Lead-through on page 62*.

Precautions

IRB 14050 is designed to be safe in contact with the operator, but the following requires some caution.[2]

- Pushing the moving robots gripper or arm with counter force, may damage the drivetrain of the robot. The wrist and the gripper are most sensitive.
- Avoid collisions on the robot wrist or gripper, when axis 5 and its adjacent axes position in a straight line and the robot arm moves at its maximum speed. Collisions will cause gear slippage or damage to axis 5.
- Manually overriding the arm with excessive force. Manual moving should be stopped immediately when the joint reaches its extreme position (i.e. mechanical stop position) to avoid damaging the arm.

2 See also technote_170906.

2.3.6 Lead-through

What is lead-through?

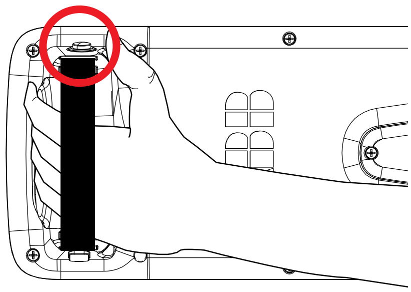
The lead-through functionality is available for robots designed for collaborative applications. If lead-through is available, this is shown on the FlexPendant.

Using lead-through, you can grab the robot arm and move it manually to a desired position, as an alternative to jogging.

Using lead-through

Use the following procedure to jog the robot using the lead-through functionality:

1 Enable lead-through in one of the following ways:
   - Press the thumb button on the FlexPendant.



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   - On the start screen, tap **Jog** and select the **Lead-through** menu.
   - In the **QuickSet** menu, select the **Lead-through** tab.

> **Note**
>
> If the robot is in motors off state, it will automatically go to the motors on state when the lead-through is enabled.

2 In the **Jog Mode** section select a mode.

3 If required, in the **Lead-through lock** section use the lock button next to a axis to lock it.

> **Note**
>
> The **Lead-through lock** section is disabled for the **Axis 1-6** mode.

4 Gently pull the robot arm to the desired position.

Continues on next page

The robot moves to the selected position. If the **Lead-through lock** option is selected, the robot moves in such a way that the movement is restricted in the locked direction.

> **Note**
>
> You can feel if an axis reaches its end position. Do not try to force the axis beyond this position.

5 If desired, save the position.

> **Note**
>
> The speed at which the robot moves when using the Lead-through functionality is managed using the horizontal scroll bar available in the **Lead-through Speed** section.

> **Note**
>
> If lead-through is enabled, it will be temporarily disabled during program execution and jogging. This means that it is possible to combine lead-through, jogging, and testing the RAPID program without having to disable the lead-through.

> **Note**
>
> When using lead-through, it is important that the load is correctly defined. If the load is heavier than defined, the effect will be the same as if you are pulling the robot arm downwards. If the load is lighter than the defined load, the effect will be the same as if you are pulling the robot arm upwards.
>
> For the CRB 15000, there is a button for updating/refreshing the load while lead-through is active.
>
> For the CRB 15000, if varying loads from cables and other disturbances are causing the robot to drift during lead-through, this can often be improved by setting the system parameter *Lead through load compensation* to *Always*. See *Technical reference manual - System parameters*, section *Motion*, type *Robot*.

Align to a coordinate system

It is possible to align the robot to a coordinate system either in Auto or Manual mode from the lead-through page for a CRB 15000 robot.

Use the following procedure to align the robot to a coordinate system:

1 In the Lead-through page select the a mode in the **Lead-through Mode** section.

2 In the **Align to coordinate system** section, select the required coordinate system.

Continues on next page

3 Enable the motors.

> **Note**
>
> For collaborative robots, the motors are on by default unless extra safety options are selected in the system.

4 Tap and hold the **Press and Hold Align** button.

The robot is aligned to the selected coordinate system.

2.3.7 Installation of ABB grippers

Installing grippers

The procedure for installation of ABB grippers is described in *Product manual - Grippers for IRB 14050*.

2.4 Installing the external UL lamp

General

User can connect an external signal lamp with a fixed light to indicating the status of robot. It can be installed on work-cell or any other visible location. The lamp indicates that motors are powered, and it allows the user to meet UL requirements. More detailed connection can be found in the circuit diagram for the IRB14050.

There is a preserved socket inside the robot base for user connecting the UL lamp. User can choose a lamp with 24V nominal voltage from any brand.

Note

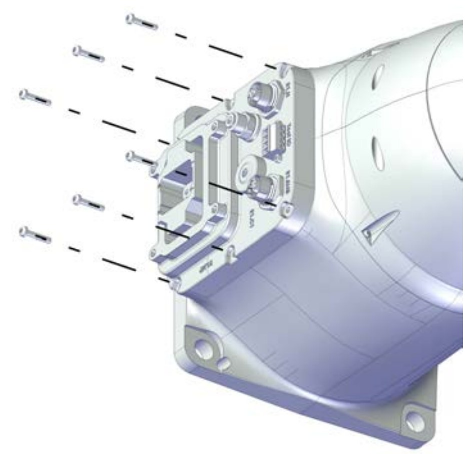
Do not use the UL lamp option in a Clean Room environment.

Required tools and equipment

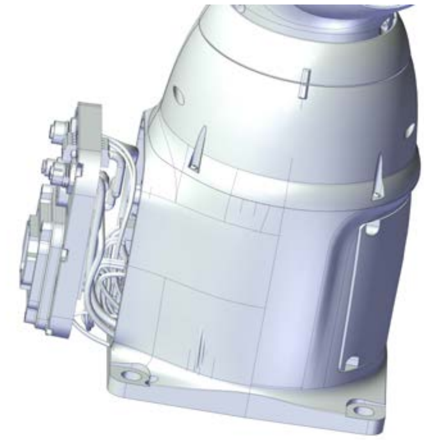
Equipment, etc.	Art. no.	Note
External UL lamp	-	This lamp is optional to customer. The maximum current consumption of UL lamp should be smaller than 500 mA. The maximum external inductance (including the cables) should be less than 1 mH.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Installing the external UL lamp

Removing the base cover of SMB

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Remove the screws on the base cover of SMB.	 xx1800001483

Continues on next page

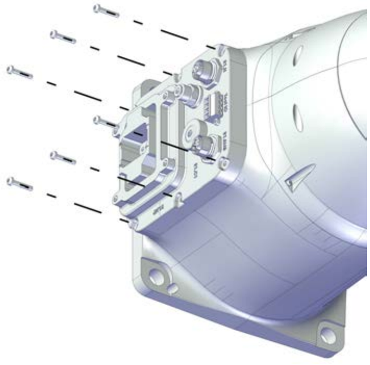
	Action	Note
3	Remove the base cover with cables connected.	 xx1800001484

Installing the external UL lamp

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Pierce the R1.C1 hole with the cable of external UL lamp.	 xx1800001486
3	Connect the lamp cable connector to the digital base. **Note** The Digital Output channels (pin 8 to pin 15) in the digital base are supposed to connect to high impedance logic input terminals. The Digital output channels are not supposed to drive any relays coils, solenoids or similar loads.	 xx1800001487
4	The external UL lamp is now ready for use and is lit in MOTORS ON mode.	

Continues on next page

Refitting the base cover of SMB

	Action	Note
1	Refit the base cover for SMB.	Screws: 3HAC050367-006 (6 pcs). Tightening torque: 0.2 Nm.  xx1800001483

Inspecting the external UL lamp

Use this procedure to inspect the function of the the external UL lamp.

	Action	Note
1	Verify that the the external UL lamp is lit when motors are put in operation ("MOTORS ON").	
2	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the inspection work on the robot.	
3	If the lamp is not lit, trace the fault by: • Make sure that the *external UL lamp* is not broken. If so, replace it. • Inspect the cable connections. • Inspect the cabling. Replace the cabling if a fault is detected.	Art. no. is specified in *Required tools and equipment on page 66*.

2.5 Making robot ready for operation

2.5.1 Additional installation procedure, Clean Room

General

Robots with protection type Clean Room are specially designed to work in a clean room environment.

Clean Room robots are designed to prevent from particle emission from the robot. For example, the maintenance work possible to perform without cracking the paint. The robot is painted with four layers of polyurethane paint. The last layer being a varnish over labels to simplify cleaning. The paint has been tested regarding outgassing of Volatile Organic Compounds (VOC) and been classified in accordance with ISO 14644-8.

Any Clean Room parts that are replaced must be replaced with parts designed for use in Clean Room environments.

Clean Room class 6

According to **IPA test result**, the robot IRB 14050 is suitable for use in Clean Room environment.

Classification of airborne molecular contamination

Parameter				Outgassing amount		
Area (m^2)	Test duration (s)	Temp (°C)	Performed test	Total detected (ng)	Norm based on 1m^2 and 1s(g)	Classification in accordance to ISO 14644-8
4.5E-03	3600	23	TVOC	2848	1.7E-07	-6.8
4.5E-03	60	90	TVOC	46524	1.7E-04	-3.8

Preparations before commissioning a Clean Room robot

During transport and handling of a Clean Room robot, it is likely that the robot has been contaminated with particles of different kinds. Therefore the robot must be carefully cleaned before installation.

Do not apply force on the plastic covers when lifting the robot! This may result in damage or cracks in the paint around the plastic cover.

2.6 Start of robot in cold environments

Introduction

This section describes how to start the robot in a cold environment if it is not starting the normal way.

Problems with starting the robot

Event message from Motion Supervision

Use this procedure if an event message indicates a problem with Motion supervision at start-up. More information about Motion Supervision is found in *Technical reference manual - System parameters*.

	Action	Note
1	Turn off Motion Supervision.	
2	Start the robot.	
3	When the robot has reached normal working temperature, the Motion Supervision can be turned on again.	

Robot stopping with other event message

Use this procedure if the robot is not starting.

	Action	Note
1	Start the robot with its normal program but with reduced speed.	The speed can be regulated with the RAPID instruction `VelSet`.

Adjusting the speed and acceleration during warm-up

Depending on how cold the environment is and what program is being used, the speed might need to be ramped up until reached maximum. The table shows examples of how to adjust the speed:

Work cycles	`AccSet`	Speed/velocity
3 Work cycles	20, 20	v100 (100 mm/s)
5 Work cycles	40, 40	v400 (400 mm/s)
5 Work cycles	60, 60	v600 (600 mm/s)
5 Work cycles	100, 100	v1000 (1000 mm/s)
More than 5 Work cycles	100, 100	Max.

If the program consists of large wrist movements, it is possible that the reorientation velocity, which is always high in predefined velocities, needs to be included in the ramping up.

2.7 Additional information for IRB 14050

Overview

IRB 14050 is designed to simplify collaborative applications. Therefore some features work somewhat different compared with standard industrial robots. Some of them are listed in this section.

Emergency stops

The configuration of emergency stops is stop category 1 and cannot be changed when using RobotWare 7.1 or later.

If using RobotWare 7.0 the default configuration is stop category 0. This can be changed to stop category 1, see *Technical reference manual - System parameters* (*Safety Run Chain*).

The axes 4-5-6 can drop when a robot stopping function triggers motors OFF status, because there are no holding brakes on these motors.

Note

The robot application shall be designed so that when the robot is in Motors OFF state, changing the position in axes 4, 5, or 6 will not cause any additional hazards.

The robot stopping functions can trigger Motors OFF state.

Collision detection for YuMi robots

As default YuMi will have collision detection active at stand still. It also has another stop ramp compared to other robots to be able to release clamping forces.

Note

If the tool data is wrong, false collisions might be triggered and the robot arm might drop a short distance during the stop ramp.

SafeMove

See *IRB 14050 with SafeMove on page 72*.

2.8 IRB 14050 with SafeMove

General

For IRB 14050 with SafeMove, some different behaviors apply.

For more information about SafeMove, see *Application manual - Functional safety and SafeMove*.

Limitations

The IRB 14050 does not have brakes on axis 4, 5, or 6. This means that SafeMove cannot brake those axes in Motors OFF state or when the controller is powered off, see *Illustration of dropped axis 4-5-6 on page 73*. This gives the following limitations.

Enabling device	When SafeMove has a valid configuration, the enabling device will be needed for moving the robot in manual mode. When the enabling device is released the power to the motors is removed and axis 4, 5, 6 will slowly drop down. The recommendation is to set up the system without a SafeMove configuration and then activate SafeMove as a last step.
SafeMove position synchronization	If any axis is moved when the system is powered off, SafeMove will lose the position synchronization with RobotWare. Since axis 4, 5, 6 do not have any brakes the robot needs to be positioned in a way that does not cause those axes to move by gravity at power off. The easiest way to find that position is to use lead-through (before configuring SafeMove) and drag the tool downward. It is recommended to use that position as a home position when the robot is idling between work. It is also recommended to use the same position as the SafeMove synchronization position, it will be a well known position for the operator and axis 4, 5, 6 will not drop when the enabling device is released.
Tool Orientation Supervision	Since the tool orientation is highly dependent on axis 4, 5, and 6, SafeMove will not be able to prevent the tool from entering a forbidden orientation in motors off state. The orientation can still safely be monitored giving a safe output.
Axis Position Supervision	The axis position supervision can not prevent the robot from entering a forbidden range on axis 4, 5, or 6 but the axis can still be monitored giving safe output.
Tool Position Supervision	When setting up zones for the tool position supervision, the movement of axis 4, 5, and 6 after the stop needs to be considered.
Lead-through	It is only possible to use lead-through if a *Contact Application Tolerance* (CAP) is configured in SafeMove. When using lead-through the servo lag increases which in normal case triggers a stop from SafeMove. By configuring a Contact Application Tolerance the servo lag can be decreased. For more information, see *Application manual - Functional safety and SafeMove*. When using lead-through, the dual channel safety is reduced to a single channel system. The recommendation is to add speed supervision in the safeguarded space. In manual mode, more effort is required to move the robot arm in lead-through mode. This is to avoid getting speed violations from SafeMove.
Calibration	Calibration is only possible when the SafeMove configuration is deactivated.

Continues on next page

Illustration of dropped axis 4-5-6

IRB 14050 with Motors ON	IRB 14050 with Motors OFF, axis 4-5-6 drops
 xx2000000134	 xx2000000133

2.9 Test run after installation, maintenance, or repair

Safe handling

Use the following procedure after installation, maintenance, or repair, before initiating motion.

DANGER

Initiating motion without fulfilling the following aspects, may increase the risk for injury or cause damage to the robot.

	Action
1	Remove all tools and foreign objects from the robot and its working area.
2	Verify that the robot is properly secured to its position by all screws, before it is powered up.
3	Verify that any safety equipment installed to secure the position or restrict the robot motion during service activity is removed.
4	Verify that the fixture and work piece are well secured, if applicable.
5	Verify that no personnel is leaning on, or have their head or neck close to the robot.
6	Verify that all arm covers and paddings, if any, are properly secured to the robot.
7	If maintenance or repair has been done, verify the function of the part that was maintained.
8	Verify the application in the operating mode manual reduced speed.

3 Maintenance

3.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 14050.

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 15* before performing any service work.

The maintenance must be done by qualified personnel in accordance with the safety requirements set forth in the applicable national and regional standards and regulations.

Note

If the IRB 14050 is connected to power, always make sure that the IRB 14050 is connected to protective earth and a residual current device (RCD) before starting any maintenance work.

For more information see:

- *Product manual - OmniCore C30*
- *Robot cabling and connection points on page 58*.

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 14050:

- 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 OmniCore is further described in the *Operating manual - OmniCore*.

Robots with the functionality *Service Information System* activated can show active counters in the device browser in RobotStudio, or on the FlexPendant.

3.2.2 Maintenance schedule

Scheduled and non-predictable maintenance

The robot must be maintained regularly to ensure proper function. The maintenance activities and intervals are specified in the table below.

Non-predictable situations also give rise to inspections of the robot. Any damages must be attended to immediately!

Life of each component

The inspection intervals *do not* specify the life of each component.

Maintenance schedule

Maintenance activities	Regularly[i]	Every 1 months	Every 6 months	Every 12 months	Every 20,000 hours[ii]	Reference
Cleaning the robot	x					*Cleaning the IRB 14050 on page 94*
Inspecting the robot	x					Check for abnormal wear or contamination.
Inspecting the robot harness			x			*Inspecting, cable harness on page 82*
Inspecting the information labels				x		*Inspecting the information labels on page 78*
Inspecting plastics and padding	x [iii]	x				*Inspecting, plastic and padding on page 84*
Overhaul of complete robot					x	

i "Regularly" implies that the activity is to be performed regularly, but the actual interval may not be specified by the robot manufacturer. The interval depends on the operation cycle of the robot, its working environment and movement pattern. Generally, the more contaminated environment, the shorter intervals. The more demanding movement pattern (sharper bending cable harness), the shorter intervals.

ii Operating hours counted by the DTC = Duty time counter.

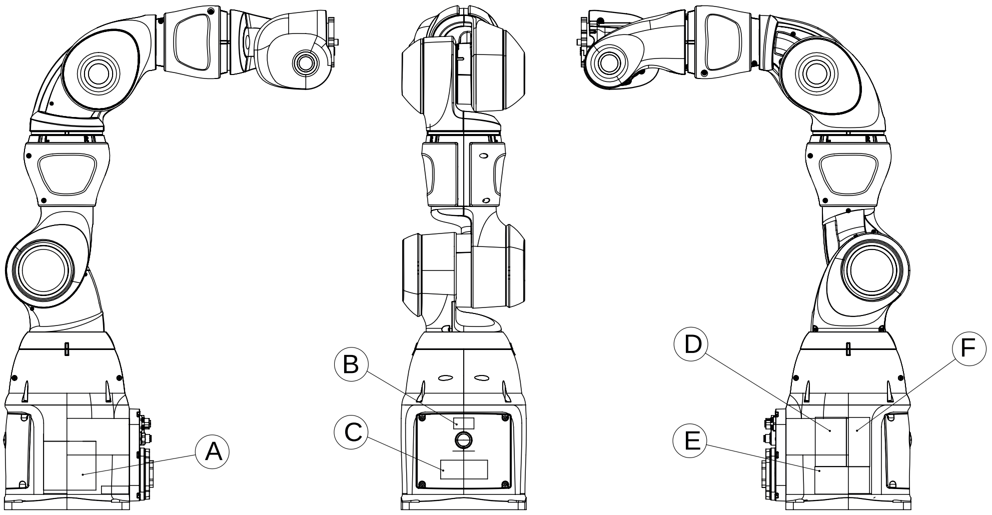
iii Plastic and padding parts are a safety feature of the robot, that limit impact during collisions. To ensure a maintained safety level of the robot, regular inspections of these parts are necessary.

3.3 Inspection activities

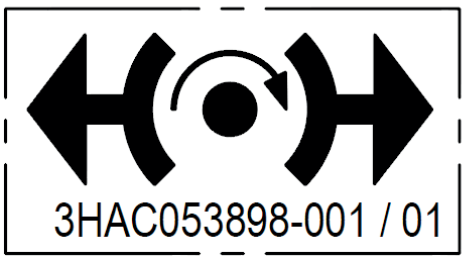
3.3.1 Inspecting the information labels

Location of labels

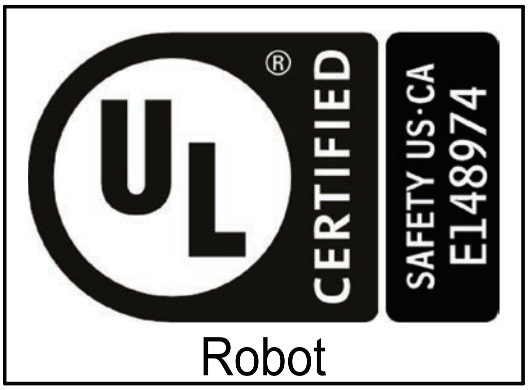
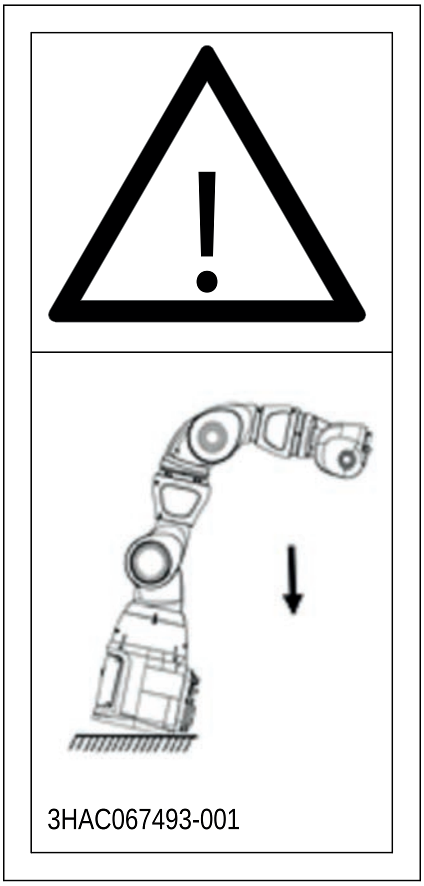
These figures show the location of the information labels to be inspected. The symbols are described in section *Safety symbols on manipulator labels on page 19*.



xx1800000745

	Description	Illustration
A	Rating label	
B	Instruction plate brake release	 xx1500000723
C	ABB logotype	
D	Calibration label	

Continues on next page

	Description	Illustration
E	UL label	 xx1900001593
F	Warning label	 xx1800000818

Required tools and equipment

Visual inspection, no tools are required.

Continues on next page

Inspecting, labels

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Inspect the labels.	See *Location of labels on page 78*.
3	Replace any missing or damaged labels.	

3.3.2 Inspecting the robot for oil seepage

Overview

Slight amount of oil might accumulate at the seal lip or cover edges of the robot depending on the application environment and movement pattern of the axes. Accumulated oil may drop down, so wipe it off when necessary.

Required tools and equipment

Visual inspection, no tools are required.

Inspecting for oil seepage

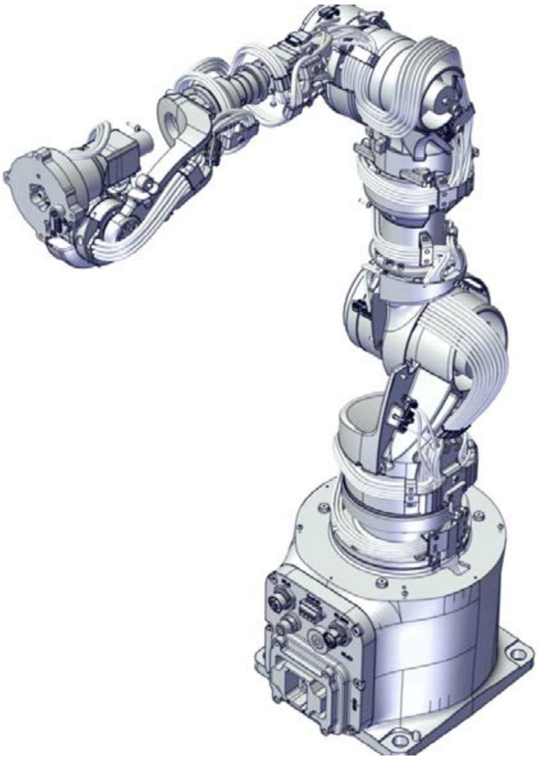
Check the points of oil seepage, especially the seal lips and cover edges of the robot, regularly. If oil accumulation is observed, wipe it clean softly with a lint-free cloth to prevent oil dropping.

3.3.3 Inspecting, cable harness

Location of cable harness

The cable harness for the arm runs undivided from its connection point at the drive unit on the controller, out from the body, throughout the arm to the axis motors and ends up at the tool flange.

In the figure below all covers required to be removed for visual access to the cable harness, are removed.



xx1800000603

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Inspecting the cable harness

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Remove all covers required to achieve visibility of all cabling.	Information for removal and refitting of covers is found in *Replacing the encapsulation and covers on page 99*.

Continues on next page

	Action	Note
3	Visually inspect all arm cabling. Look for abrasions, cuts or crush damages. If any damage is detected, replace the complete robot arm.	See *Replacing the complete arm on page 98*.
4	Inspect that the cabling is lubricated properly. If needed, apply grease evenly on the moving part of the cable harness. It is normal that the grease color turns into black.	Grease: Mobil FM222.
5	Refit all covers. If any cover is damaged, it must be replaced. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Replacement information for the covers, such as pare part numbers and tightening torques for the attachment screws are detailed in section *Replacing the encapsulation and covers on page 99*.

3.3.4 Inspecting, plastic and padding

Location of plastic and padding

The plastic and padding are located on the whole arm.

xx1800000612

CAUTION

Plastic and padding parts are a safety feature of the robot, that limit impact during collisions. To ensure a maintained safety level of the robot, regular inspections of these parts are necessary.

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Inspecting plastic and padding

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

	Action	Note
2	Visually inspect all plastics and padding parts for damage. If any cover is damaged or cannot perform its protective function for other reasons, it must be replaced.	Spare part numbers and replacement information is found in *Replacing the encapsulation and covers on page 99*.
3	Make sure that all plastic and padding covers are fully fastened. Manually check that the parts are not loose. Tighten, if needed.	Tightening torques are specified in *Replacing the encapsulation and covers on page 99*.

3.4 Replacement/changing activities

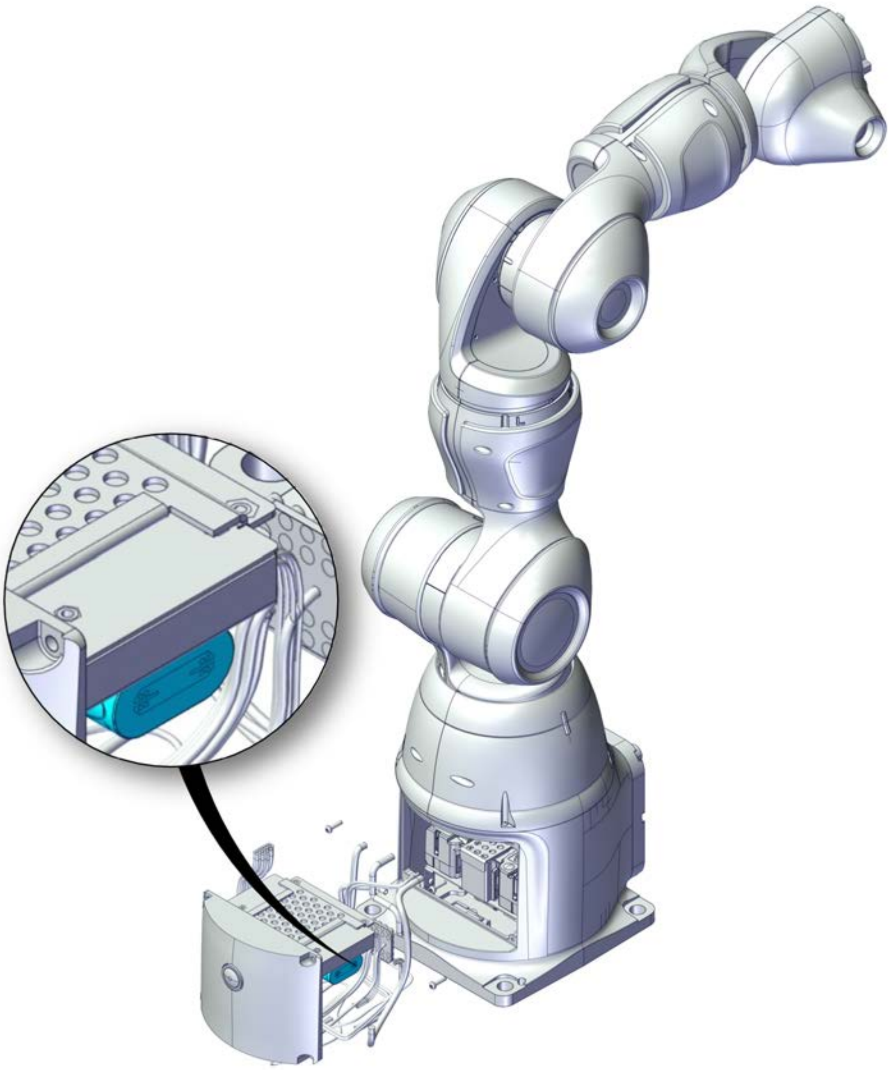
3.4.1 Replacing the battery pack

Note

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

Location of battery pack

The battery pack is located as shown in the figure.



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Required spare parts

> **Note**
>
> The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Battery unit	3HAC044075-001	Battery includes protection circuits. Only replace with a specified spare part or an ABB-approved equivalent.

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Consumables

Consumable	Article number	Note
Cable ties	-	-

Removing the battery pack

Use this procedure to remove the battery pack.

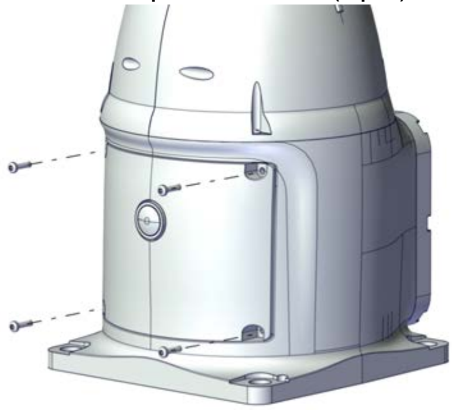
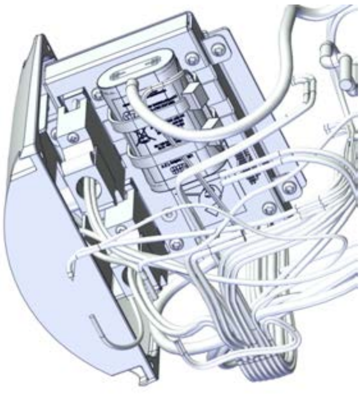
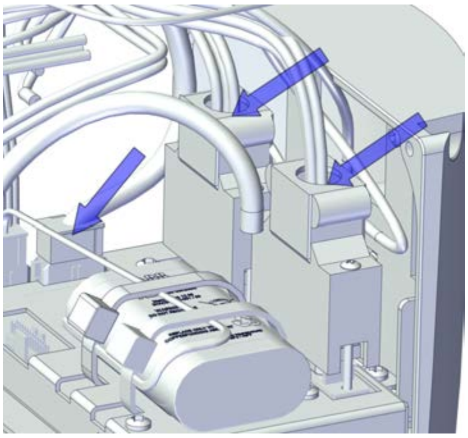
Preparations before removing the battery pack

	Action	Note
1	Move the robot to its calibration position.	This is done in order to facilitate updating of the revolution counter.
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

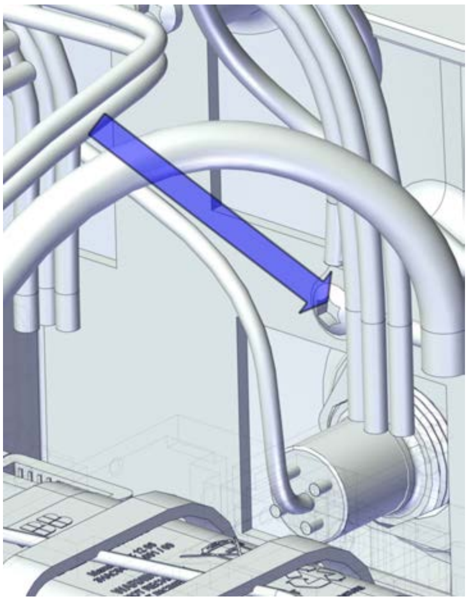
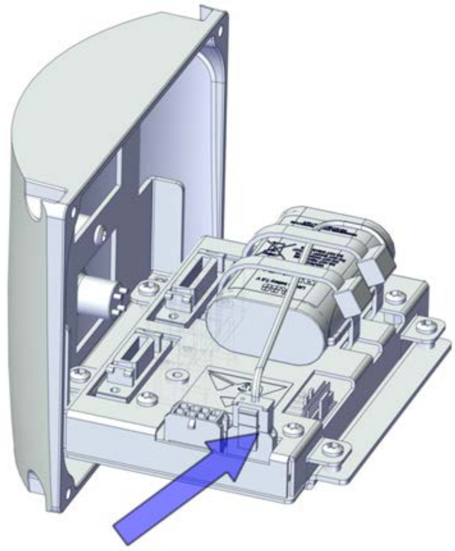
Removing the battery pack

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	**WARNING** The unit is sensitive to ESD. Before handling the unit, see *The unit is sensitive to ESD on page 51*.	

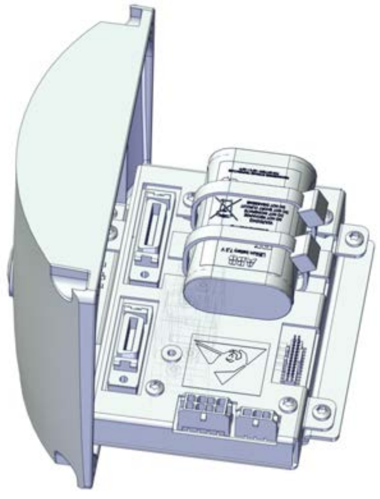
Continues on next page

	Action	Note
3	Remove the base cover.	Screws: Torx pan head screw (4 pcs).  xx1800001145  xx1800001148
4	Disconnect the SMB cables: • SMB.J1 • SMB.J2 • SMB	 xx1800001149
5	Disconnect the brake release connectors to ensure enough room for further activities. • BR	

Continues on next page

	Action	Note
6	Disconnect the ground cable to ensure enough room for further activities.	 xx1800001151
7	Disconnect the battery unit connector.	 xx1800001152

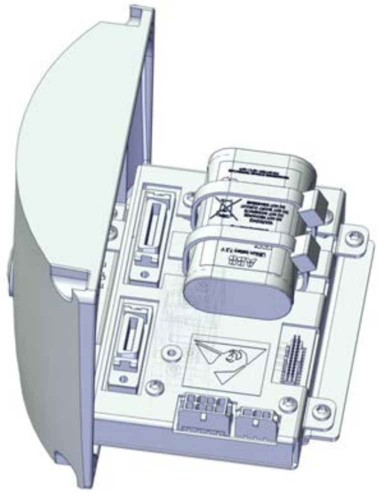
Continues on next page

	Action	Note
8	Cut the cable ties and remove the battery.	 xx1800001156

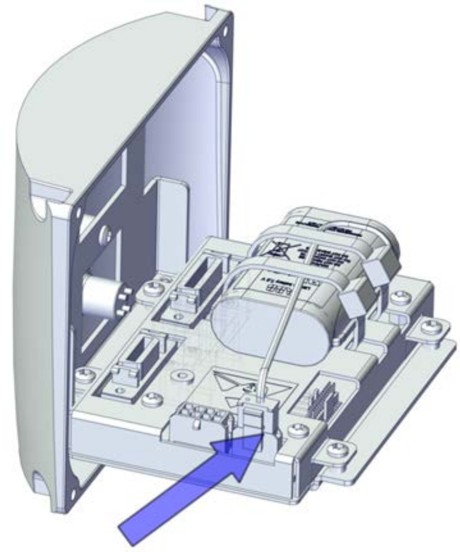
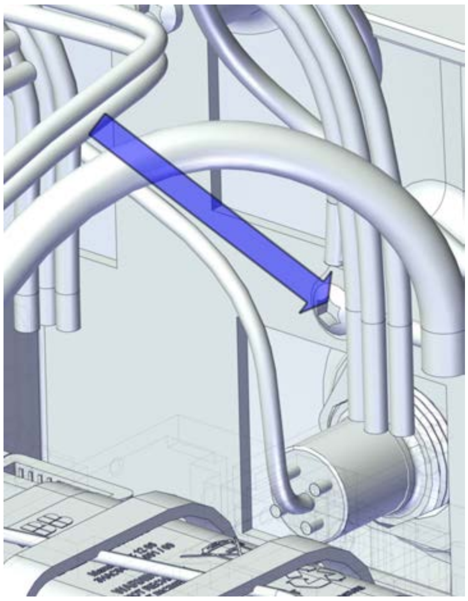
Refitting the battery pack

Use these procedures to refit the battery pack.

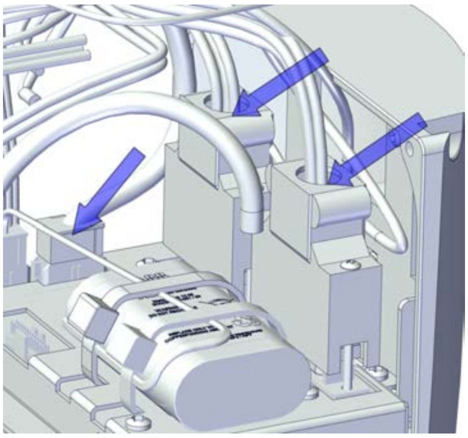
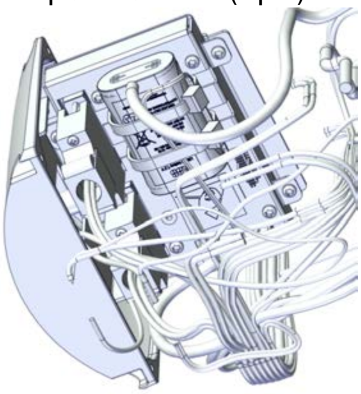
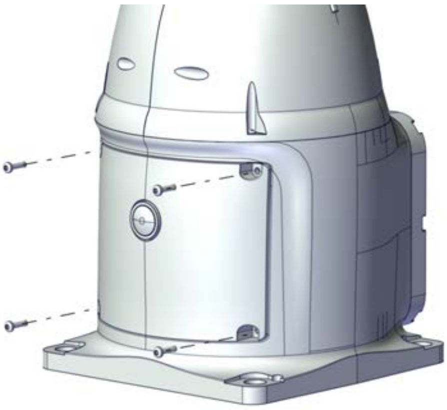
Refitting the battery pack

	Action	Note
1	**WARNING** The unit is sensitive to ESD. Before handling the unit, see *The unit is sensitive to ESD on page 51*.	
2	Fit the battery and and secure it with two cable ties. **Note** Battery includes protection circuits. Only replace with a specified spare part or with an ABB-approved equivalent.	 xx1800001156

Continues on next page

	Action	Note
3	Connect the battery connector.	 xx1800001152
4	Connect the ground cable.	 xx1800001151
5	Connect the cable connector to ensure enough room for further activities. • BR	

Continues on next page

	Action	Note
6	Connect the SMB connectors: • SMB.J1 • SMB.J2 • SMB	 xx1800001149
7	Refit the base cover.	Screws: Torx pan head screw (4 pcs).  xx1800001148  xx1800001145

Concluding procedure

	Action	Note
1	Update the revolution counters.	See *Updating revolution counters on page 339*.

Continues on next page

	Action	Note
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

3.5 Cleaning activities

3.5.1 Cleaning the IRB 14050

WARNING

Turn off all electrical power supplies to the robot before starting the cleaning.

General

To secure high uptime it is important that the IRB 14050 is cleaned regularly. The frequency of cleaning depends on the environment in which the product works.

Note

Always verify the protection type of the robot before cleaning.

Special cleaning considerations

This section specifies some special considerations when cleaning the robot.

- Always use cleaning equipment as specified. Any other cleaning equipment may shorten the life of the robot.
- Always check that all protective covers are fitted to the robot before cleaning.
- Do not use compressed air to clean the robot.
- Never use solvents that are not approved by ABB to clean the robot.
- Do not remove any covers or other protective devices before cleaning the robot.

Cleaning methods

The following table defines what cleaning methods are allowed depending on the protection type.

Protection type	Cleaning method			
	Vacuum cleaner	Wipe with cloth	Rinse with water	High pressure water or steam
Standard	Yes	Yes. With light cleaning detergent (no spirit or isopropyl alcohol is allowed.)	No	No
Clean room	Yes	Yes. With light cleaning detergent, spirit or isopropyl alcohol.	No	No

Continues on next page

Wiping with cloth

Additional cleaning instructions for Clean Room robots

ABB robots with protection types *Clean Room* are designed to be cleaned at a low cleaning frequency, before entering the cleanroom environment, after robot commissioning or during cleanroom maintenance.

Wipe-down cleaning method is recommended. Robot surfaces shall be wiped with clean and low particle emission cleanroom cloth which is soaked in 70% ethanol .

Use the following procedure to clean Clean Room robots:

1. Before cleaning, use the lint free cloth to remove dirt, debris or any other contaminant from the to-be cleaned surfaces.
   - Make sure no visible residues left.
   - Never apply hard forces on or rub against the robot surfaces to remove dirt or debris; otherwise, protective paint layers may be damaged.
2. Wet a clean cloth with the cleaning detergent and then wipe the robot painting surfaces.
   - Make sure no cleaning agents are sprayed onto robot surfaces or into the robot structure.
   - Wipe from the surface center to edge and always in the same direction.
3. Wait a few minutes for detergent volatilization.
   - Make sure no residue of cleaning agents left on the robot surfaces after wipe down cleaning.

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4 Repair

4.1 Introduction

Structure of this chapter

This chapter describes repair activities for the IRB 14050. Each procedure contains 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.

Report replaced units

Note

When replacing a part on the IRB 14050, report to your local ABB the serial number, the article number, and the revision of both the replaced unit and the replacement unit.

This is particularly important for safety equipment to maintain the safety integrity of the installation.

Safety information

Make sure to read through the chapter *Safety on page 15* before commencing any service work.

Note

If the IRB 14050 is connected to power, always make sure that the IRB 14050 is connected to protective earth and a residual current device (RCD) before starting any repair work.

For more information see:

- *Product manual - OmniCore C30*

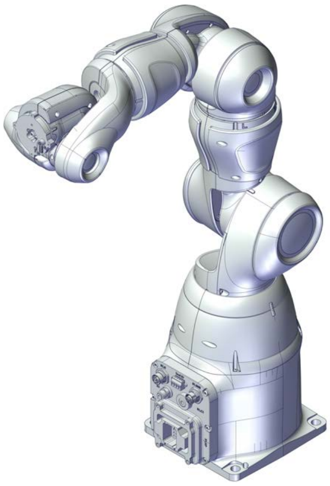
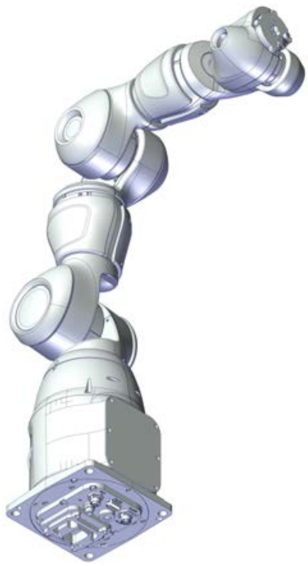
4.2 Arm and arm covers

4.2.1 Replacing the complete arm

Illustration of the manipulator

By default, the connector interface is located at the rear of the base. The interface can also be bottom mounted, as an option.

For robots with Absolute Accuracy option, it is recommended to exchange the complete manipulator in case of a broken axis-1 motor, axis-7 motor and/or hall sensors; otherwise, the motors and/or hall sensors must be replaced by ABB. Contact your local ABB for more information.

Manipulator with rear connector interface	Manipulator with bottom connector interface
 xx1800000612	 xx1800001264
3HAC074256-001	3HAC074260-001

4.2.2 Replacing the encapsulation and covers

Required tools and equipment

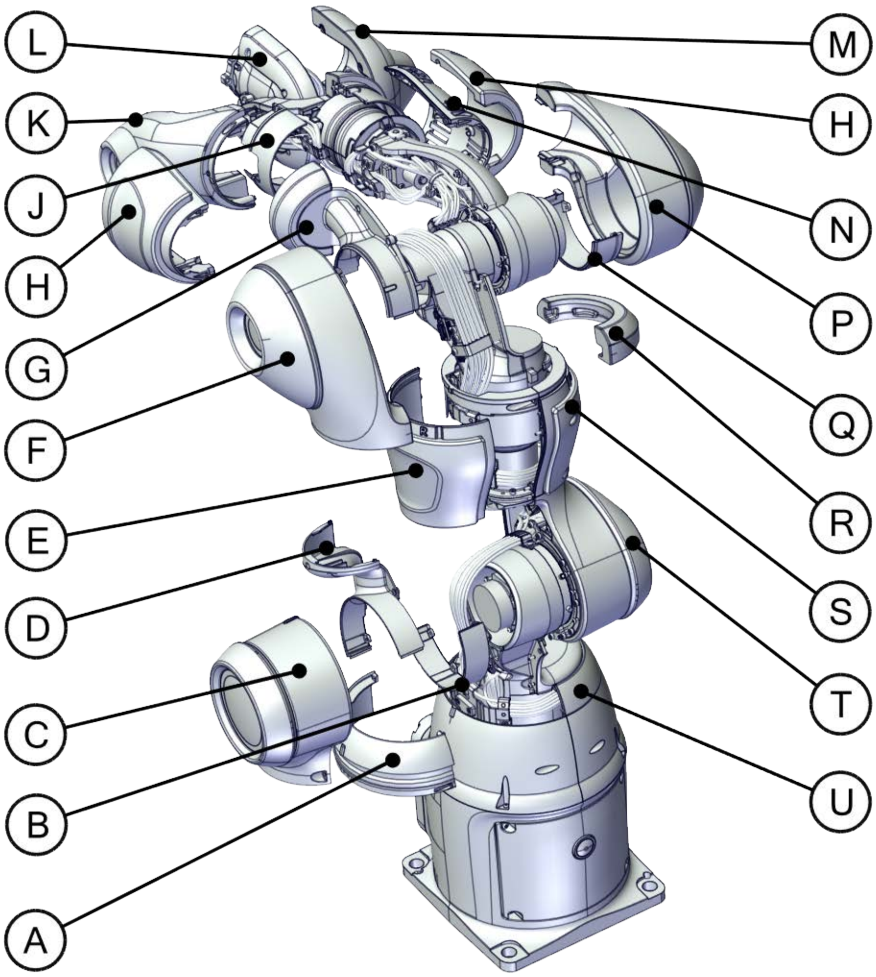
Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Consumables

Consumable	Article number	Note
Locking liquid	-	Loctite 454

Replacing the arm covers

Location of arm covers



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Information for replacement

Replace any damaged covers. The table gives input for removal order and shows tightening torques for the cover attachment screws.

	Spare part number	Description	Covers that need to be removed for access	Tightening torque
A	3HAC057718-001 9ADA267-4	Upper axis-1 cover, ESD coated Nut		0.14 Nm
B	3HAC057721-001	Axis-2 cable collar, ESD coated	Cover C (3HAC050559-001) Cover D (3HAC057722-001)	0.14 Nm
C	3HAC050559-001	Lower axis-2 cover, ESD coated		0.14 Nm
D	3HAC057722-001	Axis-2 cable cover, ESD coated	Cover C (3HAC050559-001) Cover E (3HAC050529-002) Cover Q (3HAC050529-001)	0.14 Nm
E	3HAC050529-002	Axis-7 cover, ESD coated		0.14 Nm
F	3HAC050532-001	Lower axis-3 cover, ESD coated		0.14 Nm
G	3HAC050538-001	Upper axis-3 cover, ESD coated	Cover F (3HAC050532-001) Cover M (3HAC050542-001) Cover N (3HAC050535-001)	0.14 Nm
H	3HAC050545-001	Axis-4 body cover, ESD coated	Cover M (3HAC050542-001) Cover J (3HAC050548-001)	0.14 Nm
J	3HAC049878-001	Axis-4 cable protection	Cover M (3HAC050542-001) Cover J (3HAC050548-001) Cover H (3HAC050545-001)	0.14 Nm
K	3HAC050548-001	Upper axis-4 cover, ESD coated	Cover M (3HAC050542-001)	0.14 Nm

Continues on next page

	Spare part number	Description	Covers that need to be removed for access	Tightening torque
L	3HAC041286-001	Cooling flange with padding	Cover J (3HAC050548-001) Cover L () 3HAC050553-001/3HAC074222-001 [i]	0.2 Nm
M	3HAC050553-001/3HAC074222-001 [ii]	Axis-6 cover, ESD coated		0.2 Nm
N	3HAC050542-001	Lower axis-4 cover, ESD coated		0.14 Nm
P	3HAC050535-001	Axis-3 body cover, ESD coated	Cover F (3HAC050532-001) Cover M (3HAC050542-001)	0.14 Nm
Q	3HAC057727-001	Axis-3 cable collar, ESD coated	Cover F (3HAC050532-001) Cover G (3HAC050538-001) Cover N (3HAC050535-001)	0.14 Nm
R	3HAC050526-001	Axis-7 body padding Use locking liquid Loctite 454 when fitting.		-
S	3HAC050529-001	Axis-7 cover, ESD coated		0.14 Nm
T	3HAC050558-001	Axis-2 padding Use locking liquid Loctite 454 when fitting.		-

i Axis-6 cover 3HAC050553-001 is used with robot no-type-specified while axis-6 cover 3HAC074222-001 is used with robot Type A. See *Robot description on page 349* for robot type.

ii Axis-6 cover 3HAC050553-001 is used with robot no-type-specified while axis-6 cover 3HAC074222-001 is used with robot Type A. See *Robot description on page 349* for robot type.

CAUTION

Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.

4.3 Motors

4.3.1 Replacing the axis-1 motor

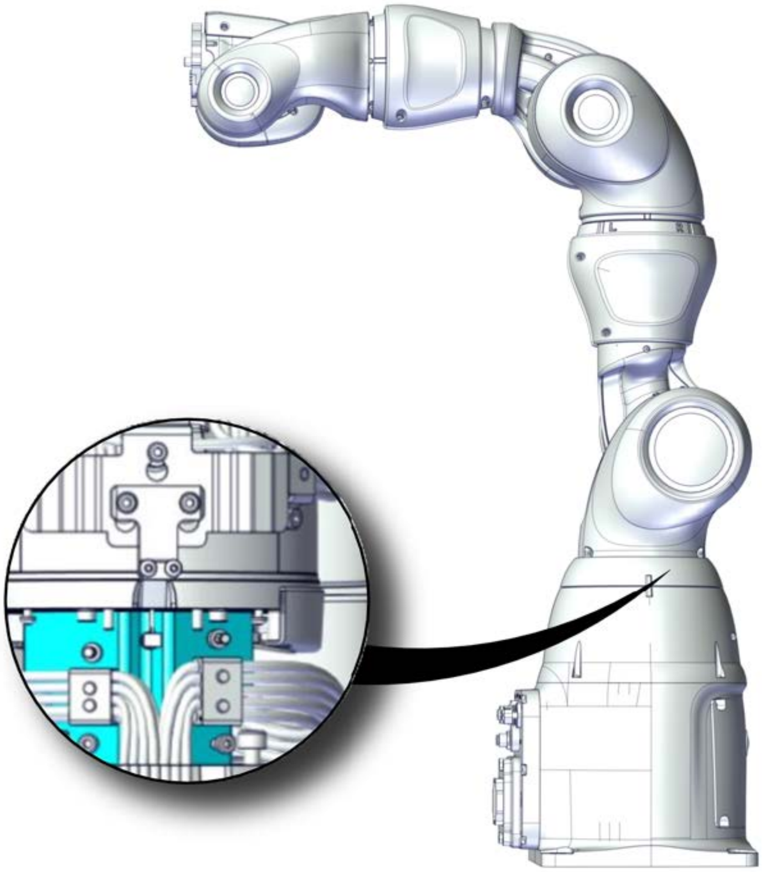
Note

For robots without Absolute Accuracy option, replace the axis-1 motor by following the instructions specified in this section.

For robots with Absolute Accuracy option, it is recommended to exchange the complete manipulator in case of a broken axis-1 motor; otherwise, the motor must be replaced by ABB. Contact your local ABB for more information.

Location of the axis-1 motor

The axis-1 motor is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest revision of *Product manual, spare parts - Product.ProductName* on ABB Library.

Spare part	Article number	Note
Motor M93	3HAC072394-001	Always use a new o-ring 3HAB3772-137. To be ordered separately.
O-ring	3HAB3772-137	Required to be replaced when removing and refitting the motor.
Hex socket head cap screw	3HAB3409-212	M4x16 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAB3409-232	M4x12 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAB3409-233	M2.5x6 12.9 Lafre 2C2B/FC6.9
Torx pan head screw	3HAC050367-005	M3x12 8.8 Gleitmo 605
Hex socket head cap screw	3HAC050368-005	M2x8 8.8

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.
Removal tool	3HAC054868-001	Used to pull out the motor.
Fixture tool for wave generator M93	3HAC054870-001	

Consumables

Consumable	Article number	Note
Grease	3HAC042536-001	Used to lubricate the seals. Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

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Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.

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Removing the motor

Use these procedures to remove the axis-1 motor.

Preparations before removing the motor

	Action
1	Jog the robot to the specified position: • Axis 1: -53° • Axis 2: -25° • Axis 7: 169° • Axis 3: -109° • Axis 4: No significance. • Axis 5: No significance. • Axis 6: No significance.
2	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.

Removing the axis-1 covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

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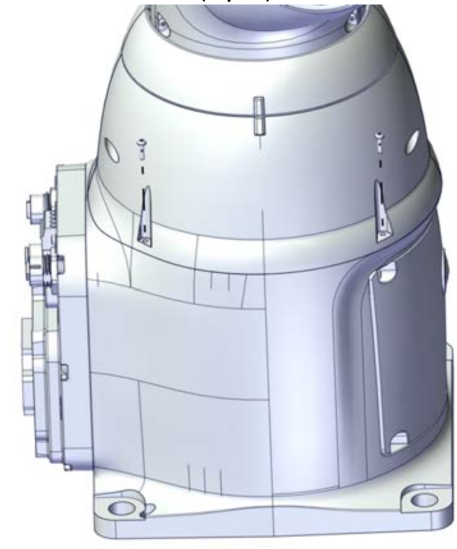
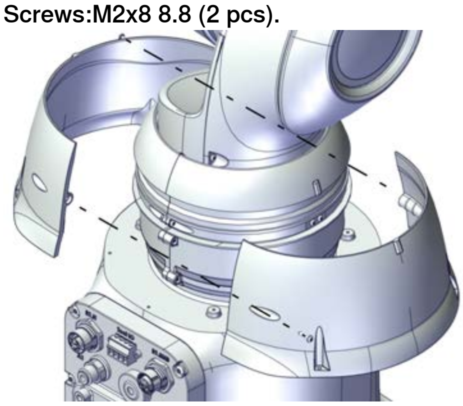
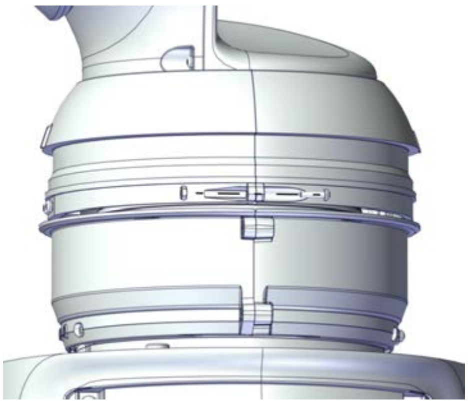
	Action	Note
2	Remove the outer axis 1 cover screws.	Screws:M2x8 8.8 (4 pcs).  xx1800001240 Screws:M2x8 8.8 (2 pcs).  xx1800001241
3	Remove the upper axis-1 cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.	Screws:M2x8 8.8 (2 pcs).  xx1800001242

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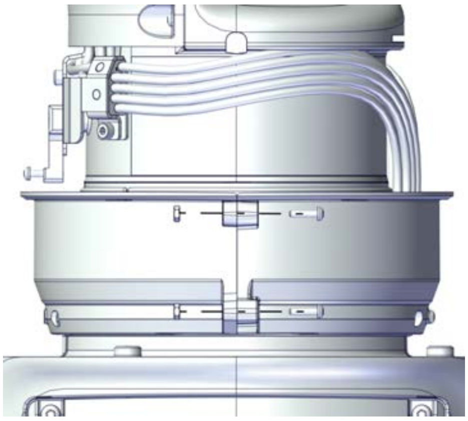
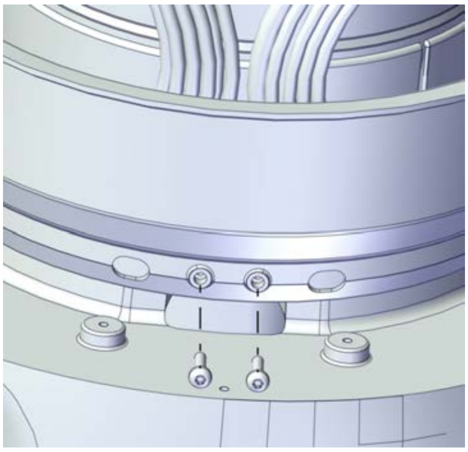
	Action	Note
4	Turn the lower axis-1 cover in order to access all screws properly and remove the lower axis-1 cover.	Screws:M2x8 8.8 (4 pcs).  xx1800001243  xx1800001252

Removing the arm from the body with cabling still connected

Note

Two persons working together are required to perform this procedure.

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

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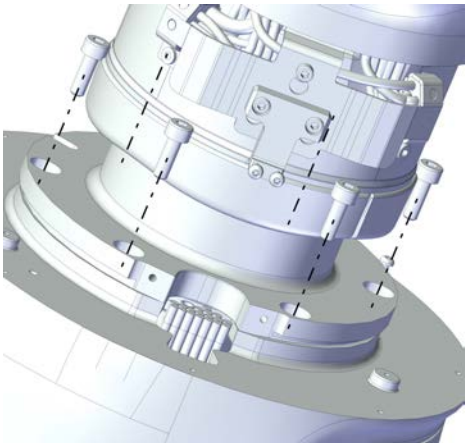
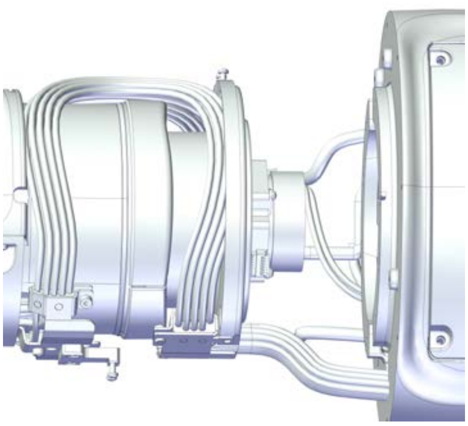
	Action	Note
2	Loosen the cable bracket from the arm by removing the screws.	 xx1800001493
3	Turn on the power to the robot temporarily.	
4	**Note** Two persons working together are required to perform this step. Person 1: Hold the arm. Person 2: Remove the screws that fasten the arm to the body. Release the brakes and rotate axis 1 in order to access all the screws. Move the axes back into original position when all the screws are removed.	 xx1800001494
5	**DANGER** Turn off the electric power supply again.	
6	Remove the arm from the body. **CAUTION** The cabling is still connected inside the robot, be careful not to strain the cables!	 xx1800001495

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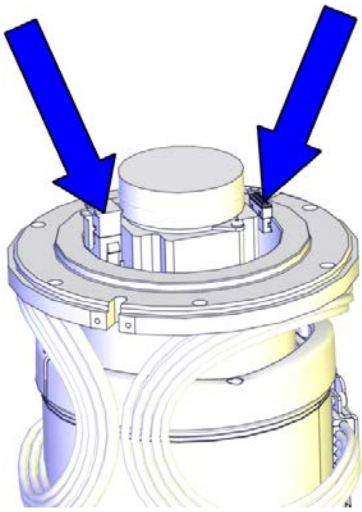
Removing the axis-1 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	If possible, place the arm on a workbench. If not possible, two persons are required for the continued procedure on removing the motor, one person holding the arm, the other person working with the motor. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables!	
3	Hold the arm so that the motor cover points upwards. **Tip** This position makes it possible to change the motor without spilling out any grease from the gearbox.	
4	Disconnect the motor connectors. • MP1 • FB1	 xx1500000590
5	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	

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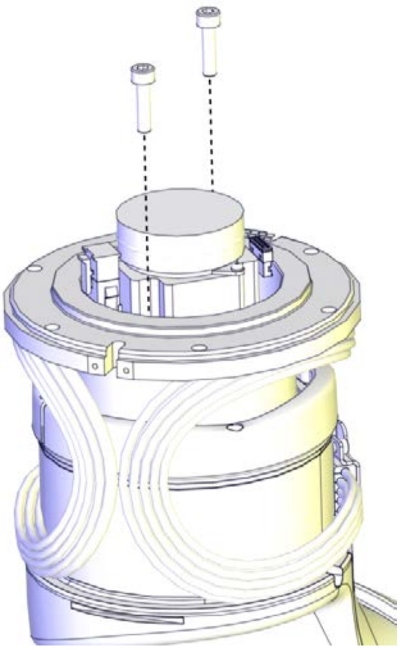
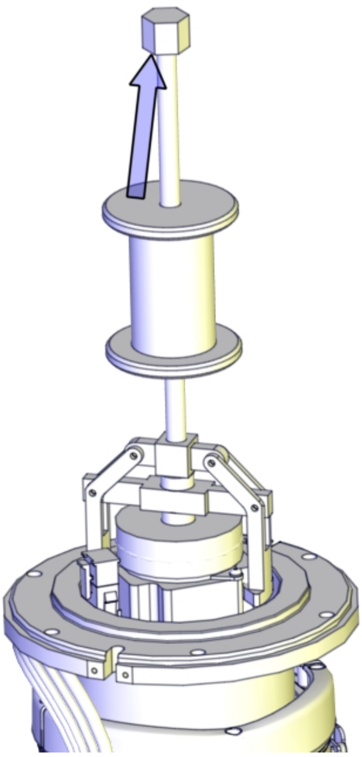
	Action	Note
6	Remove the screws.	 xx1500000517
7	Remove the motor by using the removal tool accordingly: 1 Attach the grip arms of the removal tool to the notches on the motor sides. 2 Gently knock the block upwards to the end stop of the pin repeatedly until the motor loosens. 3 Pull out the motor. **CAUTION** Lifting the motor out creates a hole into the gear, make sure no dirt falls into the hole.	Removal tool: 3HAC054868-001.  xx1500000521

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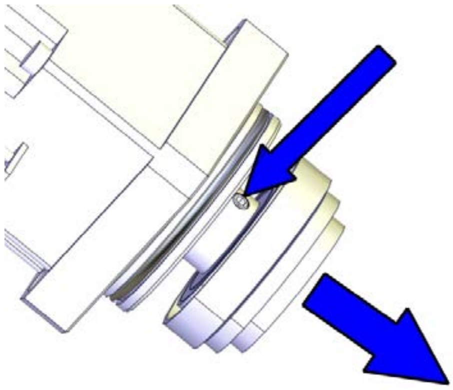
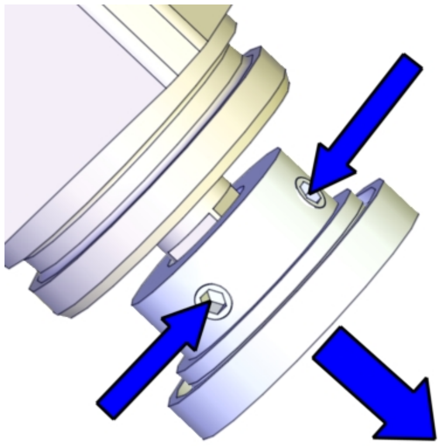
Removing the wave generator from the motor

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000515
	Axis 6.	 xx1500001651
2	Place the wave generator on a clean workbench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

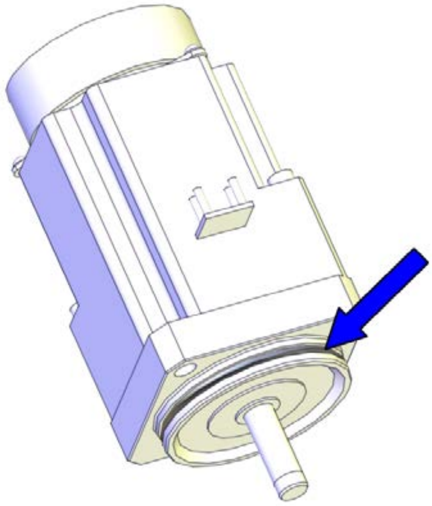
Refitting the motor

Use these procedures to refit the axis-1 motor.

Fitting a new o-ring on the motor

	Action	Note
1	Wipe the o-ring groove of the motor clean.	Motor M93: 3HAC072394-001.

Continues on next page

	Action	Note
2	Fit a new o-ring in the groove.  **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	O-ring: 3HAB3772-137 Grease: Used to lubricate the seals..  xx1400002611

Fitting the wave generator to the motor

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

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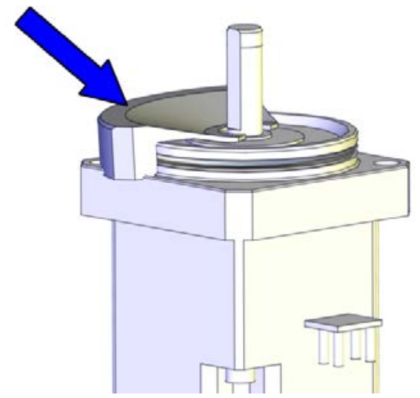
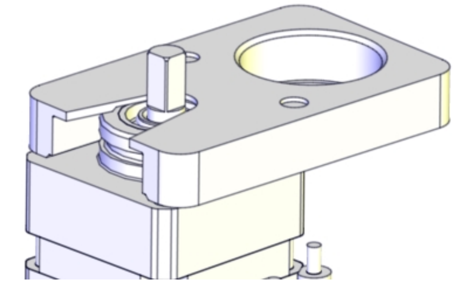
	Action	Note
2	Place the fixture tool on the new motor.	
	Axis 1 and axis 2: Fixture tool for wave generator M93, 3HAC054870-001.	 xx1500000527
	Axis 7 and axis 3: Fixture tool for wave generator M92, 3HAC054871-001.	
	Axis 6: Fixture tool for wave generator M91, 3HAC054904-001.	 xx1500001646

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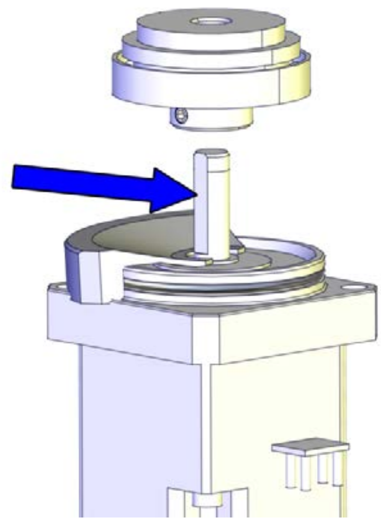
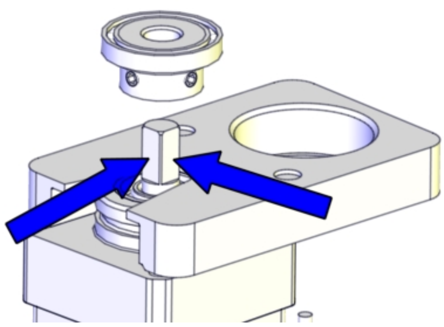
	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	
	Axis 1, axis 2, axis 3 and axis 7.	 xx1500000528
	Axis 6.	 xx1500001647

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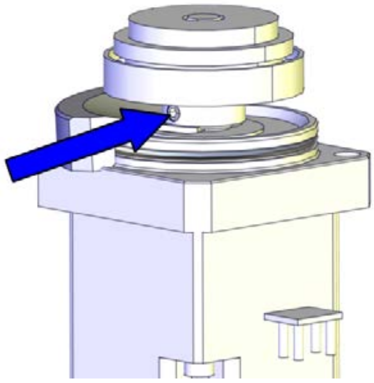
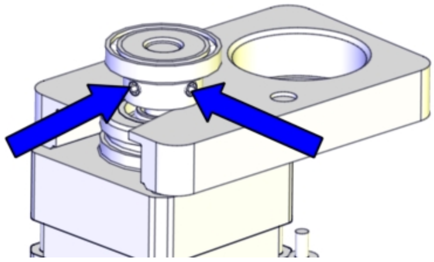
	Action	Note
4	Tighten the set screw.	
	Axis 1, axis 2, axis 3 and axis 7.	Screw: M3-set screw (1 pcs). Tightening torque: 0.6 Nm.  xx1500000518
	Axis 6.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	

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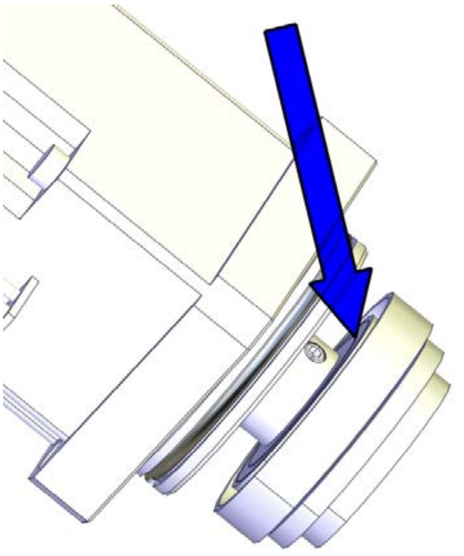
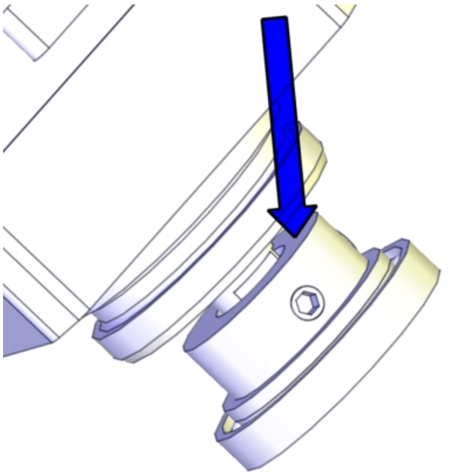
	Action	Note
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000557
	Axis 6.	 xx1500001649

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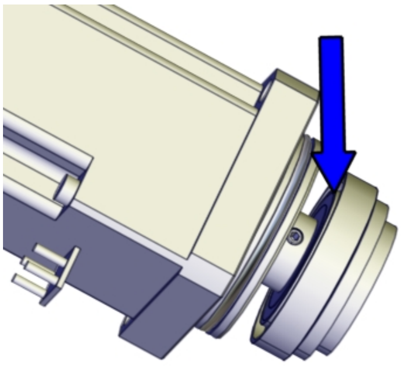
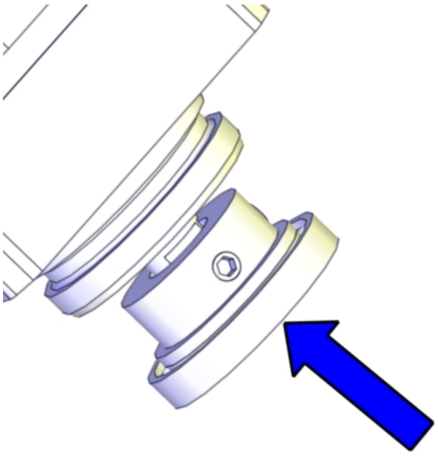
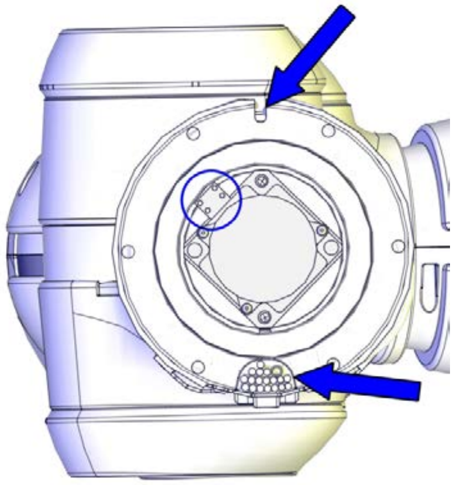
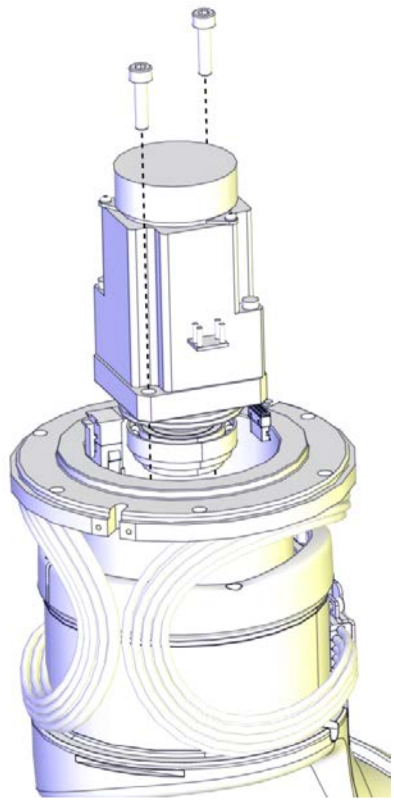
	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000556
	Axis 6.	 xx1500001650

Refitting the axis-1 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	

Continues on next page

	Action	Note
2	Orient the motor correctly and fit it into the arm. Secure with the screws. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector and to the small and the big notch at the arm mounting flange.  xx1500000539 Screw: 3HAB3409-212. (2 pcs) Tightening torque: cross-tighten all screws to 1 Nm first, then final cross-tighten to 2.5 Nm.  xx1400002609

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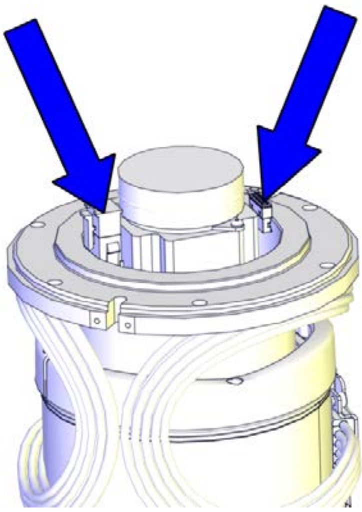
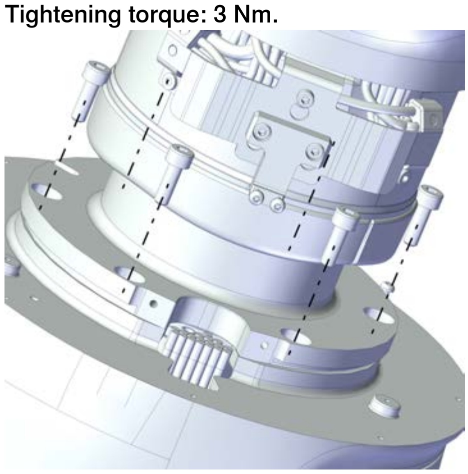
	Action	Note
3	Reconnect the motor connectors. • MP1 • FB1	 xx1500000590

Refitting the arm to the body

Note

Two persons working together are required to perform this procedure.

	Action	Note
1	Refit the arm to the body. Secure with the screws. Release the brakes and rotate axis 1 in order to access all the screws. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Screw: 3HAB3409-232. (6 pcs) Tightening torque: 3 Nm.  xx1800001494

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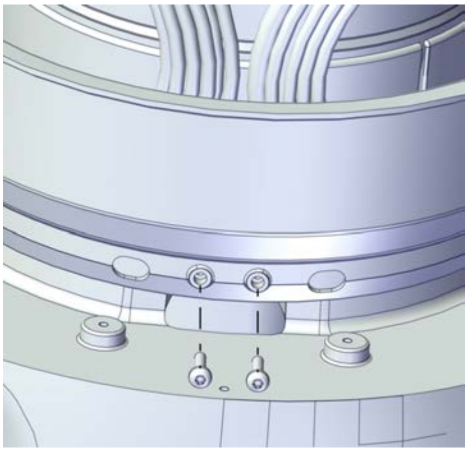
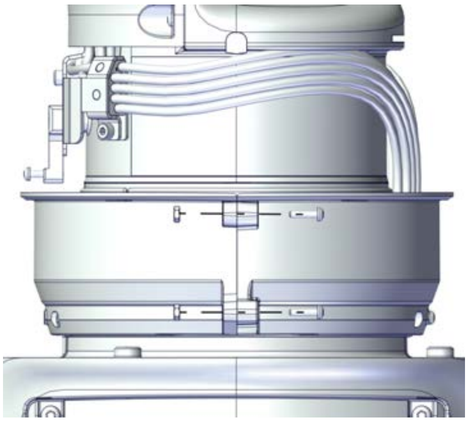
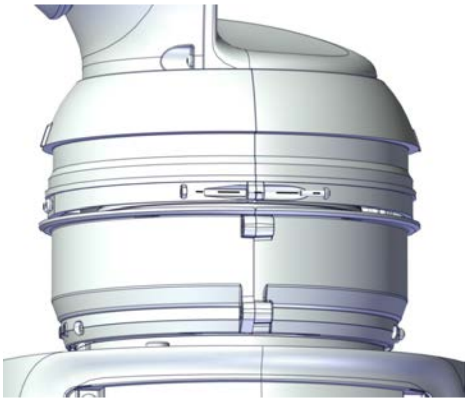
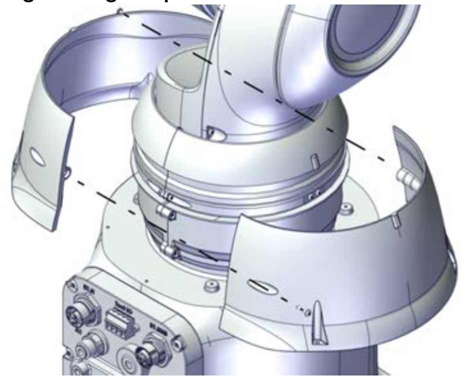
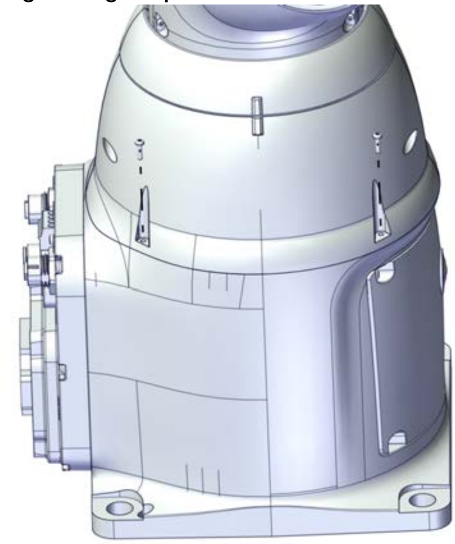
	Action	Note
2	Refit the cable bracket to the arm with the screws.	Screw: 3HAB3409-233. (2 pcs) Tightening torque: 0.8 Nm.  xx1800001493

Continues on next page

Refitting the axis-1 covers

	Action	Note
1	Refit the lower axis-1 cover.	Screws: 3HAC050368-005 (4 pcs). Nuts: 9ADA267-1 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001252  xx1800001243
2	Refit the upper axis-1 cover.	Screws: 3HAC050368-005 (2 pcs). Nuts: 9ADA267-1 (2 pcs). Tightening torque: 0.14 Nm.  xx1800001242

Continues on next page

	Action	Note
3	Refit the outer axis-1 padding.	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1800001241 Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001240

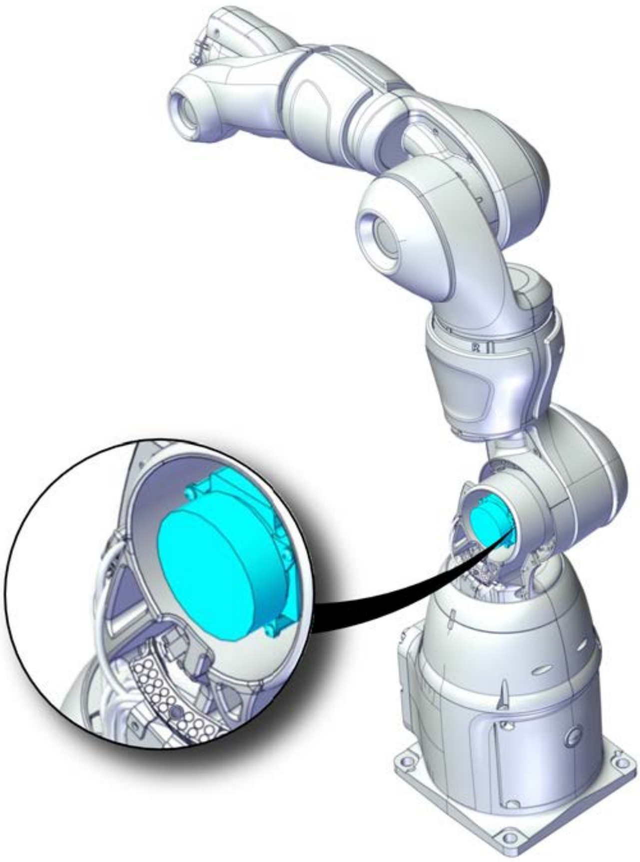
Concluding procedure

	Action	Note
1	Recalibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.3.2 Replacing the axis-2 motor

Location of the axis-2 motor

The axis-2 motor is located as shown in the figure.



xx1800001230

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Motor M93	3HAC072394-001	Always use a new o-ring 3HAB3772-137. To be ordered separately.
O-ring	3HAB3772-137	Required to be replaced when removing and refitting the motor.
Hex socket head cap screw	3HAB3409-212	M4x16 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Nut	9ADA267-1	M2 DIN934 8 ELZN

Continues on next page

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.
Removal tool	3HAC054868-001	Used to pull out the motor.
Fixture tool for wave generator M93	3HAC054870-001	

Consumables

Consumable	Article number	Note
Grease	3HAC042536-001	Used to lubricate the seals. Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

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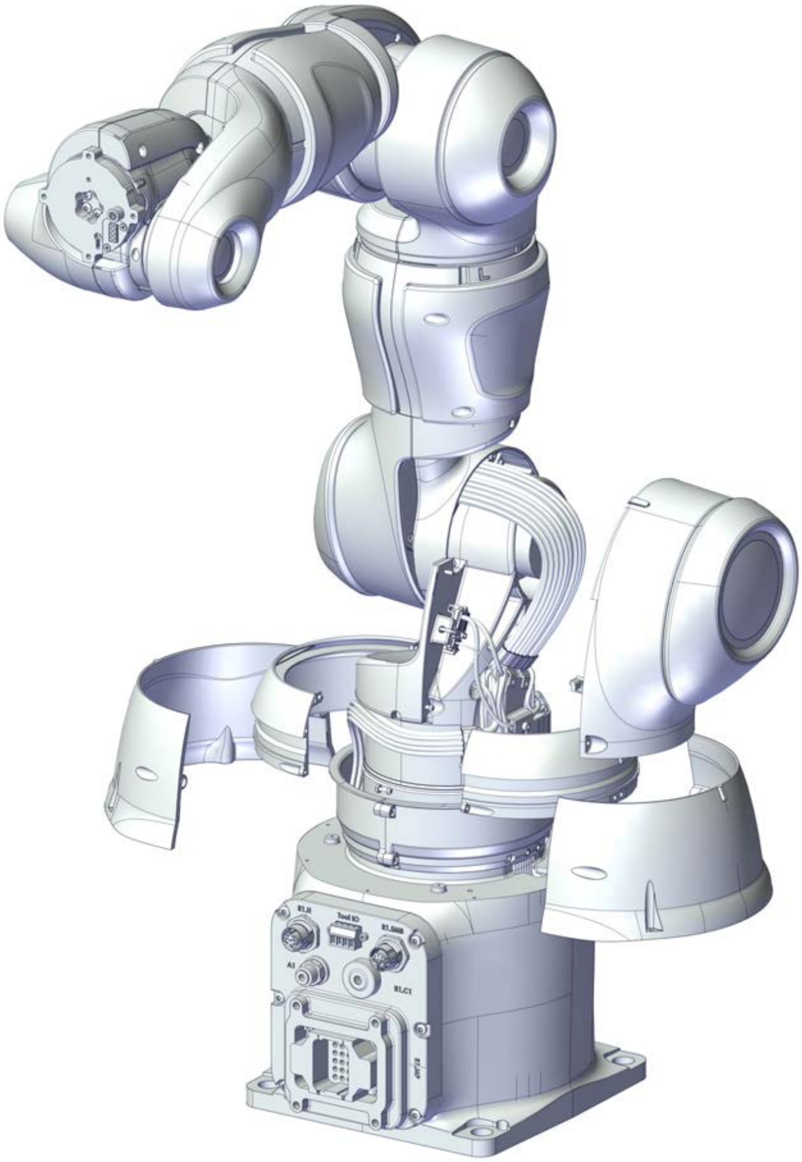
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1800001249

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Removing the motor

Use these procedures to remove the axis-2 motor.

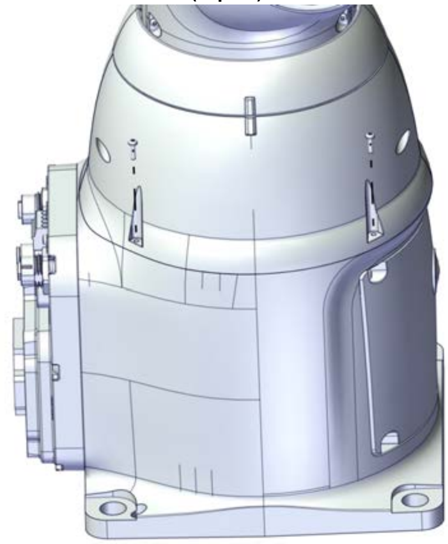
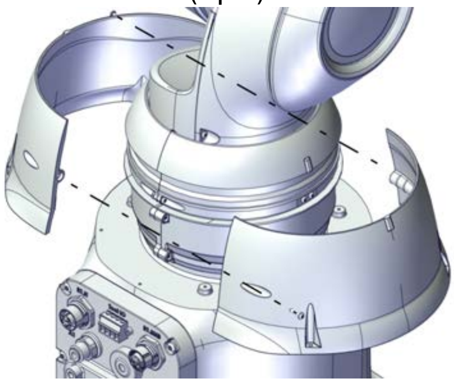
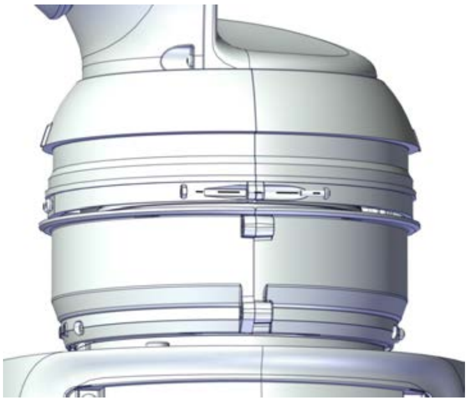
Preparations before removing the motor

	Action	Note
1	Jog the robot to the specified position: • Axis 1: keep the vertical. • Axis 2: rotate in positive direction until the axis is secured against the axis-2 mechanical stop. • Axis 7: brake release to position the axis hanging straight down. • Axis 3: brake release to position the axis hanging straight down. • Axis 4: No significance. • Axis 5: No significance. • Axis 6: No significance.	Figure shows position of arm:  xx1800000612
2	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	

Removing the axis-1 covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

Continues on next page

	Action	Note
2	Remove the outer axis 1 cover screws.	Screws:M2x8 8.8 (4 pcs).  xx1800001240 Screws:M2x8 8.8 (2 pcs).  xx1800001241
3	Remove the upper axis-1 cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.	Screws:M2x8 8.8 (2 pcs).  xx1800001242

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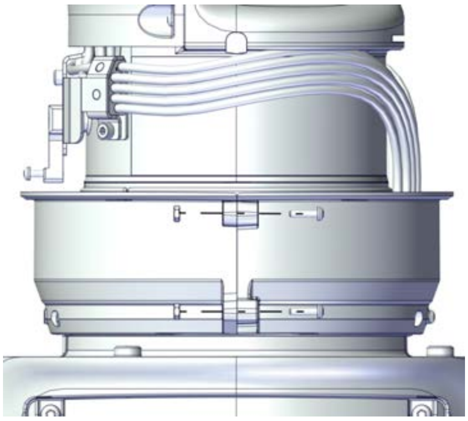
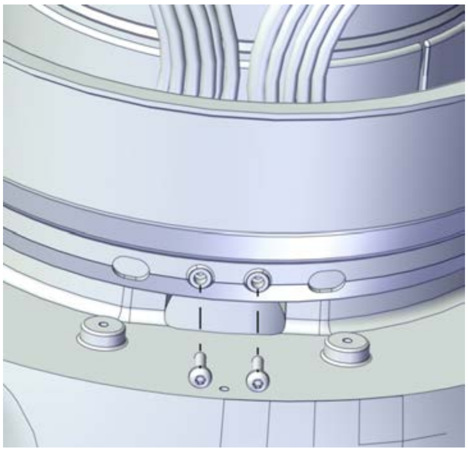
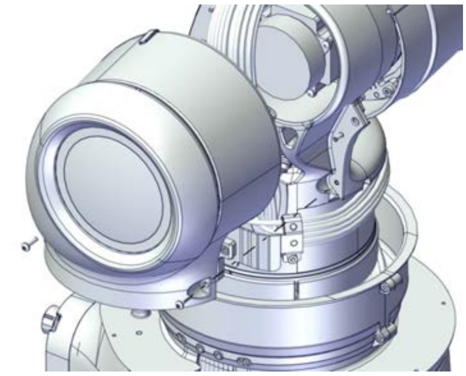
	Action	Note
4	Turn the lower axis-1 cover in order to access all screws properly and remove the lower axis-1 cover.	Screws:M2x8 8.8 (4 pcs).  xx1800001243  xx1800001252

Removing the axis-2 covers

	Action	Note
1	Remove the lower axis-2 cover.	 xx1800001248

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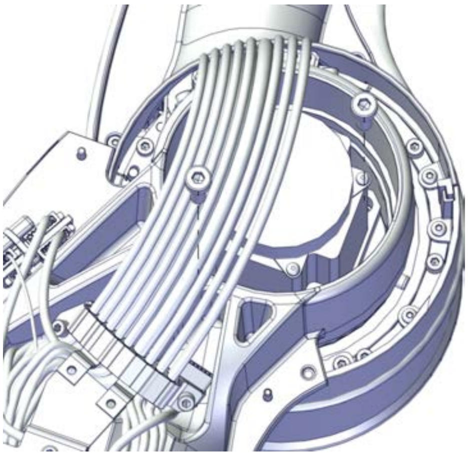
Removing the axis-2 motor

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Disconnect the motor connectors. • R1.MP2 • R1.FB2	
3	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
4	**CAUTION** The gravity will cause the arm to suddenly fall down when the motor is removed, if the axis is not secured. Make sure the axis is secured against the mechanical stop prior to removing the motor.	
5	Move the cabling in order to access the motor screws. Loosen the cable bracket, if needed. Remove the screws.	 xx1800001250

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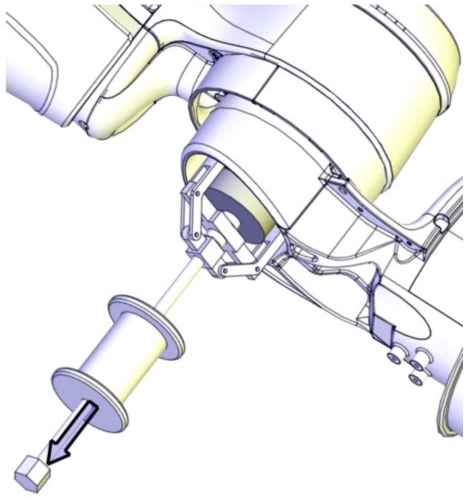
<table>
<tr><th></th><th>Action</th><th>Note</th></tr>
<tr><td>6</td><td>Remove the motor by using the removal tool accordingly:
1 Attach the grip arms of the removal tool to the notches on the motor sides.
2 Gently knock the block backwards to the end stop of the pin to carefully knock the motor loose.
3 Pull out the motor.

CAUTION

Lifting the motor out creates a hole into the gear, make sure no dirt falls into the hole.</td><td>Removal tool: 3HAC054868-001

xx1800001251</td></tr>
</table>

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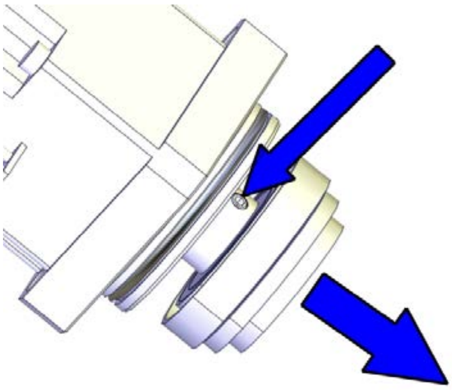
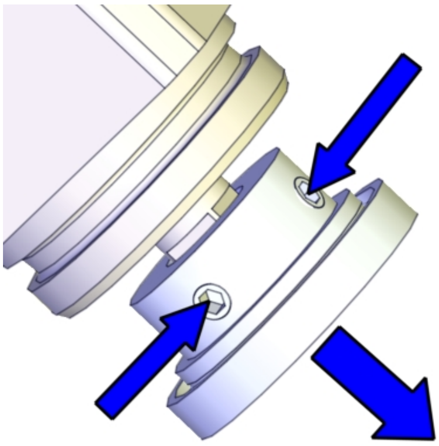
Removing the wave generator from the motor

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000515
	Axis 6.	 xx1500001651
2	Place the wave generator on a clean workbench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

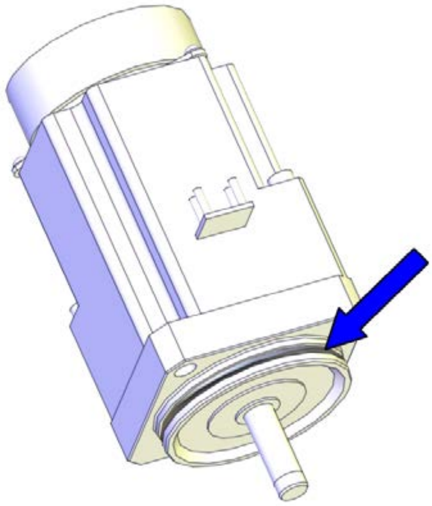
Refitting the motor

Use these procedures to refit the axis-2 motor.

Fitting a new o-ring on the motor

	Action	Note
1	Wipe the o-ring groove of the motor clean.	Motor M93: 3HAC072394-001.

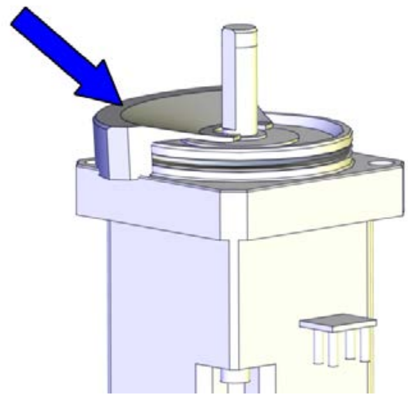
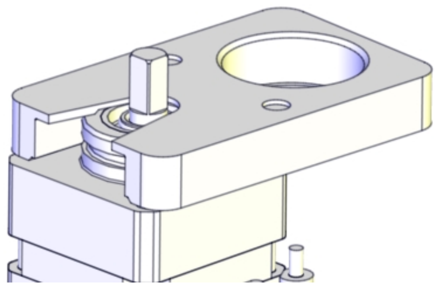
Continues on next page

	Action	Note
2	Fit a new o-ring in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	O-ring: 3HAB3772-137 Grease: Used to lubricate the seals..  xx1400002611

Fitting the wave generator to the motor

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

Continues on next page

	Action	Note
2	Place the fixture tool on the new motor.	
	Axis 1 and axis 2: Fixture tool for wave generator M93, 3HAC054870-001.	 xx1500000527
	Axis 7 and axis 3: Fixture tool for wave generator M92, 3HAC054871-001.	
	Axis 6: Fixture tool for wave generator M91, 3HAC054904-001.	 xx1500001646

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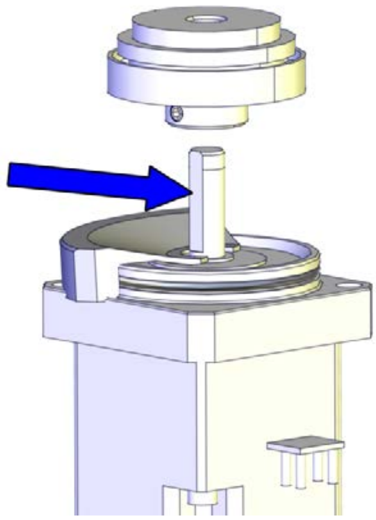
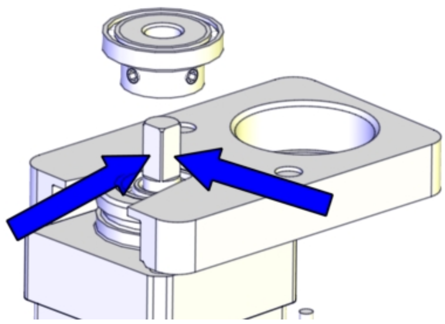
	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	
	Axis 1, axis 2, axis 3 and axis 7.	 xx1500000528
	Axis 6.	 xx1500001647

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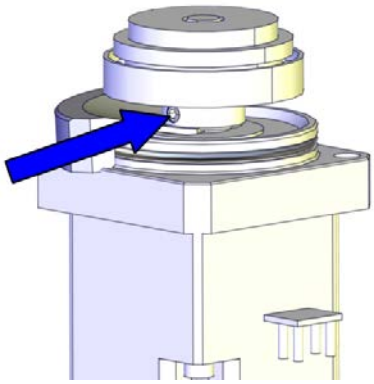
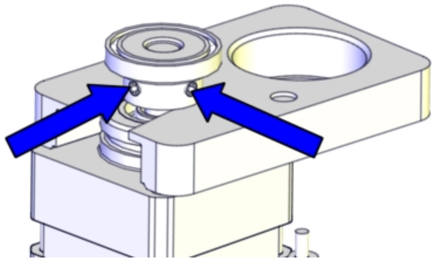
	Action	Note
4	Tighten the set screw.	
	Axis 1, axis 2, axis 3 and axis 7.	Screw: M3-set screw (1 pcs). Tightening torque: 0.6 Nm.  xx1500000518
	Axis 6.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	

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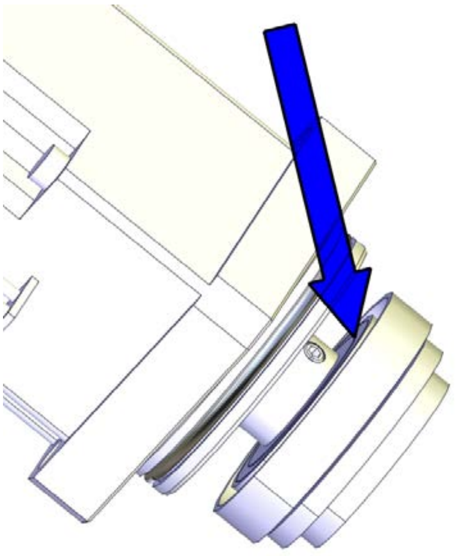
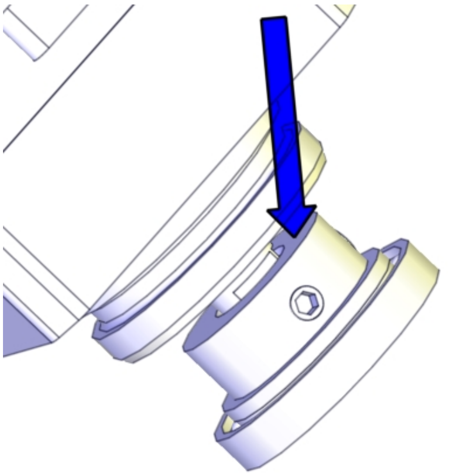
	Action	Note
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000557
	Axis 6.	 xx1500001649

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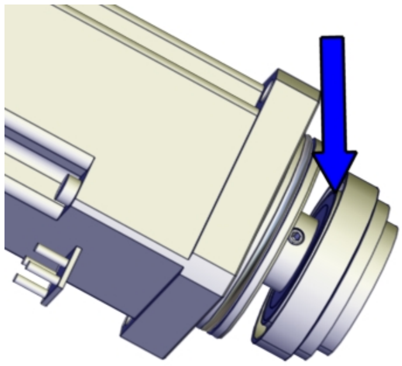
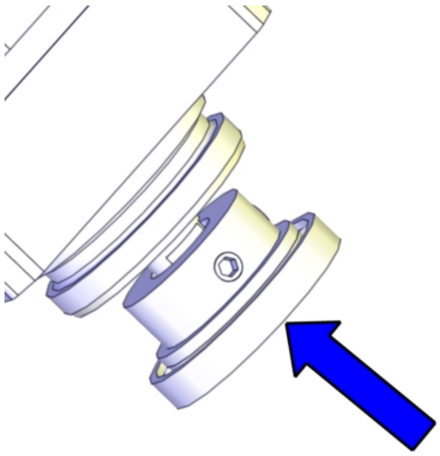
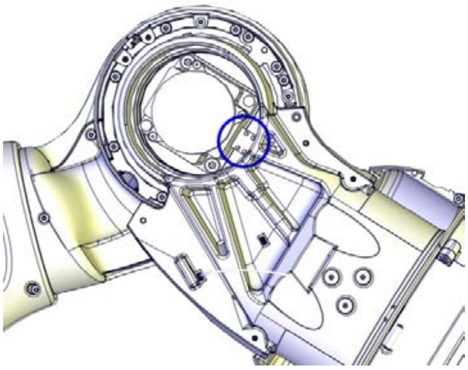
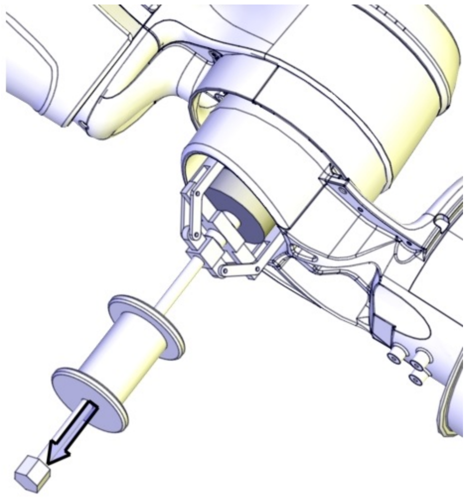
	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000556
	Axis 6.	 xx1500001650

Refitting the axis-2 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

Continues on next page

	Action	Note
2	Orient the motor correctly and fit it into the arm. Secure with the screws. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1500000566 Screws: 3HAB3409-212  xx1800001251 Tightening torque: cross-tighten all screws to 1 Nm first, then final cross-tighten to 2.5 Nm.
3	Connect the motor connectors: • R1.MP2 • R1.FB2	

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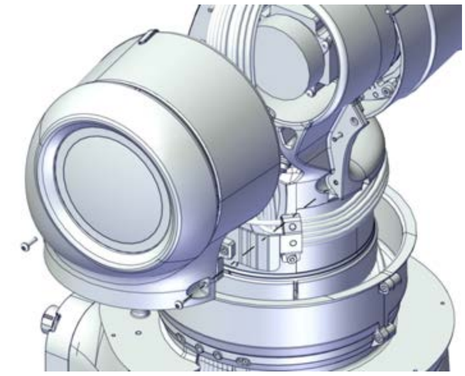
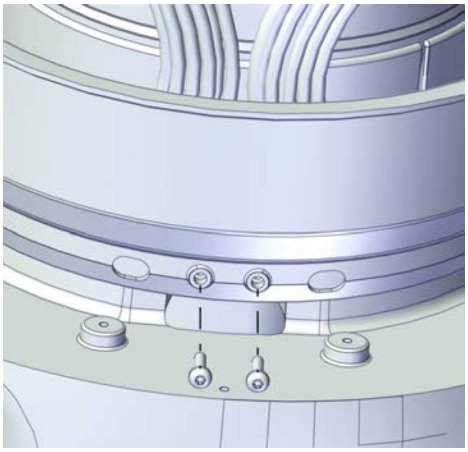
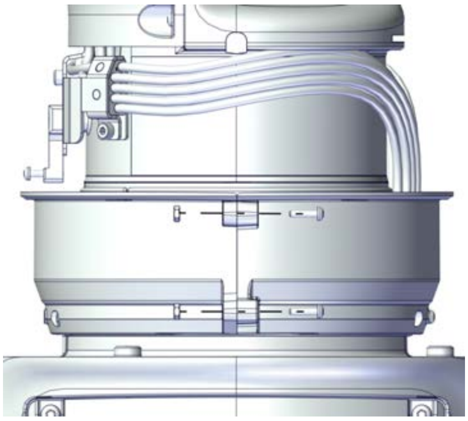
Refitting the axis-2 covers

	Action	Note
1	Refit the lower axis-2 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001248

Refitting the axis-1 covers

	Action	Note
1	Refit the lower axis-1 cover.	Screws: 3HAC050368-005 (4 pcs). Nuts: 9ADA267-1 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001252  xx1800001243

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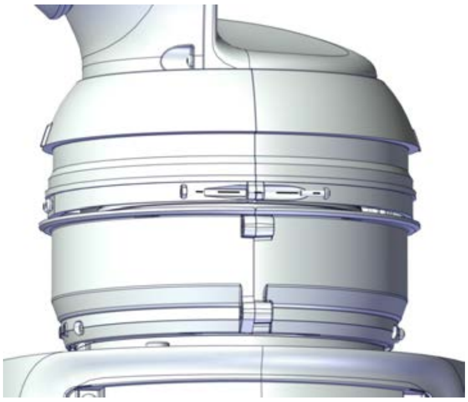
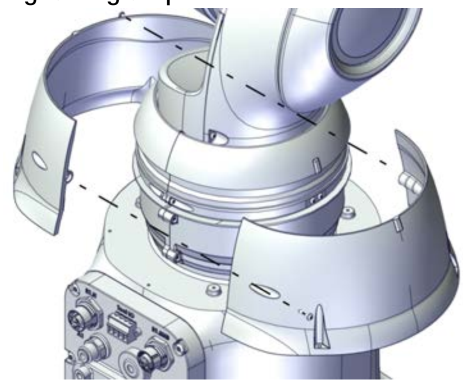
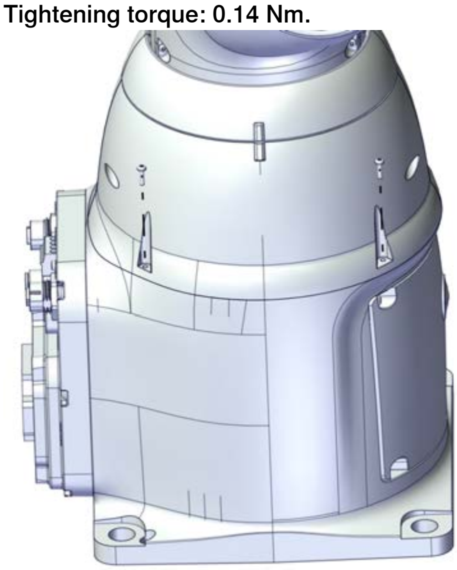
	Action	Note
2	Refit the upper axis-1 cover.	Screws: 3HAC050368-005 (2 pcs). Nuts: 9ADA267-1 (2 pcs). Tightening torque: 0.14 Nm.  xx1800001242
3	Refit the outer axis-1 padding.	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1800001241 Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001240

Continues on next page

Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.3.3 Replacing the axis-7 motor

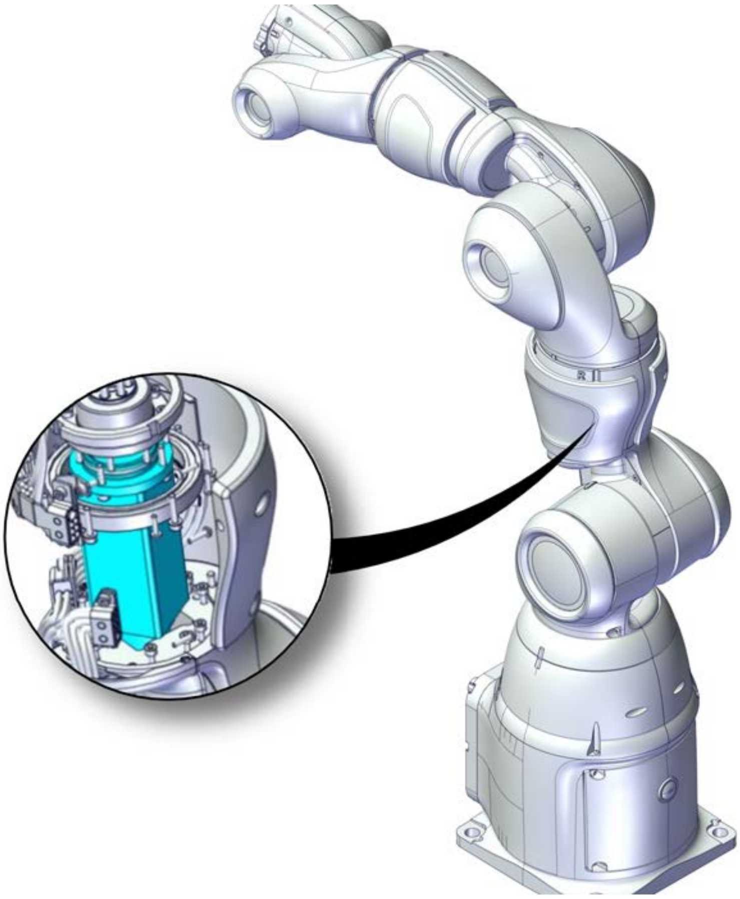
Note

For robots without Absolute Accuracy option, replace the axis-7 motor by following the instructions specified in this section.

For robots with Absolute Accuracy option, it is recommended to exchange the complete manipulator in case of a broken axis-7 motor; otherwise, the motor must be replaced by ABB. Contact your local ABB for more information.

Location of the axis-7 motor

The axis-7 motor is located as shown in the figure.



xx1800001231

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest revision of *Product manual, spare parts - Product.ProductName* on ABB Library.

Continues on next page

Spare part	Article number	Note
Motor M92	3HAC036900-001	Always use a new o-ring 3HAB3772-136. To be ordered separately.
O-ring	3HAB3772-136	Required to be replaced when removing and refitting the motor.
Hex socket head cap screw	3HAB3409-212	M4x16 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAC050368-005	M2x8 8.8

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.
Removal tool	3HAC054869-001	Used to pull out the motor.
Fixture tool for wave generator M92	3HAC054871-001	

Consumables

Consumable	Article number	Note
Grease	3HAC042536-001	Used to lubricate the seals. Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

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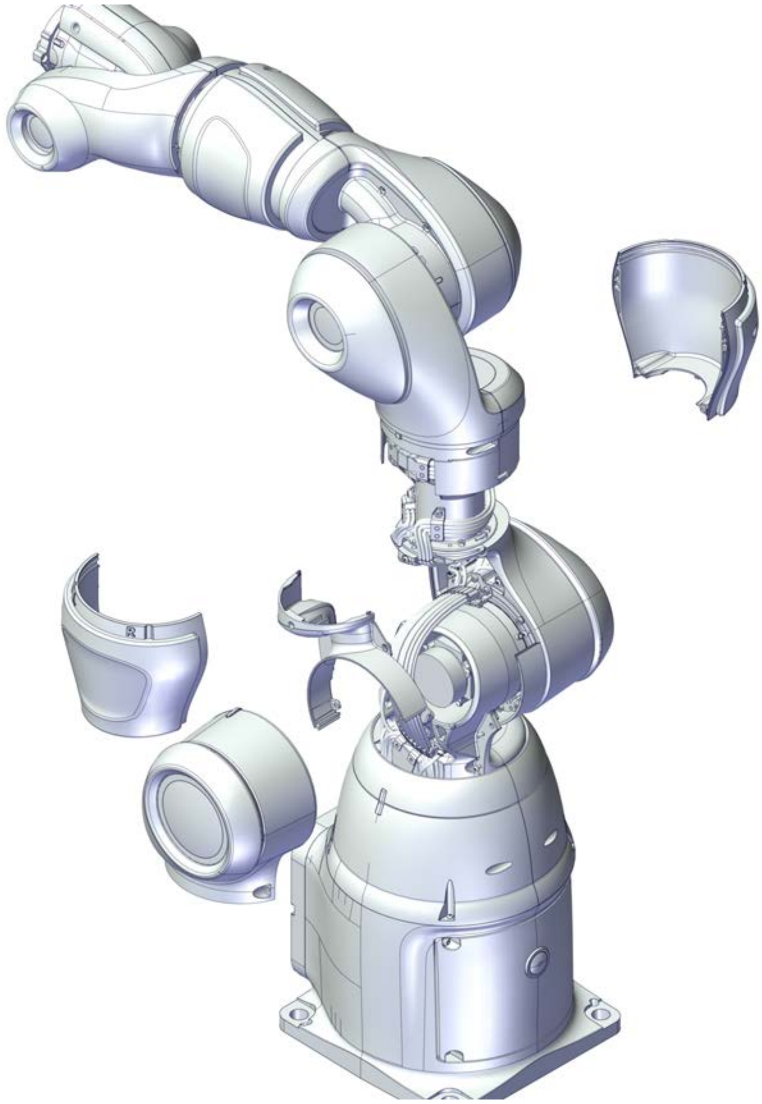
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1800001492

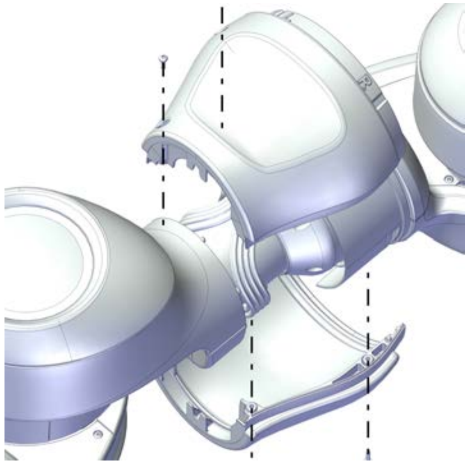
Removing the motor

Use these procedures to remove the axis-7 motor.

Preparations before removing the motor

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	

Continues on next page

	Action	Note
2	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
3	Remove the axis-7 cover.	 xx1800001488

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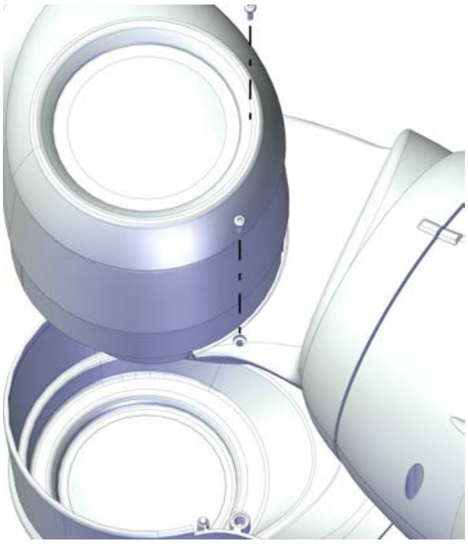
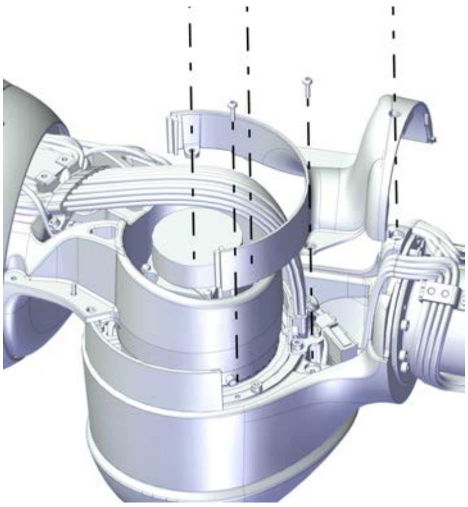
	Action	Note
4	Remove the lower axis-2 cover.	 xx1800001489  xx1800001490
5	Remove the axis-2 cable cover.	 xx1800001491

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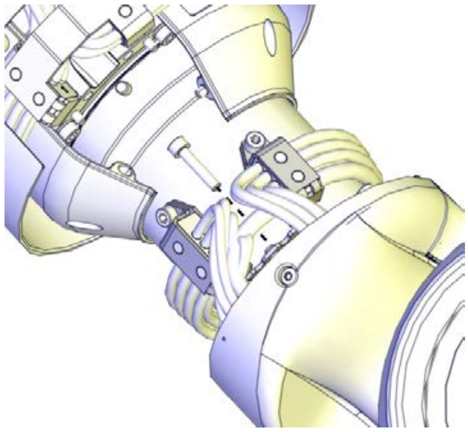
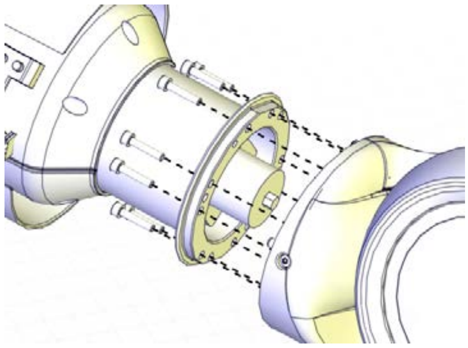
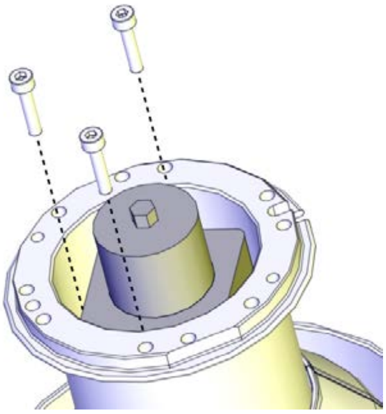
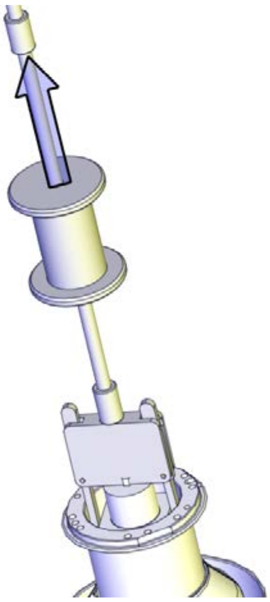
Removing the axis-7-3-4 assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Loosen the cable bracket from the arm by removing the screw.	 xx1400002692
3	Disconnect the motor connectors. • R1.MP7R / R1.MP7L • R1.FB7R / R1.FB7L	
4	Loosen the axis-7-3-4 and wrist assembly from the axis-1-2 assembly by removing the screws. **CAUTION** The cabling is still connected inside the robot, so be careful not to strain the cables! **Note** There are 14 attachment screw holes, but only 10 of them are used to secure the axis 7-3-4 and wrist assembly.	 xx1400002693

Removing the axis-7 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	

Continues on next page

	Action	Note
2	Hold the arm so that the motor cover points upwards. **Tip** This position makes it possible to change the motor without spilling out any grease from the gearbox.	
3	Remove the screws.	Screws: 3 pcs (no screw underneath the connector).  xx1500000520
4	Remove the motor by using the removal tool accordingly: 1 Attach the grip arms of the removal tool to the notches on the motor sides. 2 Gently knock the block backwards to the end stop of the pin to carefully knock the motor loose. 3 Pull out the motor.	Removal tool: 3HAC054869-001  xx1500000524

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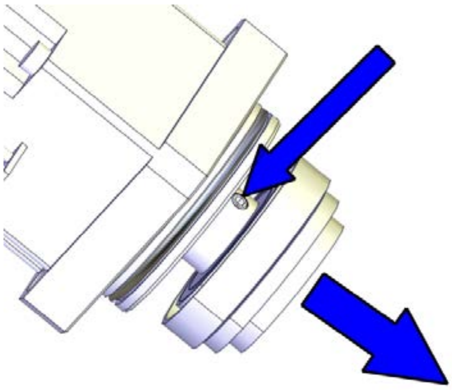
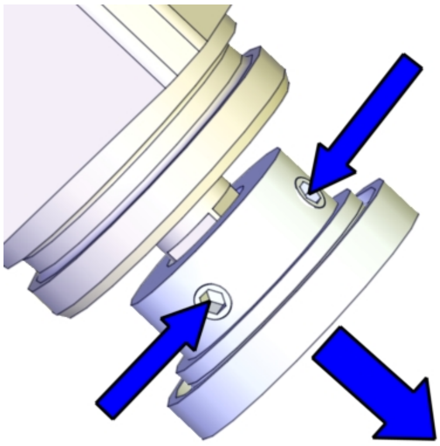
Removing the wave generator from the motor

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000515
	Axis 6.	 xx1500001651
2	Place the wave generator on a clean workbench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

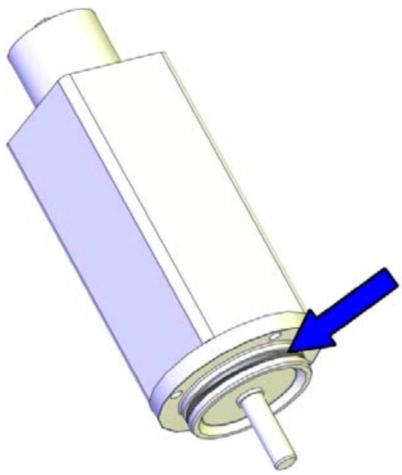
Refitting the motor

Use these procedures to refit the axis-7 motor.

Fitting a new o-ring on the motor

	Action	Note
1	Wipe the o-ring groove of the motor clean.	Motor M92: 3HAC036900-001.

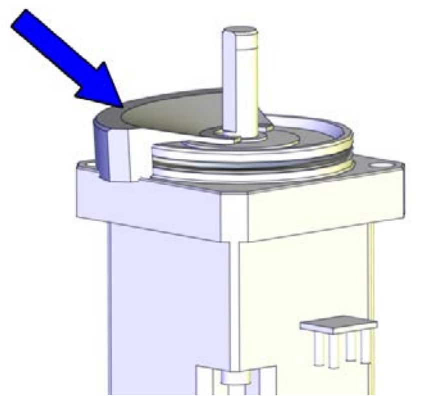
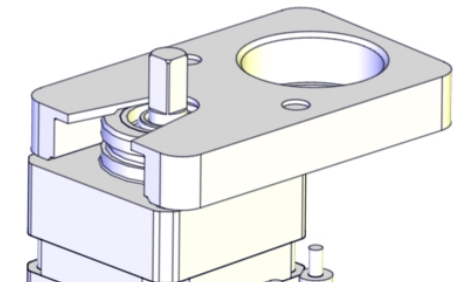
Continues on next page

	Action	Note
2	Fit a new o-ring in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	O-ring: 3HAB3772-136 Grease: Used to lubricate the seals..  xx1400002700

Fitting the wave generator to the motor

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

Continues on next page

	Action	Note
2	Place the fixture tool on the new motor.	
	Axis 1 and axis 2: Fixture tool for wave generator M93, 3HAC054870-001.	 xx1500000527
	Axis 7 and axis 3: Fixture tool for wave generator M92, 3HAC054871-001.	
	Axis 6: Fixture tool for wave generator M91, 3HAC054904-001.	 xx1500001646

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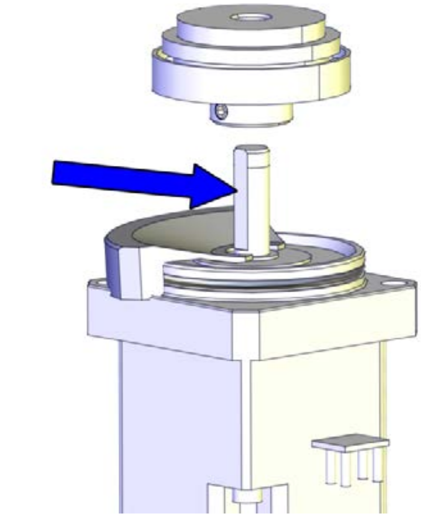
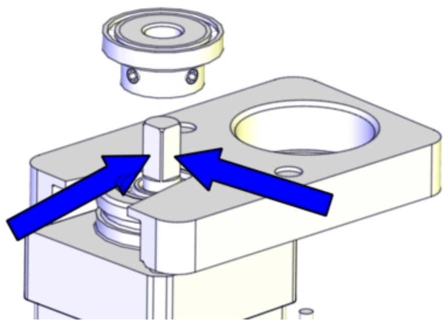
	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	
	Axis 1, axis 2, axis 3 and axis 7.	 xx1500000528
	Axis 6.	 xx1500001647

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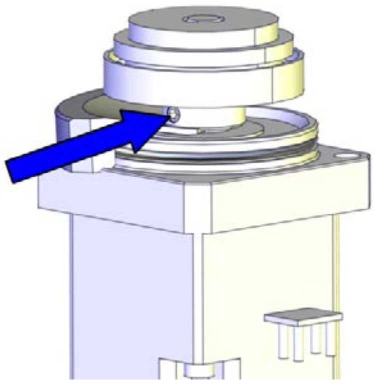
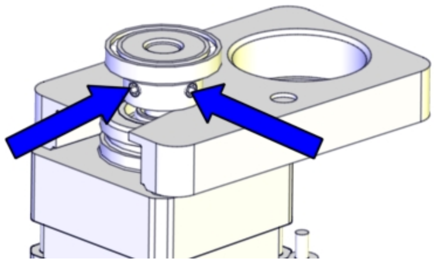
	Action	Note
4	Tighten the set screw.	
	Axis 1, axis 2, axis 3 and axis 7.	Screw: M3-set screw (1 pcs). Tightening torque: 0.6 Nm.  xx1500000518
	Axis 6.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	

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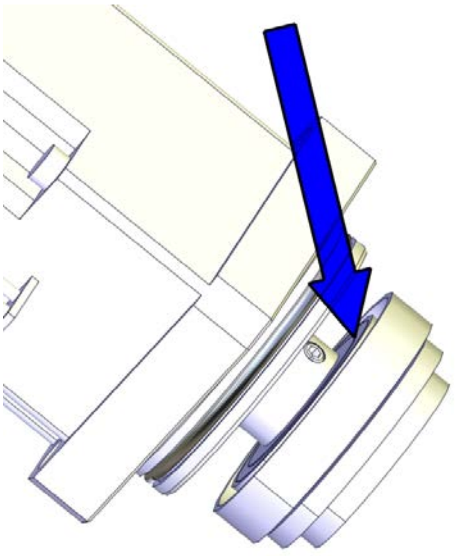
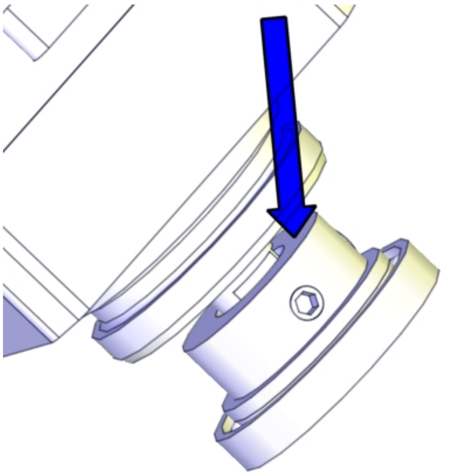
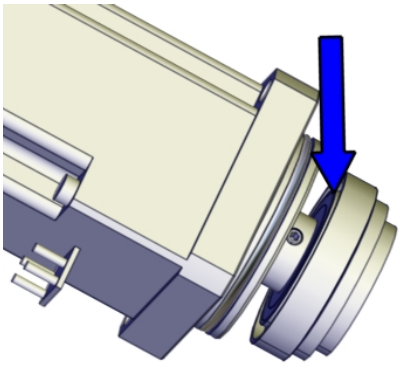
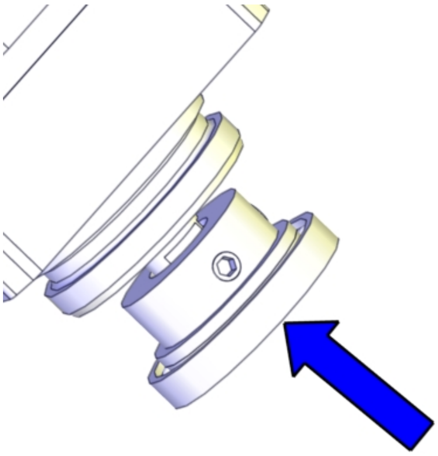
	Action	Note
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000557
	Axis 6.	 xx1500001649

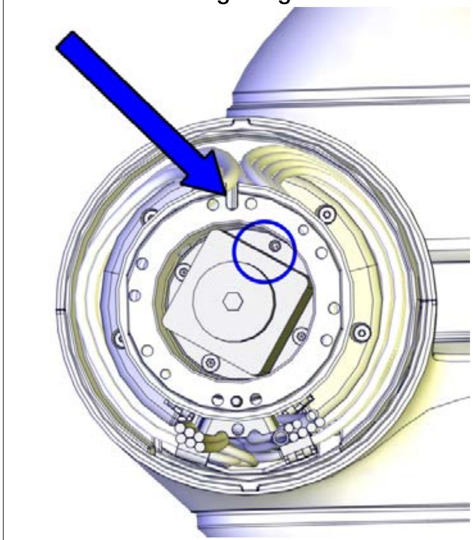
Continues on next page

	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000556
	Axis 6.	 xx1500001650

Refitting the axis-7 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	

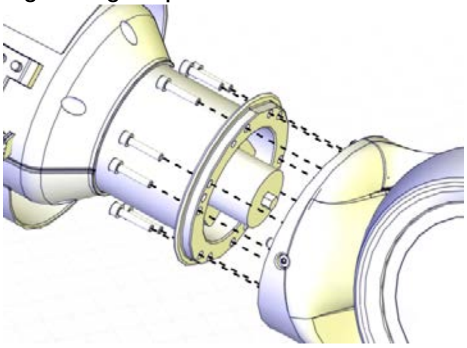
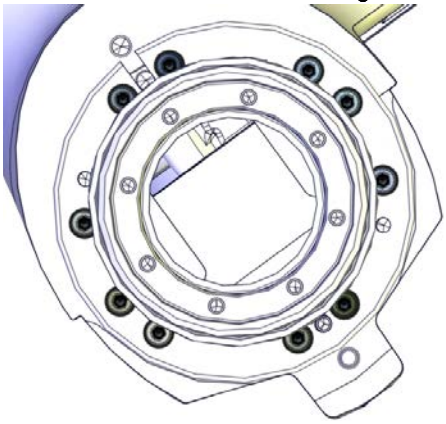
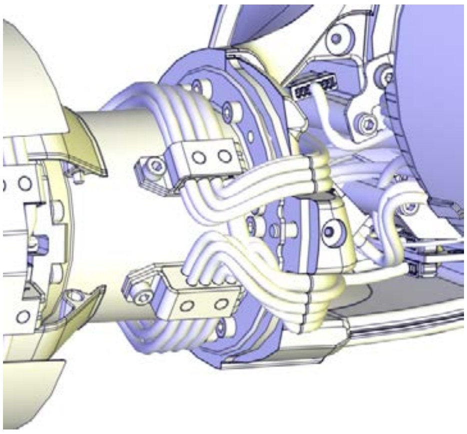
Continues on next page

	Action	Note
2	Orient the motor correctly and fit it into the arm. Secure with the screws. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector and to the notch at the arm mounting flange.  xx1500000571 Screws: 3HAB3409-212 (3 pcs) (no screw underneath the connector). Tightening torque: 0.9 Nm.  xx1400002699

Refitting the axis-7-3-4 assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

Continues on next page

	Action	Note
2	Refit the assembly and secure with screws. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure. **CAUTION** There are 14 attachment screw holes, but only 10 of them are used to secure the axis 7-3-4 and wrist assembly.	Screws: 3HAB3409-241 (10 pcs). Tightening torque: 0.8 Nm.  xx1400002693 The figure below shows the hole configuration of the assembly. Use the screw holes that are used for screws in the figure.  xx1500000639
3	Reconnect the motor connectors. • R1.MP7R / R1.MP7L • R1.FB7R / R1.FB7L	
4	Route and secure the cabling according to the figure. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	 xx1500000572

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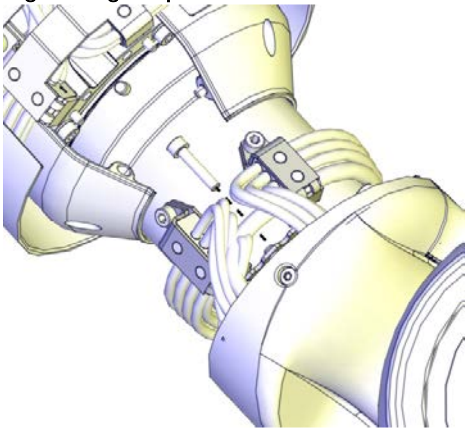
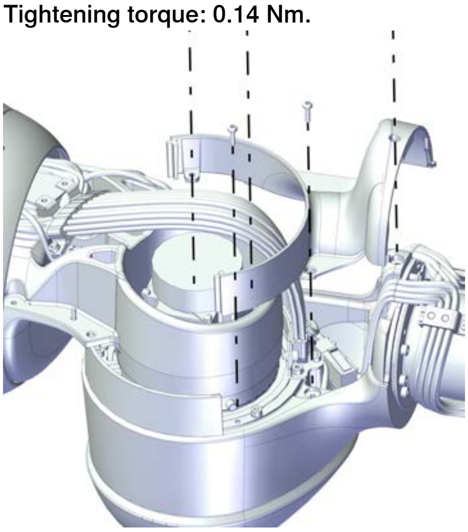
	Action	Note
5	Refit the axis-7 cable bracket.	Screws: 3HAB3409-241 (1 pc). Tightening torque: 0.8 Nm.  xx1400002692

Refitting the covers

	Action	Note
1	Refit the axis-2 cable cover. Replace if damaged.	Axis-2 cable cover, ESD coated: 3HAC057722-001. Screws: 3HAC050368-005 (5 pcs). Tightening torque: 0.14 Nm.  xx1800001491

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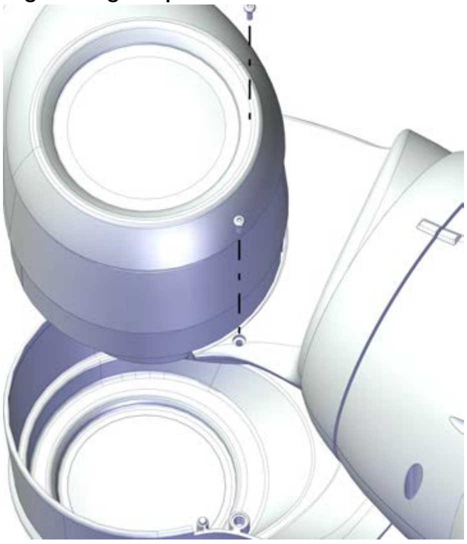
	Action	Note
2	Refit the lower axis-2 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001490  xx1800001489

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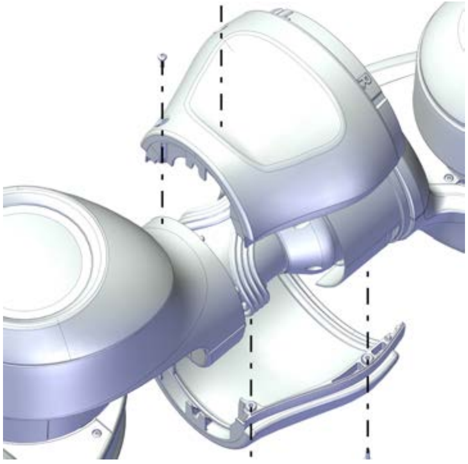
	Action	Note
3	Refit the axis-7 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001488

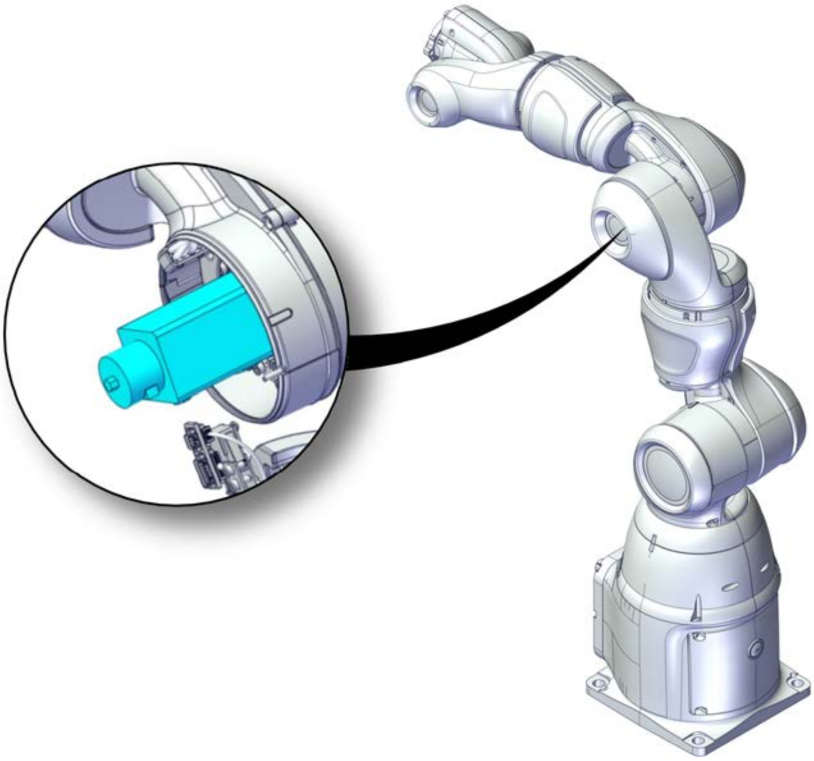
Concluding procedure

	Action	Note
1	Recalibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.3.4 Replacing the axis-3 motor

Location of the axis-3 motor

The axis-3 motor is located as shown in the figure.



xx1800001232

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Motor M92	3HAC036900-001	Always use a new o-ring 3HAB3772-136. To be ordered separately.
O-ring	3HAB3772-136	Required to be replaced when removing and refitting the motor.
Hex socket head cap screw	3HAB3409-212	M4x16 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAC050368-005	M2x8 8.8

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Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.
Removal tool	3HAC054869-001	Used to pull out the motor.
Fixture tool for wave generator M92	3HAC054871-001	

Consumables

Consumable	Article number	Note
Grease	3HAC042536-001	Used to lubricate the seals. Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

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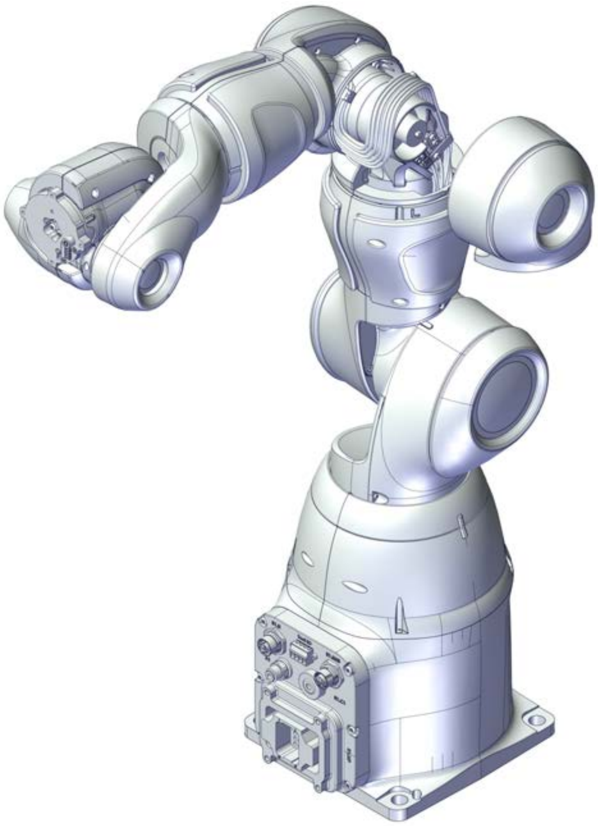
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1800001260

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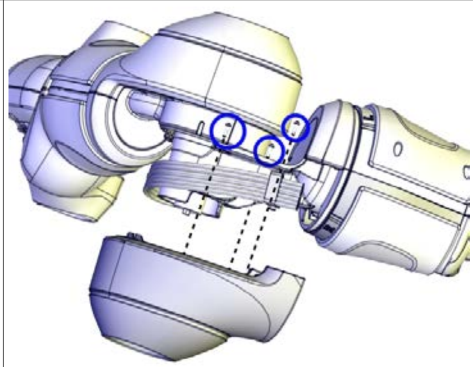
Removing the motor

Use these procedures to remove the axis-3 motor.

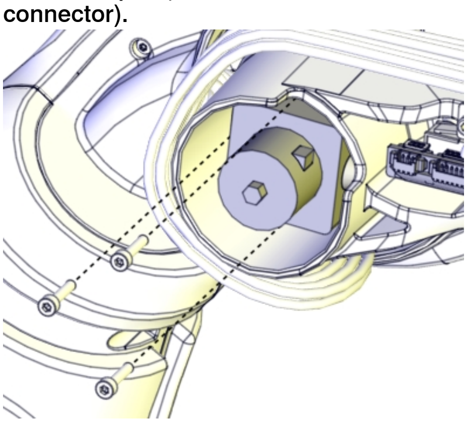
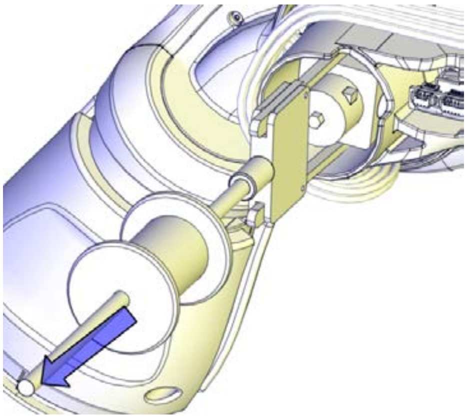
Preparations before removing the motor

	Action	Note
1	Jog the robot to the specified position: • Axis 1, axis 7 and axis 2: brake release and rotate so that axis-3 motor shaft is vertical. • Axis 3: rotate in positive direction until the axis is secured against the axis-3 mechanical stop. • Axis 4: No significance. • Axis 5: No significance. • Axis 6: No significance.	The figure shows the specified position on the left arm:  xx1800000612
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
3	Remove the lower axis-3 cover.	 xx1400002751

Removing the axis-3 motor

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

	Action	Note
2	Disconnect the motor connectors. • R1.MP3 • R1.FB3	
3	**CAUTION** Whenever parting/mating motor and gear-box, the gears may be damaged if excess-ive force is used.	
4	**CAUTION** The gravity will cause the arm to suddenly fall down when the motor is removed, if the axis is not secured. Make sure the axis is secured against the mechanical stop prior to removing the motor.	
5	Remove the screws.	Screws: 3 pcs (no screw underneath the connector).  xx1500000519
6	Remove the motor by using the removal tool accordingly: 1 Attach the grip arms of the removal tool to the notches on the motor sides. 2 Gently knock the block backwards to the end stop of the pin to carefully knock the motor loose. 3 Pull out the motor.	Removal tool: 3HAC054869-001  xx1500000523

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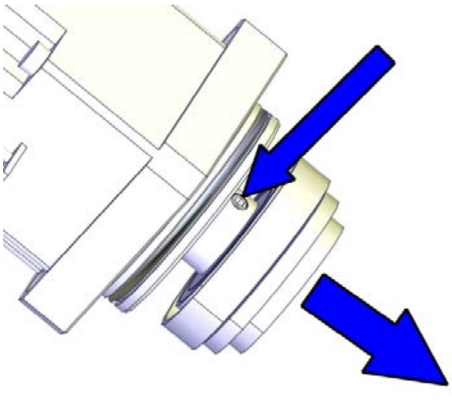
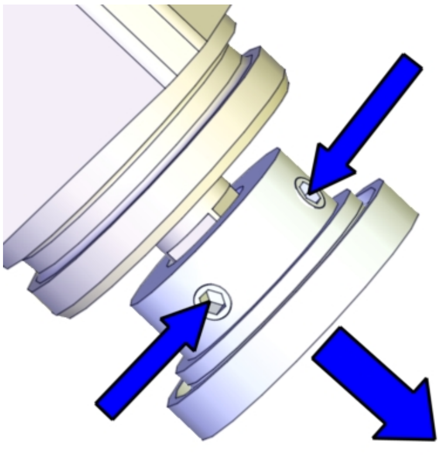
Removing the wave generator from the motor

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000515
	Axis 6.	 xx1500001651
2	Place the wave generator on a clean workbench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

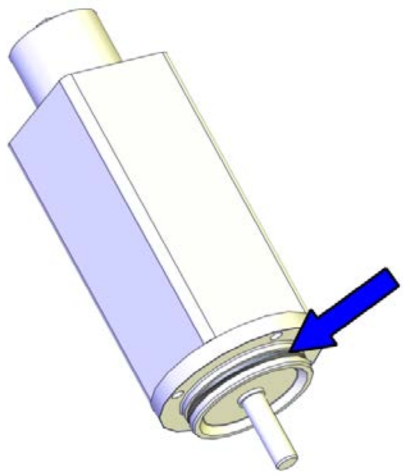
Refitting the motor

Use these procedures to refit the axis-3 motor.

Fitting a new o-ring on the motor

	Action	Note
1	Wipe the o-ring groove of the motor clean.	Motor M92: 3HAC036900-001.

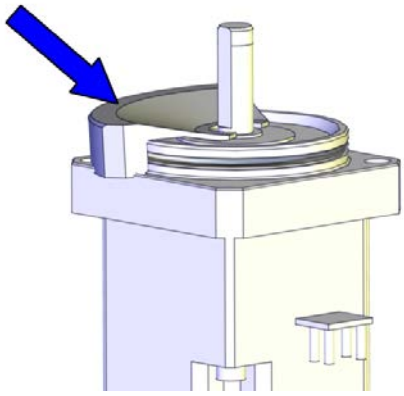
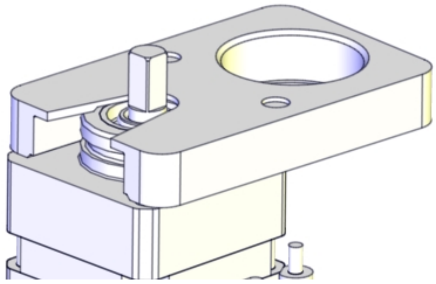
Continues on next page

	Action	Note
2	Fit a new o-ring in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	O-ring: 3HAB3772-136 Grease: Used to lubricate the seals..  xx1400002700

Fitting the wave generator to the motor

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

Continues on next page

	Action	Note
2	Place the fixture tool on the new motor.	
	Axis 1 and axis 2: Fixture tool for wave generator M93, 3HAC054870-001.	 xx1500000527
	Axis 7 and axis 3: Fixture tool for wave generator M92, 3HAC054871-001.	
	Axis 6: Fixture tool for wave generator M91, 3HAC054904-001.	 xx1500001646

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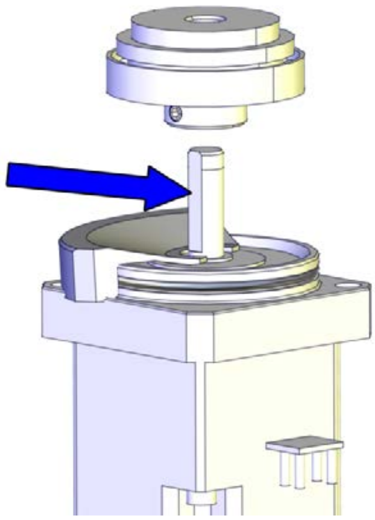
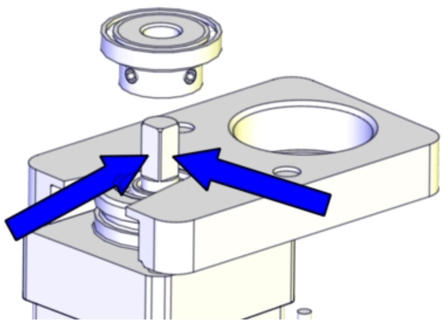
	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	
	Axis 1, axis 2, axis 3 and axis 7.	 xx1500000528
	Axis 6.	 xx1500001647

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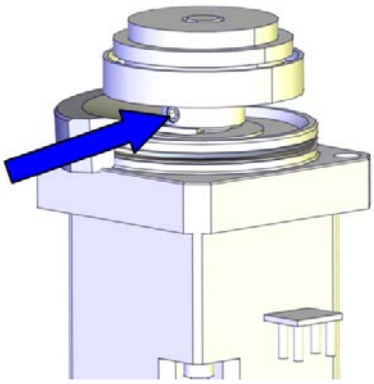
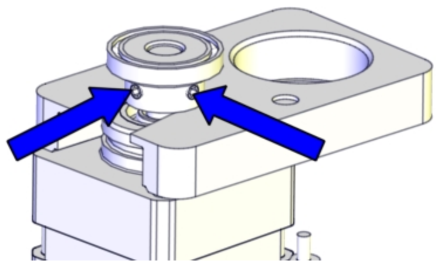
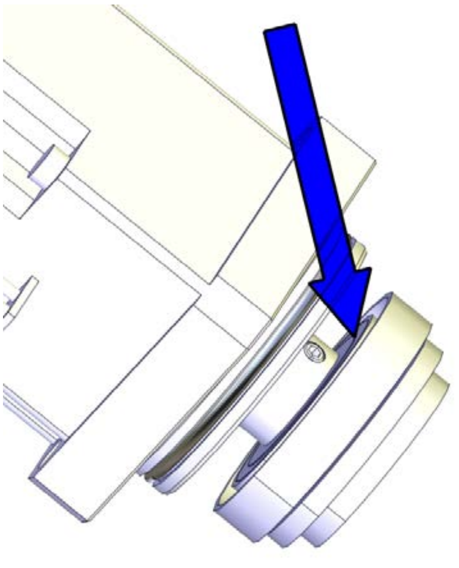
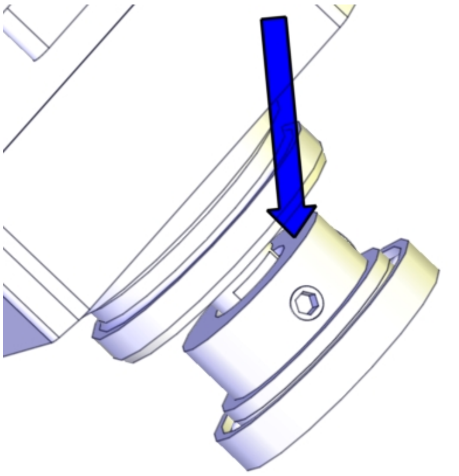
	Action	Note
4	Tighten the set screw.	
	Axis 1, axis 2, axis 3 and axis 7.	Screw: M3-set screw (1 pcs). Tightening torque: 0.6 Nm.  xx1500000518
	Axis 6.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	

Continues on next page

	Action	Note
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000557
	Axis 6.	 xx1500001649

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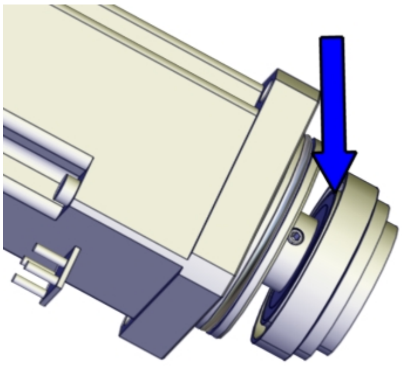
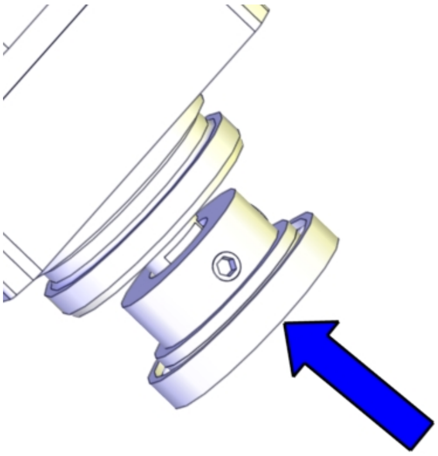
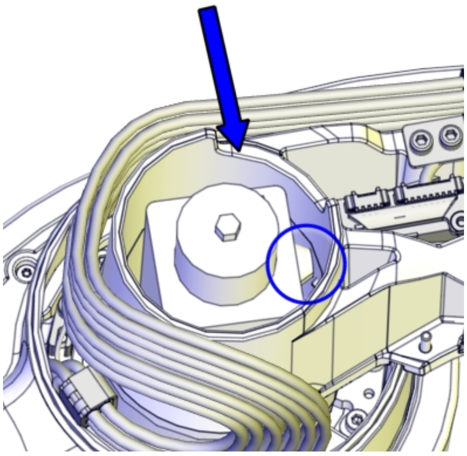
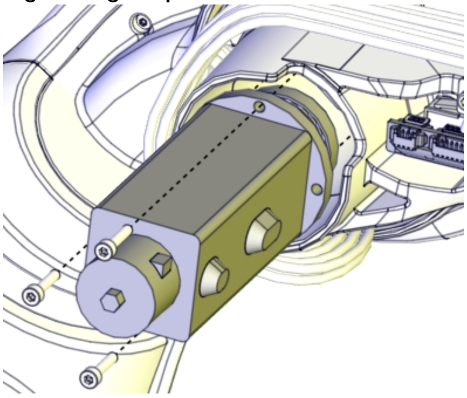
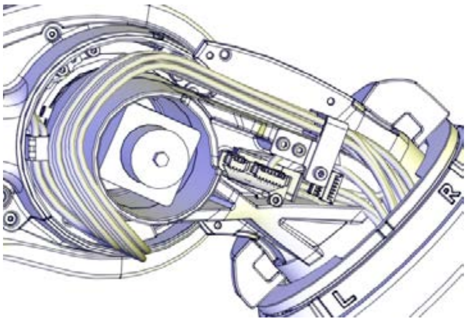
	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000556
	Axis 6.	 xx1500001650

Refitting the axis-3 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

Continues on next page

	Action	Note
2	Orient the motor correctly and fit it into the arm. Secure with the screws. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor so that the motor connector faces the big notch at the arm mounting flange.  xx1500000567 Screws: 3HAB3409-212 (3 pcs) (no screw underneath the connector). Tightening torque: 0.9 Nm.  xx1400002752
3	Connect the motor connectors: • R1.MP3 • R1.FB3	
4	Route and secure the cabling according to the figure. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	 xx1500000573

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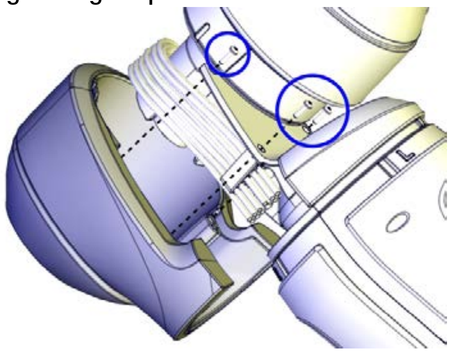
Refitting the covers

	Action	Note
1	Refit the lower axis-3 cover. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Lower axis-3 cover, ESD coated: 3HAC050532-001 Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1400002753

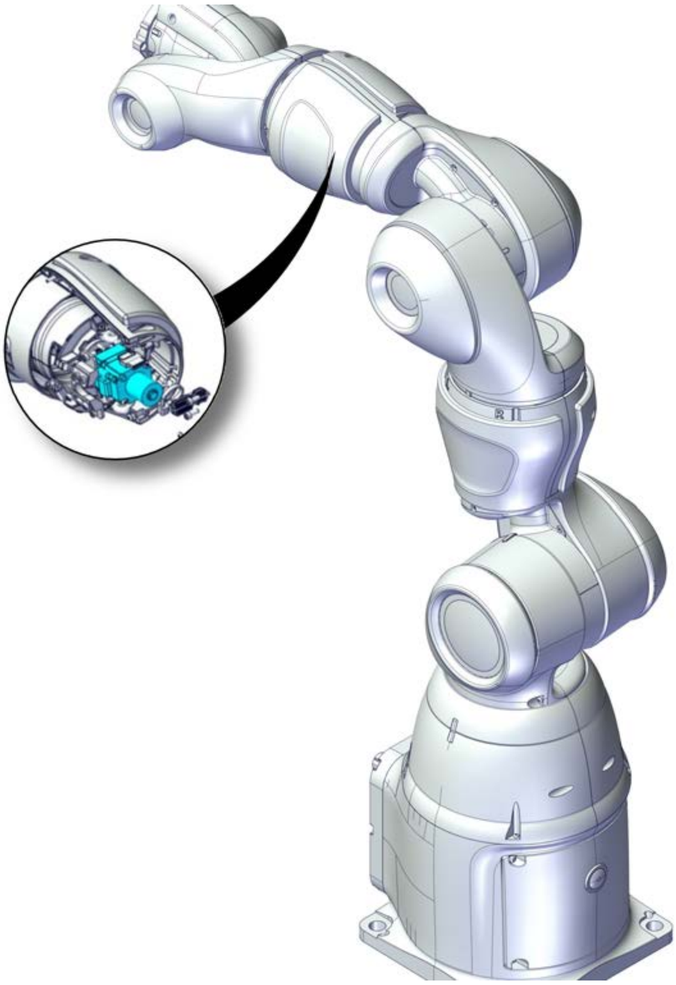
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.3.5 Replacing the axis-4 motor

Location of the axis-4 motor

The axis-4 motor is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Motor M91	3HAC036950-001	Always use a new o-ring 3HAB3772-138. To be ordered separately.
O-ring	3HAB3772-138	Required to be replaced when removing and refitting the motor.

Continues on next page

Spare part	Article number	Note
Flange	3HAC072381-001	
O-ring on flange	3HAB3772-119	Replace if damaged.
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Torx pan head screw	3HAC050367-039	M2x30 8.8 Gleitmo 605
Small head screw	3HAC072396-001	M2x16 12.9
Washer	3HAC073135-001	2.2x4.5x0.3

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.
Fixture tool for wave generator M91	3HAC054904-001	Used for axes 4 and 5 of IRB 14050 no-type-specified and axis 6 of both robot types. See *Robot description on page 349* for robot type.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.
Fixture tool for wave generator M91 (IRB 14050 Type A)	3HAC074531-001	Used for axes 4 and 5 of IRB 14050 Type A. See *Robot description on page 349* for robot type.

Consumables

Consumable	Article number	Note
Grease	3HAC042536-001	Used to lubricate the seals. Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

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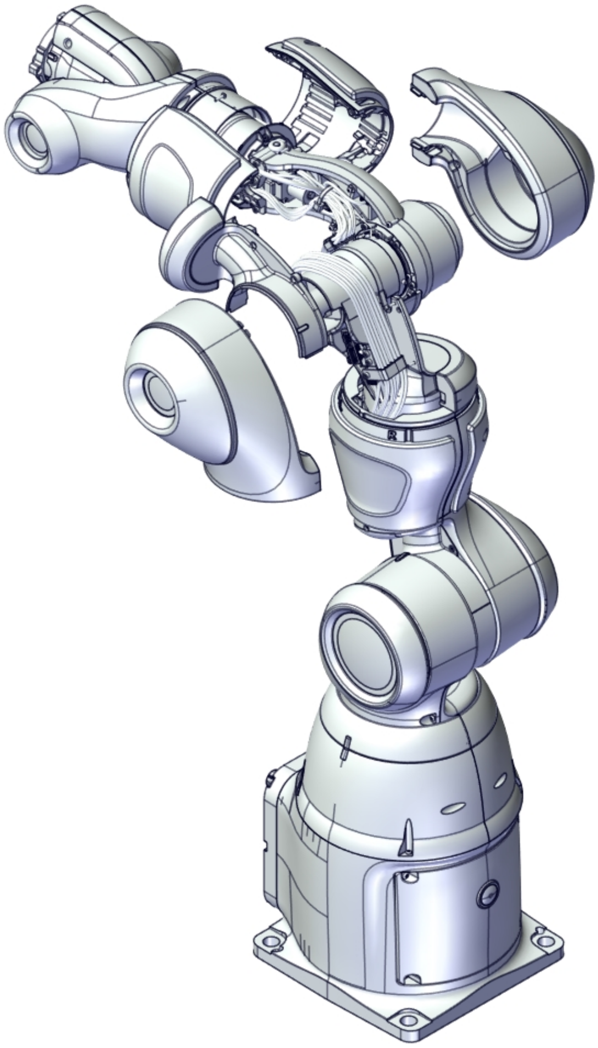
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



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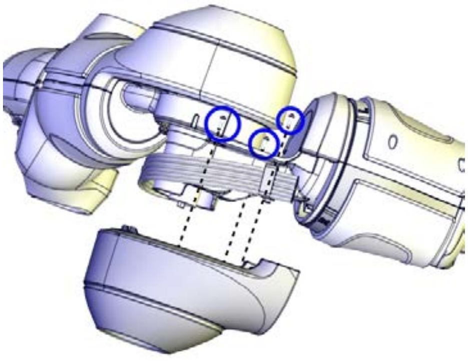
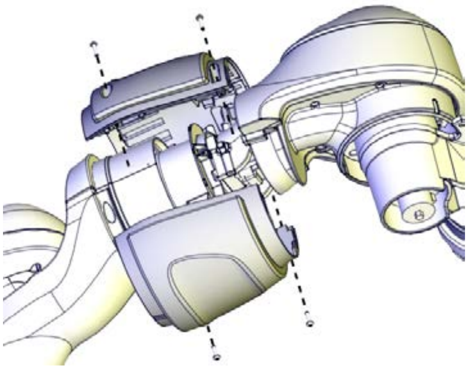
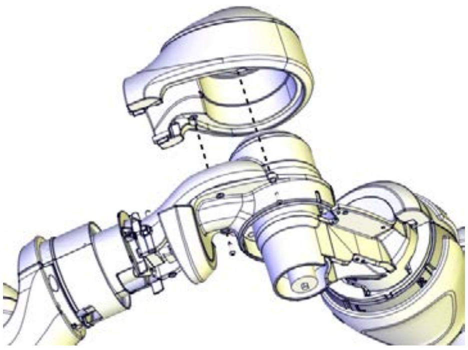
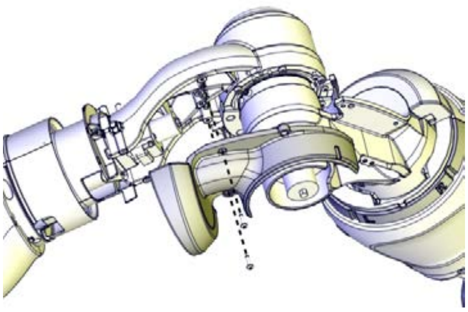
Removing the motor

Use these procedures to remove the axis-4 motor.

Preparations before removing the motor

	Action	Note
1	Jog the robot so that the axis-3 and axis-4 covers can be easily accessed and removed.	
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

	Action	Note
3	Remove the lower axis-3 cover.	 xx1400002751
4	Remove the lower axis-4 cover.	 xx1400002756
5	Remove the axis-3 body cover.	 xx1400002754
6	Remove the upper axis-3 cover.	 xx1400002755

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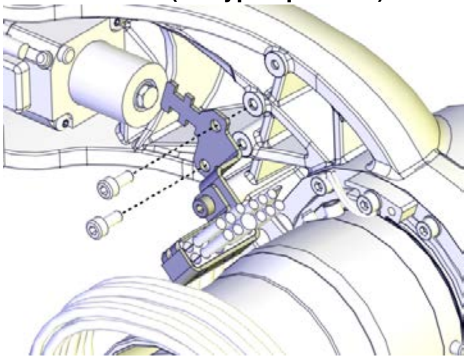
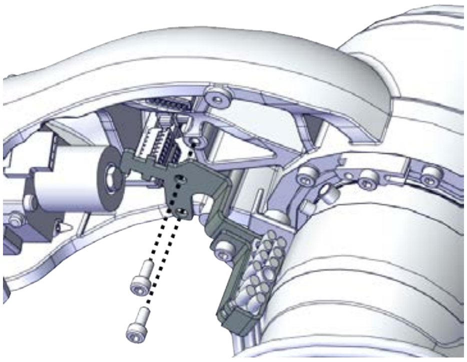
Removing the axis-4 motor

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Remove the upper axis-3 cable bracket.	**For IRB 14050 (no-type-specified)**  xx1400002757 **For IRB 14050 Type A**  xx1900002068
3	Disconnect the motor connectors. • R1.MP • R1.FB4	
4	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

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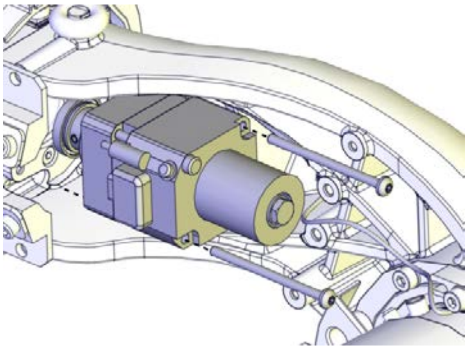
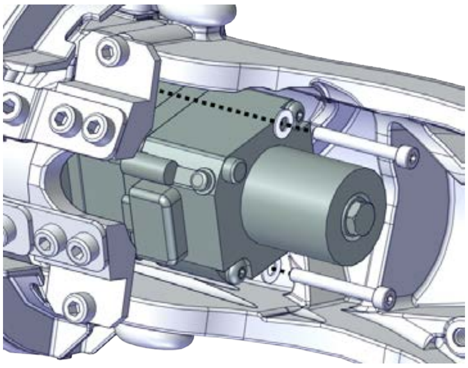
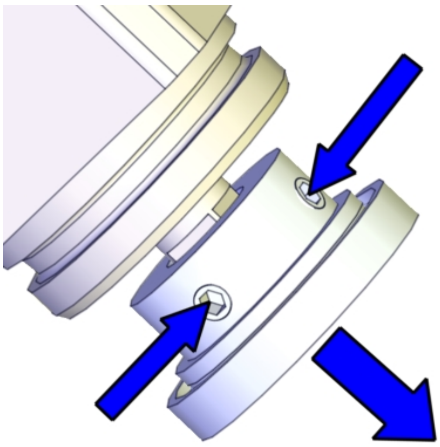
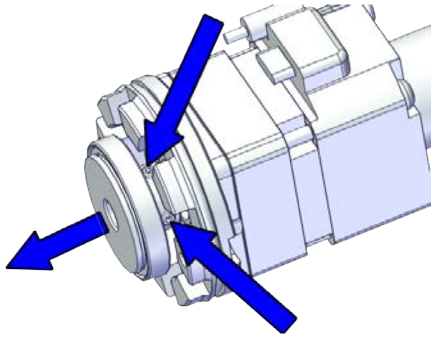
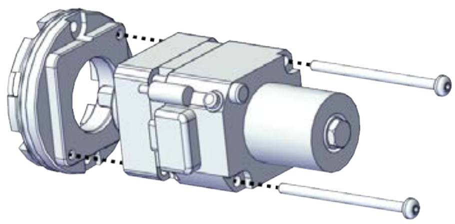
	Action	Note
5	**For IRB 14050 (no-type-specified)** Remove the screws and lift the motor out carefully.	 xx1400002758
6	**For IRB 14050 Type A** Remove the flange screws and washers, and lift the motor together with the flange and wave generator out carefully.	 xx1900002069

Removing the wave generator from the motor (IRB 14050 no-type-specified)

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	 xx1500001651
2	Place the wave generator on a clean work-bench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

Continues on next page

Removing the flange and wave generator from the motor (IRB 14050 Type A)

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	 xx1900002070
2	Place the wave generator on a clean work-bench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	
3	Remove the flange.	 xx1900002071

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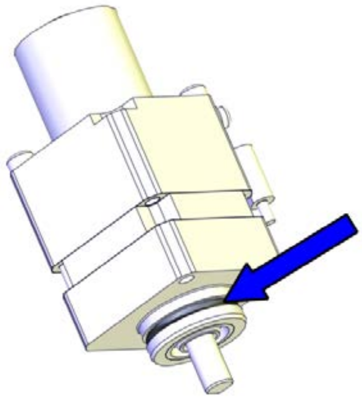
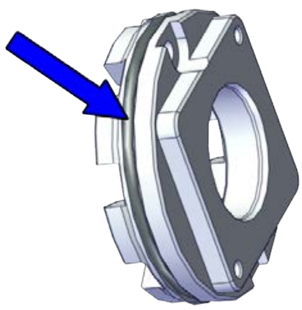
Refitting the motor

Use these procedures to refit the axis-4 motor.

Checking the o-ring

	Action	Note
1	Check that the o-ring on the motor is properly seated in its groove and that it is not damaged. Replace if damaged. **Tip** If needed, lubricate the o-ring with some grease for a better fitting in the groove.	Motor M91: 3HAC036950-001. O-ring: 3HAB3772-138 Grease: Used to lubricate the seals..  xx1400002759
2	**For IRB 14050 Type A** Check that the o-ring on the flange is properly seated in its groove and that it is not damaged. Replace if damaged. **Tip** If needed, lubricate the o-ring with some grease for a better fitting in the groove.	Flange: 3HAC072381-001. O-ring on flange: 3HAB3772-119 Grease: Used to lubricate the seals..  xx1900002072

Fitting the wave generator to the motor (IRB 14050 Type A)

	Action	Note
1	Wipe the contact surfaces of the motor, flange and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

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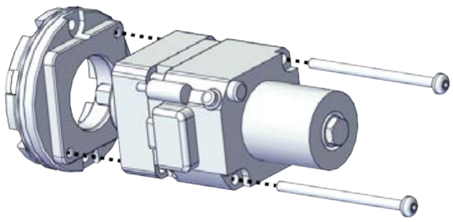
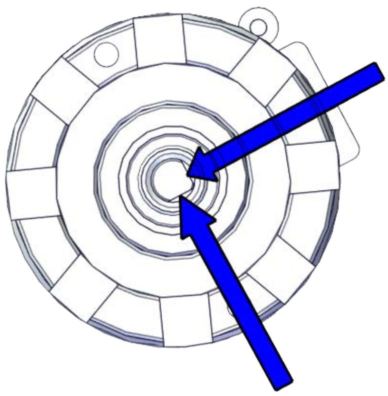
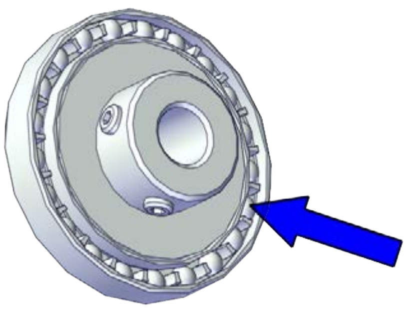
	Action	Note
2	Refit the motor to the flange.	Screws: 3HAC050367-039 (2 pcs). Tightening torque: 0.3 Nm.  xx1900002071
3	Orient the output axis of the motor so that the flat surfaces on the output axis are positioned towards the gaps on the flange.	 xx1900002073
4	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1900002074

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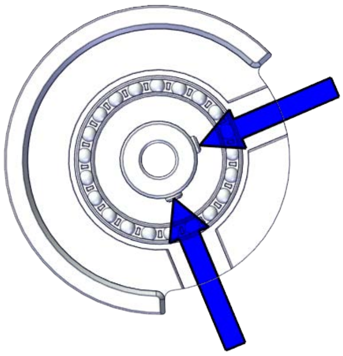
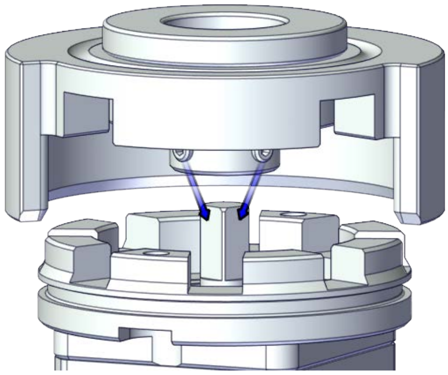
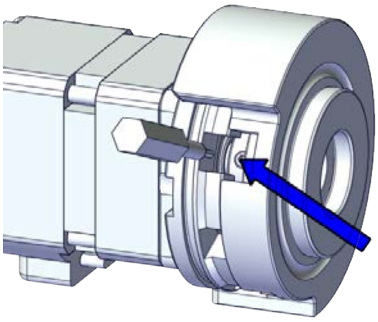
	Action	Note
5	Place the wave generator to the fixture tool. Orient the wave generator so that the set screws are positioned towards the gaps on the fixture tool.  **Tip** Use a magnet on the other side of the fixture tool to prevent the wave generator drop from the tool.	 xx1900002075
6	Fit the wave generator to the motor shaft, place the fixture tool against the flange. Orient the wave generator so that the set screws are positioned towards the flat surface on the output axis of the motor and accessible from the aligned gaps on the fixture tool and flange.	 xx1900002076
7	Tighten the set screws.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1900002077

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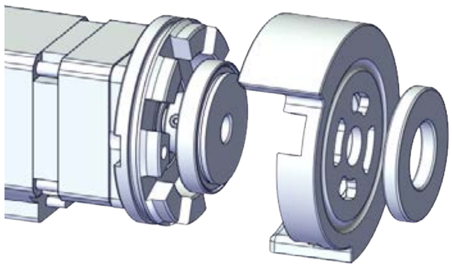
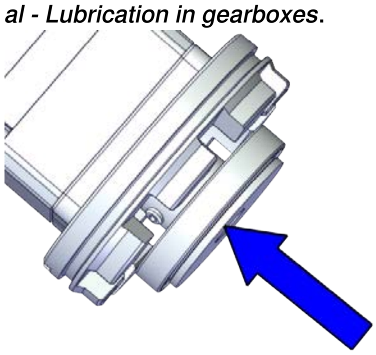
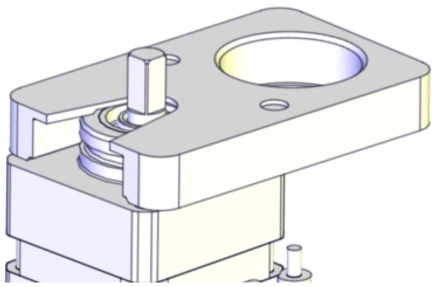
	Action	Note
8	Remove the fixture.	 xx1900002078
9	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1900002079

Fitting the wave generator to the motor (IRB 14050 no-type-specified)

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	
2	Place the fixture tool on the new motor.	 xx1500001646

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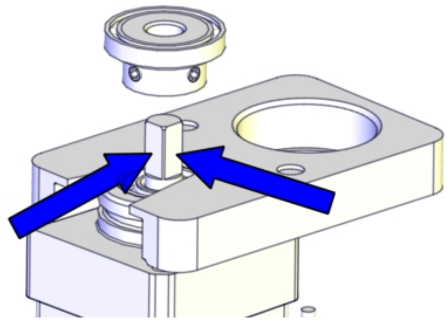
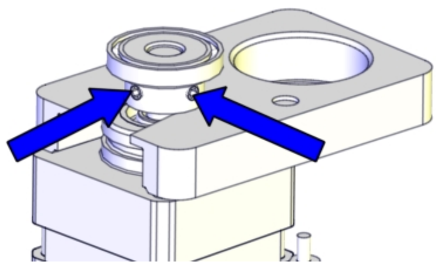
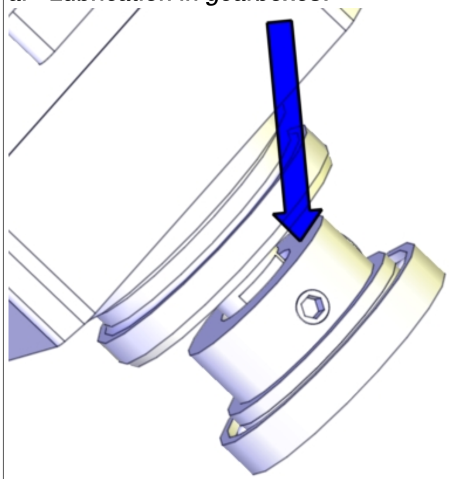
	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	 xx1500001647
4	Tighten the set screw.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1500001649

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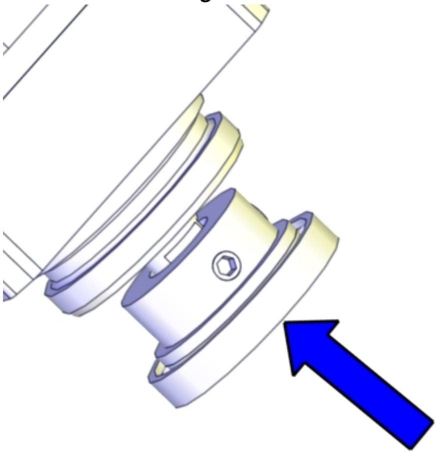
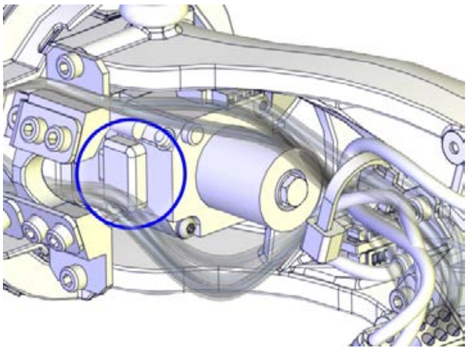
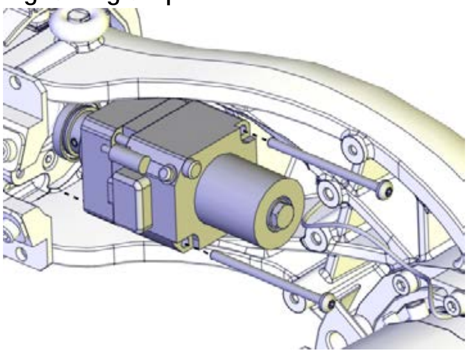
	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1500001650

Refitting the axis-4 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

Continues on next page

	Action	Note
2	**For IRB 14050 (no-type-specified)** Orient the motor correctly and fit it into the arm. Secure with the screws.  **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1500000568 Screws: 3HAC050367-039 (2 pcs). Tightening torque: 0.3 Nm.  xx1400002758

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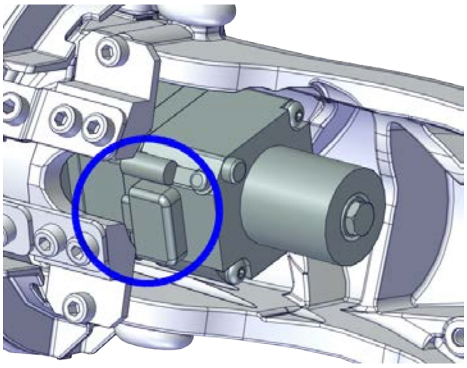
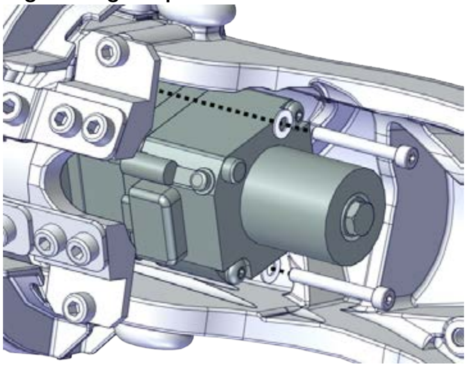
	Action	Note
3	**For IRB 14050 Type A** Orient the motor correctly and fit it into the arm. Secure the flange with the screws and washers. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1900002080 Screws: 3HAC072396-001 (2 pcs). Washers: 3HAC073135-001 (2 pcs). Tightening torque: 0.4 Nm.  xx1900002069
4	Connect the motor connectors: • R1.MP4 • R1.FB4	

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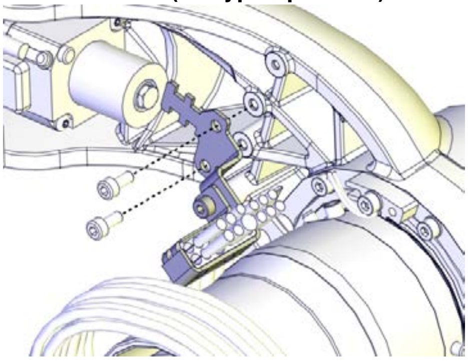
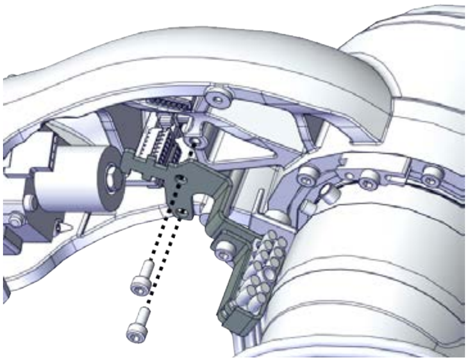
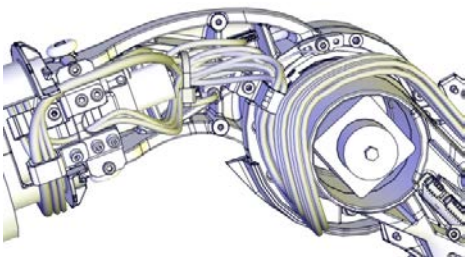
	Action	Note
5	Refit the upper axis-3 cable bracket.	Screws: 3HAB3409-233 (2 pcs). Tightening torque: 0.3 Nm. **For IRB 14050 (no-type-specified)**  xx1400002757 **For IRB 14050 Type A**  xx1900002068
6	Route and secure the cabling according to the figure. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	 xx1500000583

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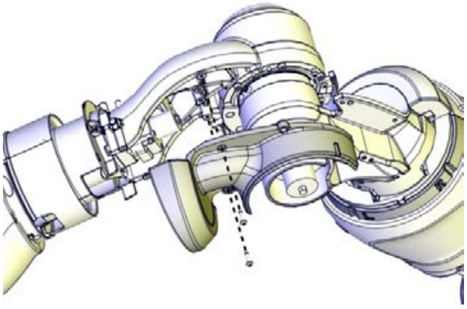
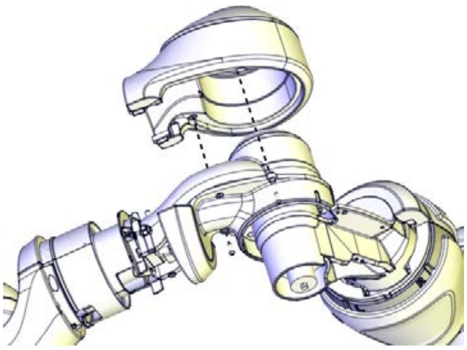
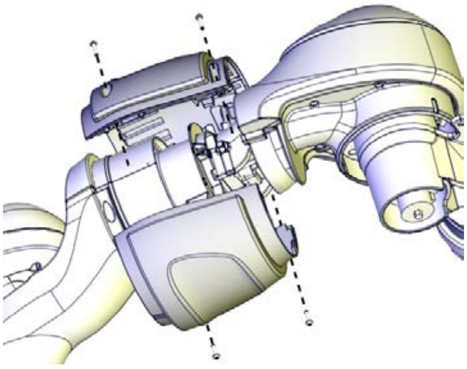
Refitting the covers

	Action	Note
1	Refit the upper axis-3 cover.	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1400002755
2	Refit the axis-3 body cover.	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1400002754
3	Refit the lower axis-4 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002756

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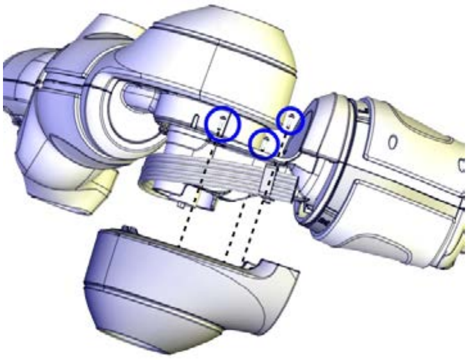
	Action	Note
4	Refit the lower axis-3 cover. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1400002751

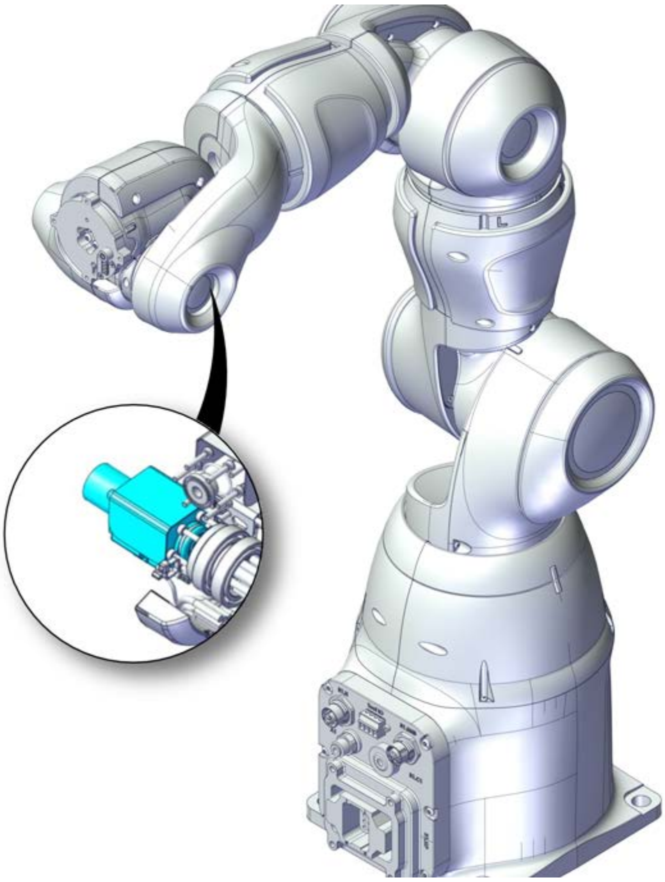
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.3.6 Replacing the axis-5 motor

Location of the axis-5 motor

The axis-5 motor is located as shown in the figure.



xx1800001234

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Motor M91	3HAC036950-001	Includes o-ring 3HAB3772-138.
O-ring	3HAB3772-138	Required to be replaced when removing and refitting the motor.
Flange	3HAC072381-001	
O-ring on flange	3HAB3772-119	Replace if damaged.

Continues on next page

Spare part	Article number	Note
PTFE film on axis-5 and axis-6 motors	3HAC051316-001	Replace if damaged. Used only on axis-5 motor of IRB 14050 no-type-specified and axis-6 motor of both robot types. See *Robot description on page 349* for robot type.
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Torx pan head screw	3HAC050367-039	M2x30 8.8 Gleitmo 605
Small head screw	3HAC072396-001	M2x16 12.9
Washer	3HAC073135-001	2.2x4.5x0.3

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.
Fixture tool for wave generator M91	3HAC054904-001	Used for axes 4 and 5 of IRB 14050 no-type-specified and axis 6 of both robot types. See *Robot description on page 349* for robot type.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.
Fixture tool for wave generator M91 (IRB 14050 Type A)	3HAC074531-001	Used for axes 4 and 5 of IRB 14050 Type A. See *Robot description on page 349* for robot type.

Consumables

Consumable	Article number	Note
Grease	3HAC042536-001	Used to lubricate the seals. Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

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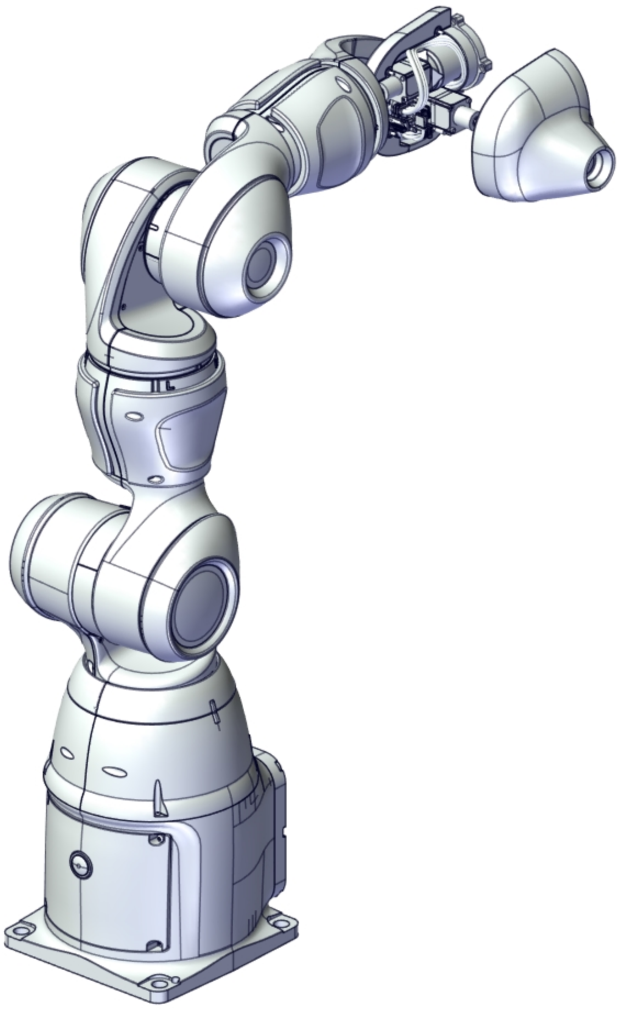
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1800001261

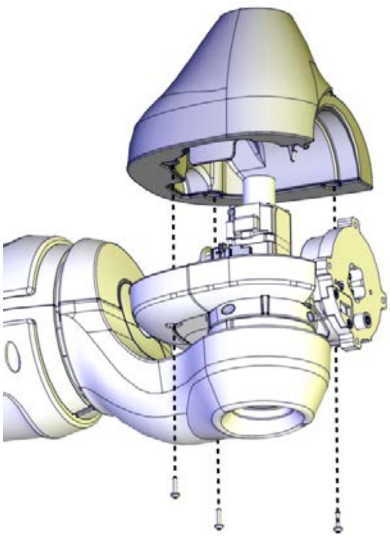
Removing the motor

Use these procedures to remove the axis-5 motor.

Preparations before removing the motor

	Action	Note
1	Jog the robot so that the wrist cover points upward.	
2	Jog axis 6 clockwise (facing the tool flange) to the limiting position -229° so that the cable will stay in place when removing the cover.	

Continues on next page

	Action	Note
3	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
4	Remove the axis-6 cover. Rotate axis 5 manually so that all screws can be accessed.	 xx1400002760

Removing the axis-5 motor

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Disconnect the motor connectors. Cut some cable ties, if needed. • R1.MP5 • R1.FB5	
3	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

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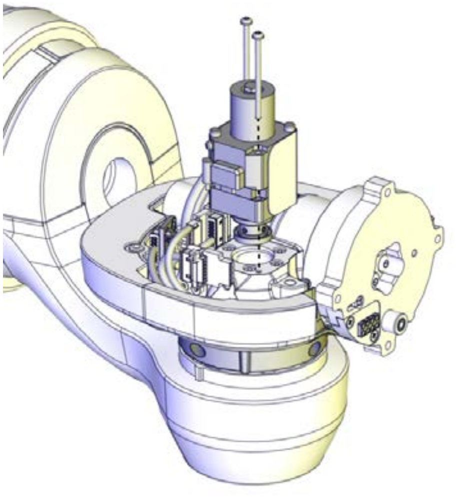
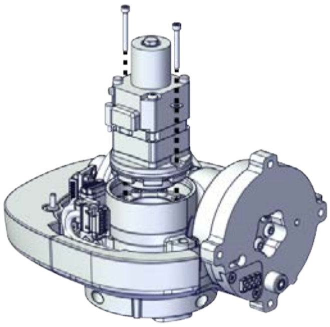
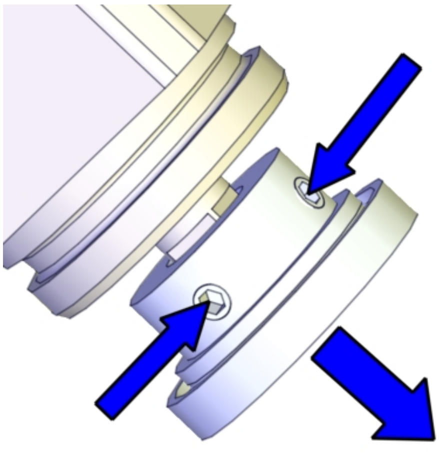
	Action	Note
4	**For IRB 14050 (no-type-specified)** Remove the screws and lift the motor out carefully.	 xx1400002790
5	**For IRB 14050 Type A** Remove the flange screws and washers, and lift the motor together with the flange and wave generator out carefully.	 xx1900002141

Removing the wave generator from the motor (IRB 14050 no-type-specified)

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	 xx1500001651

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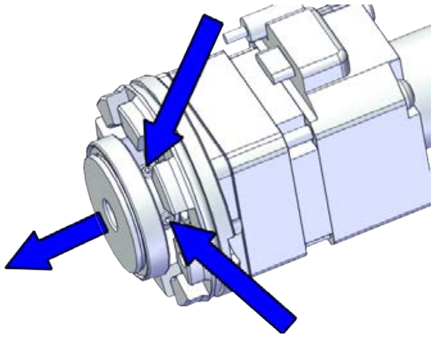
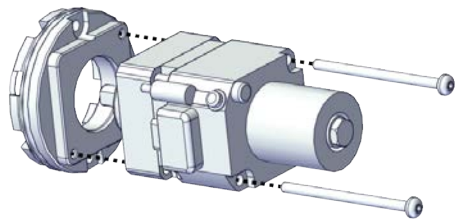
	Action	Note
2	Place the wave generator on a clean work-bench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

Removing the flange and wave generator from the motor (IRB 14050 Type A)

	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	 xx1900002070
2	Place the wave generator on a clean work-bench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	
3	Remove the flange.	 xx1900002071

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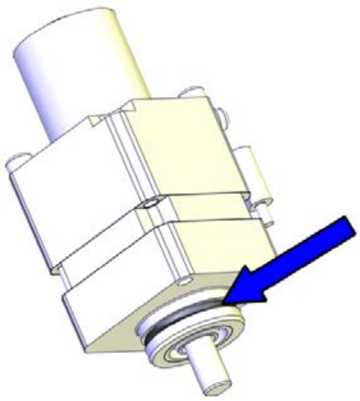
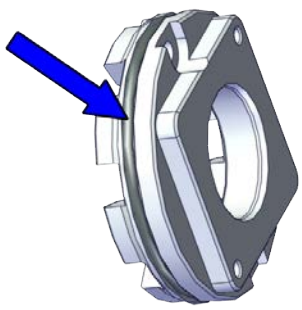
Refitting the motor

Use these procedures to refit the axis-5 motor.

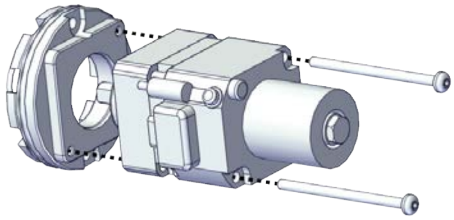
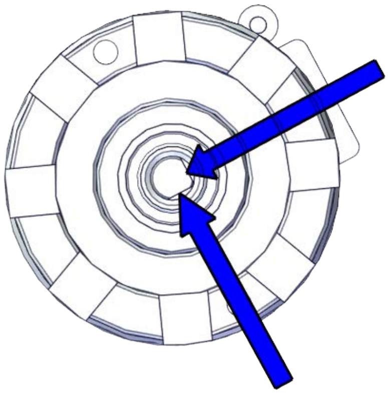
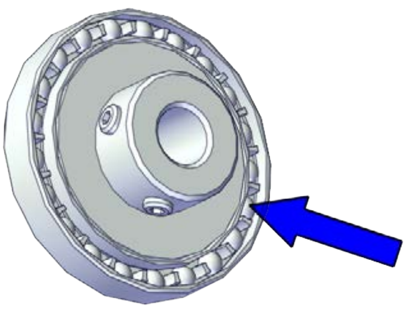
Checking the o-ring

	Action	Note
1	Check that the o-ring is properly seated in its groove and that it is not damaged. Replace if damaged. **Tip** If needed, lubricate the o-ring with some grease for a better fitting in the groove.	Motor M91: 3HAC036950-001. O-ring: 3HAB3772-138 Grease: Used to lubricate the seals..  xx1400002759
2	**For IRB 14050 Type A** Check that the o-ring on the flange is properly seated in its groove and that it is not damaged. Replace if damaged. **Tip** If needed, lubricate the o-ring with some grease for a better fitting in the groove.	Flange: 3HAC072381-001. O-ring on flange: 3HAB3772-119 Grease: Used to lubricate the seals..  xx1900002072

Fitting the wave generator to the motor (IRB 14050 Type A)

	Action	Note
1	Wipe the contact surfaces of the motor, flange and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

Continues on next page

	Action	Note
2	Refit the motor to the flange.	Screws: 3HAC050367-039 (2 pcs). Tightening torque: 0.3 Nm.  xx1900002071
3	Orient the output axis of the motor so that the flat surfaces on the output axis are positioned towards the gaps on the flange.	 xx1900002073
4	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1900002074

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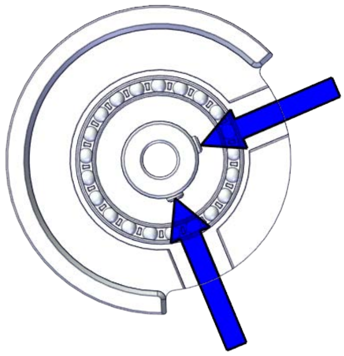
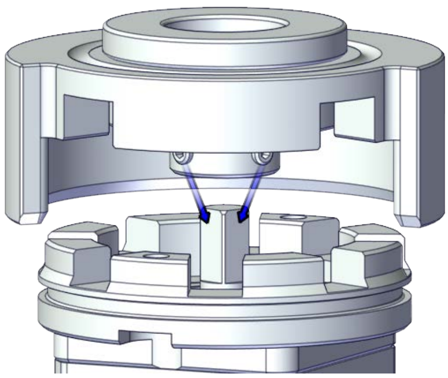
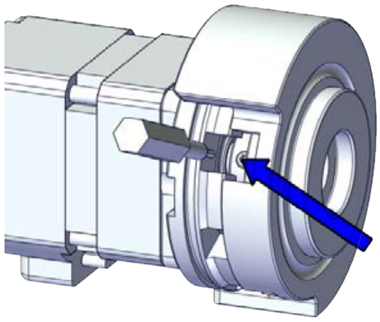
	Action	Note
5	Place the wave generator to the fixture tool. Orient the wave generator so that the set screws are positioned towards the gaps on the fixture tool. **Tip** Use a magnet on the other side of the fixture tool to prevent the wave generator drop from the tool.	 xx1900002075
6	Fit the wave generator to the motor shaft, place the fixture tool against the flange. Orient the wave generator so that the set screws are positioned towards the flat surface on the output axis of the motor and accessible from the aligned gaps on the fixture tool and flange.	 xx1900002076
7	Tighten the set screws.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1900002077

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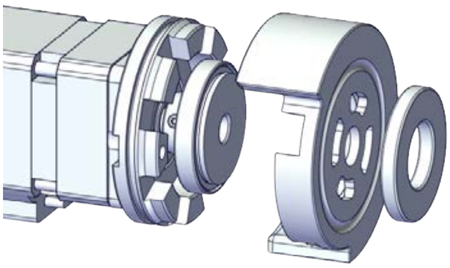
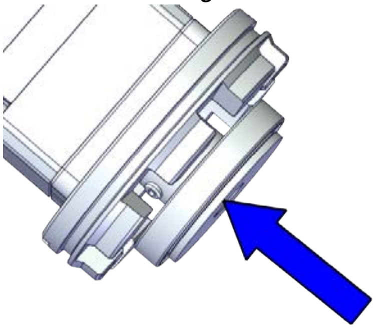
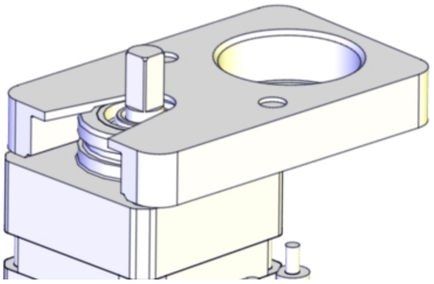
	Action	Note
8	Remove the fixture.	 xx1900002078
9	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1900002079

Fitting the wave generator to the motor (IRB 14050 no-type-specified)

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	
2	Place the fixture tool on the new motor.	 xx1500001646

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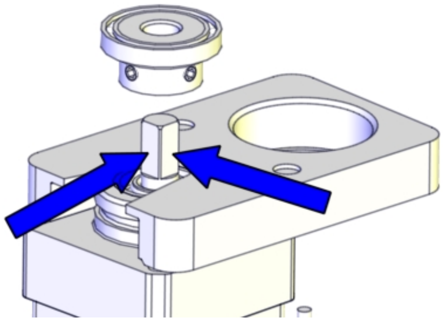
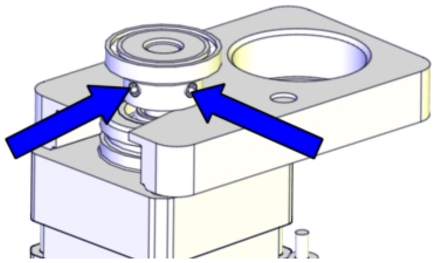
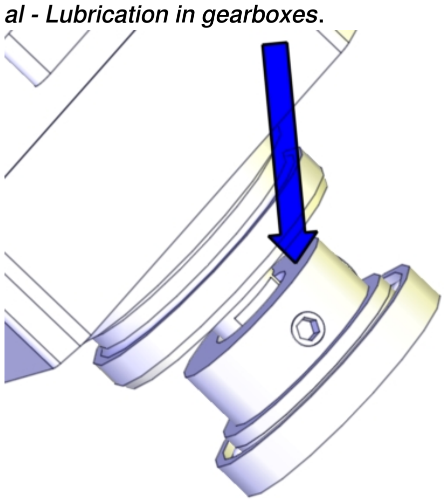
	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	 xx1500001647
4	Tighten the set screw.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1500001649

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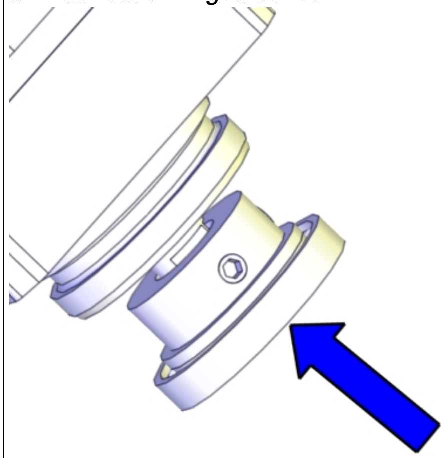
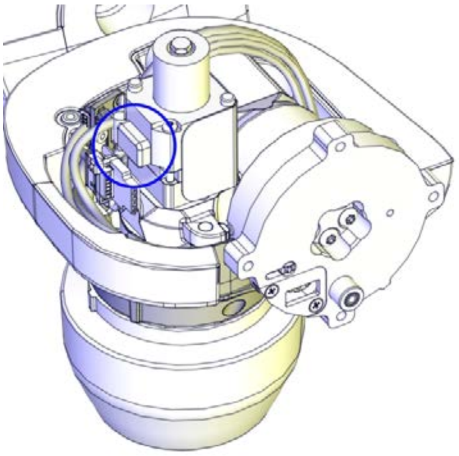
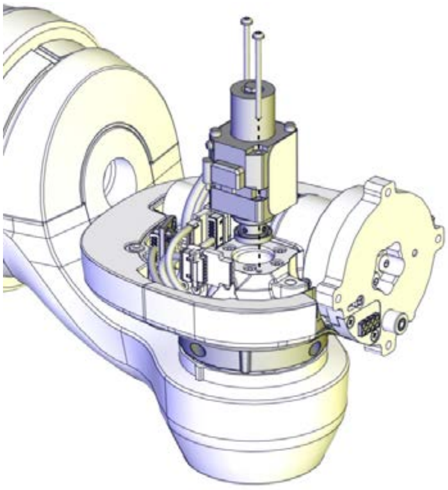
	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.  xx1500001650

Refitting the axis-5 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
2	**For IRB 14050 (no-type-specified)** Check the PTFE film. Replace if damaged.	PTFE film on axis-5 and axis-6 motors: 3HAC051316-001

Continues on next page

	Action	Note
3	**For IRB 14050 (no-type-specified)** Orient the motor correctly and fit it into the arm. Secure with the screws. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1500000569 Screws: 3HAC050367-039 (2 pcs). Tightening torque: 0.3 Nm.  xx1400002790

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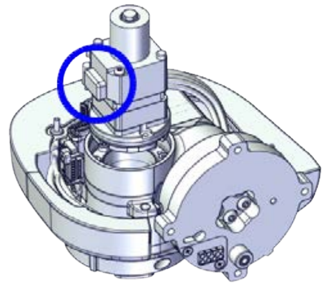
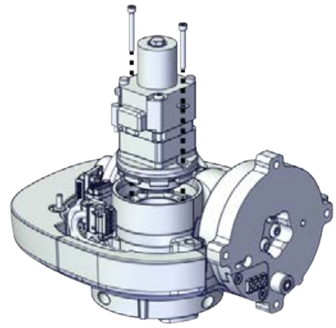
	Action	Note
4	**For IRB 14050 Type A** Orient the motor correctly and fit it into the arm. Secure the flange with the screws and washers. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1900002142 Screws: 3HAC072396-001 (2 pcs). Washers: 3HAC073135-001 (2 pcs). Tightening torque: 0.4 Nm.  xx1900002141
5	Connect the motor connectors: • R1.MP5 • R1.FB5	

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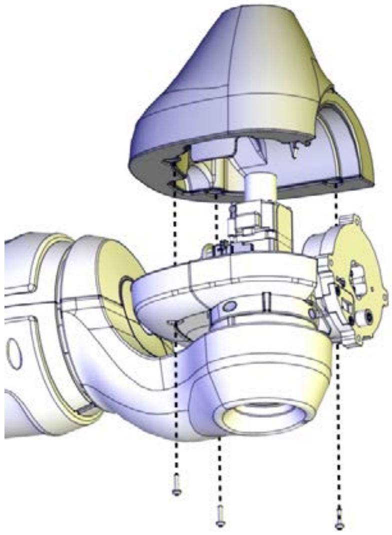
Refitting the covers

	Action	Note
1	Refit the axis-6 cover.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.2 Nm.  xx1400002760

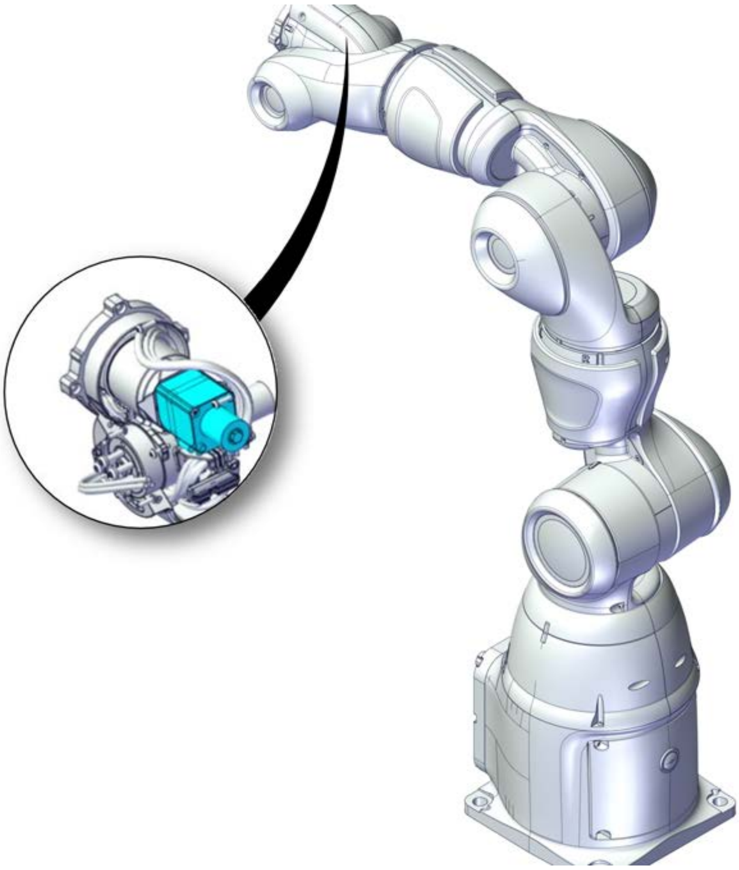
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.3.7 Replacing the axis-6 motor

Location of the axis-6 motor

The axis-6 motor is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Motor M91	3HAC036950-001	Includes o-ring 3HAB3772-138.
O-ring	3HAB3772-138	Required to be replaced when removing and refitting the motor.
PTFE film on axis-5 and axis-6 motors	3HAC051316-001	Replace if damaged. Used only on axis-5 motor of IRB 14050 no-type-specified and axis-6 motor of both robot types. See *Robot description on page 349* for robot type.

Continues on next page

Spare part	Article number	Note
Torx pan head screw	3HAC050367-039	M2x30 8.8 Gleitmo 605
Hex socket head cap screw	3HAC050368-005	M2x8 8.8

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.
Fixture tool for wave generator M91	3HAC054904-001	Used for axes 4 and 5 of IRB 14050 no-type-specified and axis 6 of both robot types. See *Robot description on page 349* for robot type.

Consumables

Consumable	Article number	Note
Grease	3HAC042536-001	Used to lubricate the seals. Used to lubricate o-rings.
Grease		Used to lubricate the wave generator. See *Technical reference manual - Lubrication in gearboxes*
Cleaning agent	-	Isopropanol

Required documents

Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

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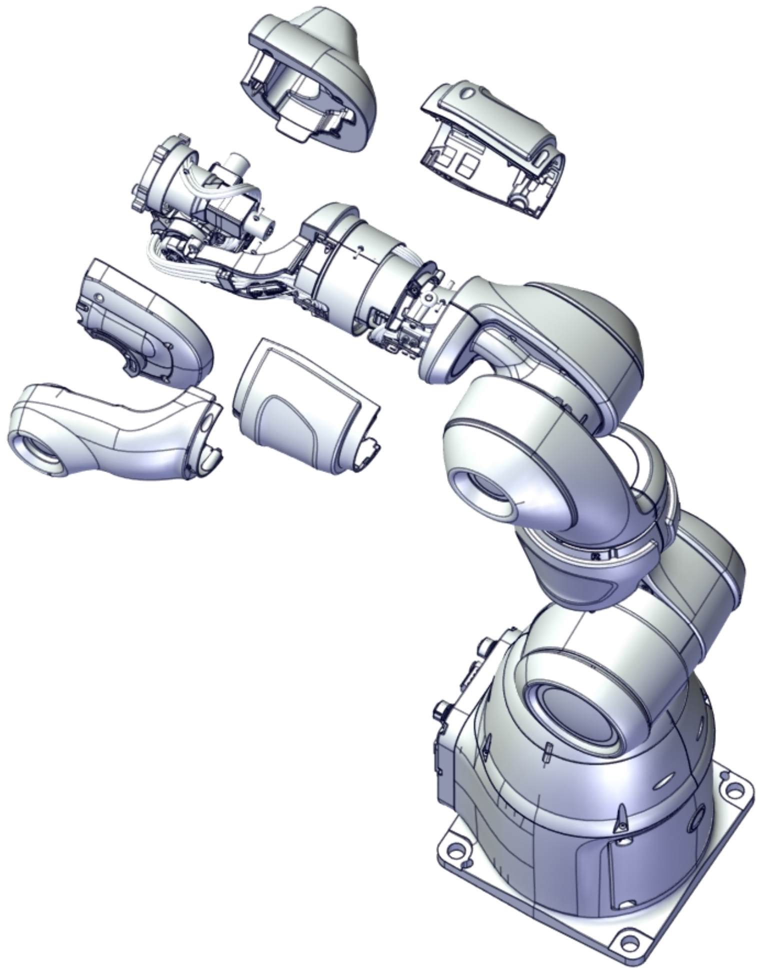
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



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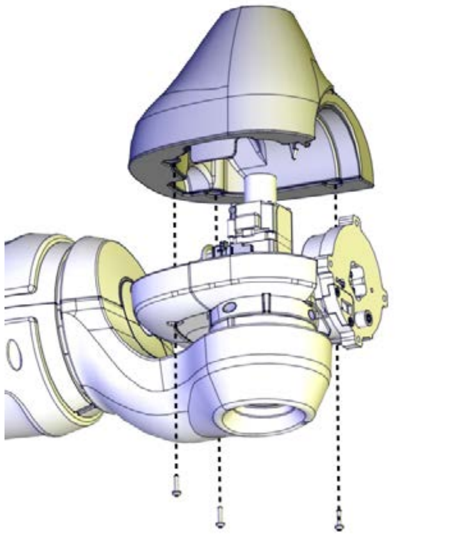
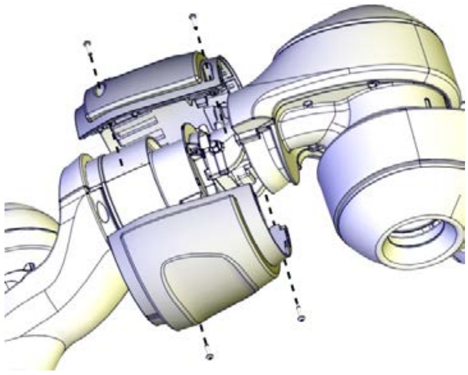
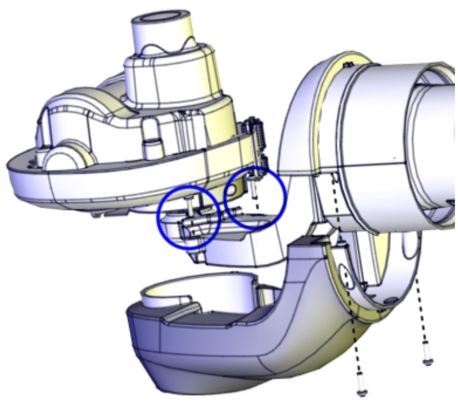
Removing the motor

Use these procedures to remove the the axis-6 motor.

Preparations before removing the motor

	Action	Note
1	Jog the robot so that the wrist is easily accessed.	
2	Jog axis 6 clockwise (facing the tool flange) to the limiting position -229° so that the cable will stay in place when removing the cover.	

Continues on next page

	Action	Note
3	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
4	Remove the wrist cover. Rotate axis 5 manually so that all screws can be accessed.	 xx1400002760
5	Remove the lower axis-4 cover.	 xx1500000360
6	Remove the upper axis-4 cover.	 xx1500001735

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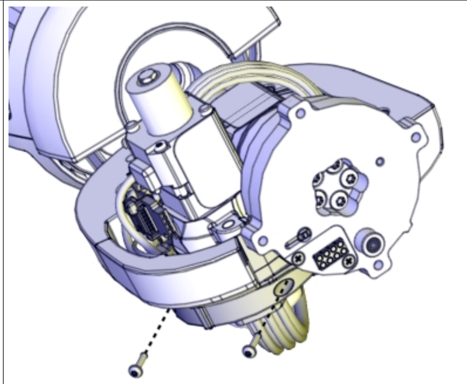
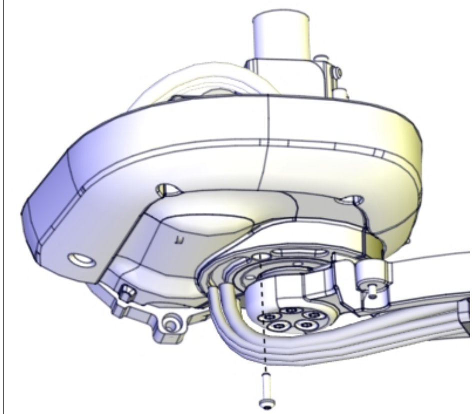
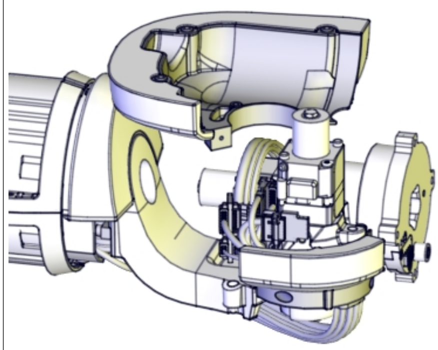
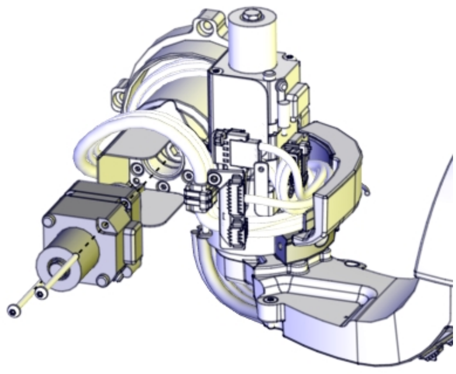
	Action	Note
7	Remove the screws for the inner part of the cooling flange.	 xx1400002867  xx1500000602
8	Remove the inner part of the cooling flange.	 xx1500000541

Removing the axis-6 motor

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Continues on next page

	Action	Note
2	Disconnect the motor connectors. Cut some cable ties, if needed. • R1.MP6 • R1.FB6	
3	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
4	Remove the screws and lift the motor out carefully.	 xx1500000542

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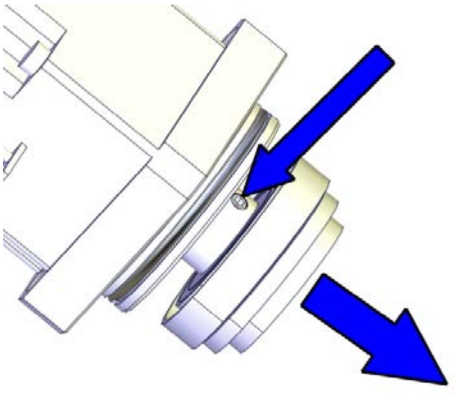
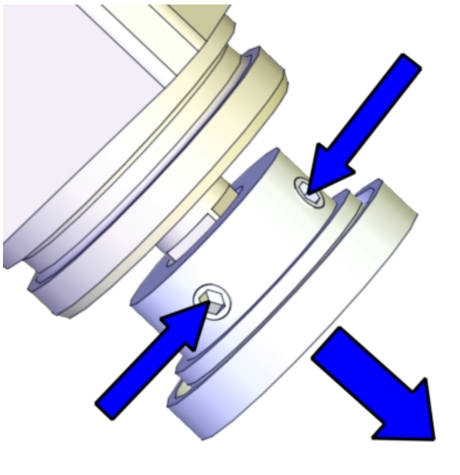
Removing the wave generator from the motor

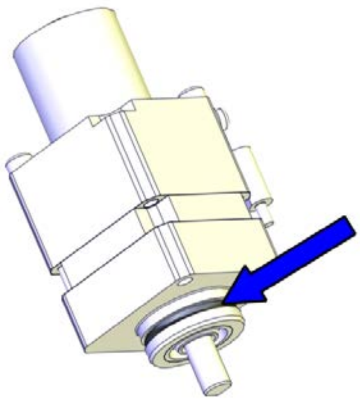
	Action	Note
1	Remove the wave generator from the motor shaft by removing the set screw(s) and then pulling it off the shaft.	
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000515
	Axis 6.	 xx1500001651
2	Place the wave generator on a clean workbench, if not instantly fitting it to a new motor. **CAUTION** Keep the wave generator clean.	

Continues on next page

Refitting the motor

Use these procedures to refit the axis-6 motor.

Checking the o-ring on the motor

	Action	Note
1	Check that the o-ring is properly seated in its groove and that it is not damaged. Replace if damaged. **Tip** If needed, lubricate the o-ring with some grease for a better fitting in the groove.	Motor M91: 3HAC036950-001. O-ring: 3HAB3772-138 Grease: Used to lubricate the seals..  xx1400002759

Fitting the wave generator to the motor

	Action	Note
1	Wipe the contact surfaces of the motor and wave generator clean from any contamination with cleaning agent applied on a cloth or paper.	

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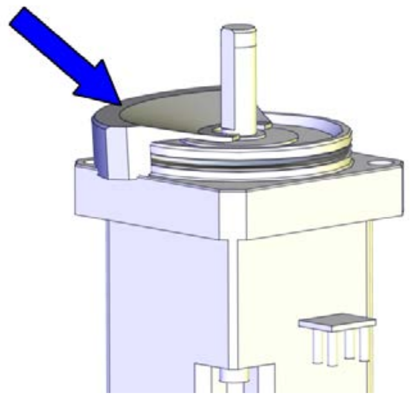
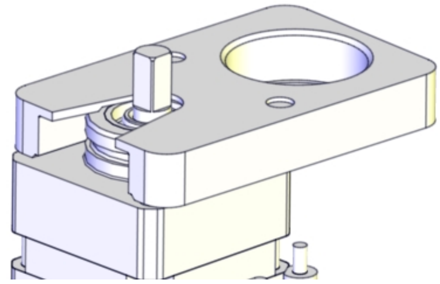
	Action	Note
2	Place the fixture tool on the new motor.	
	Axis 1 and axis 2: Fixture tool for wave generator M93, 3HAC054870-001.	 xx1500000527
	Axis 7 and axis 3: Fixture tool for wave generator M92, 3HAC054871-001.	
	Axis 6: Fixture tool for wave generator M91, 3HAC054904-001.	 xx1500001646

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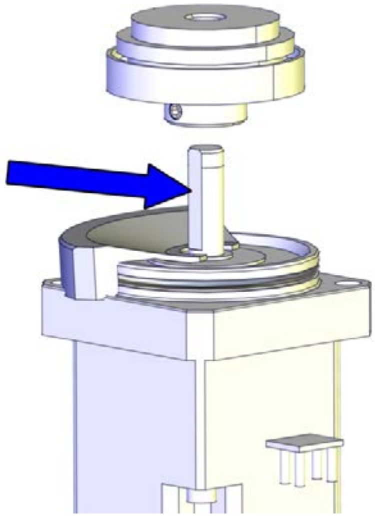
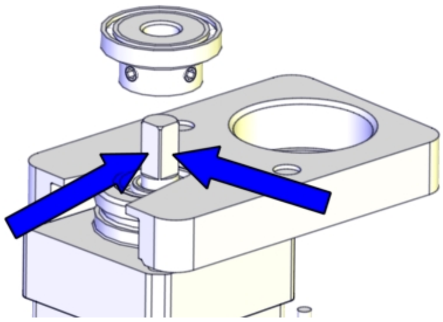
	Action	Note
3	Fit the wave generator to the motor shaft, place it against the distance fixture and secure lightly with the set screw(s). Orient the wave generator so that the set screw will be positioned towards the flat surface on the output axis of the motor. The flat surface is pointed out in the figure.	
	Axis 1, axis 2, axis 3 and axis 7.	 xx1500000528
	Axis 6.	 xx1500001647

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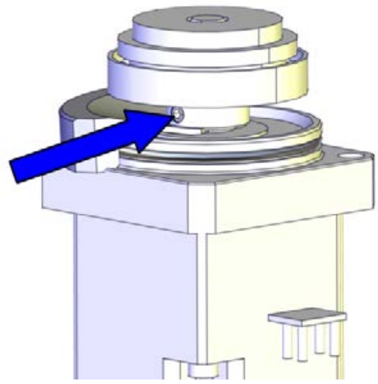
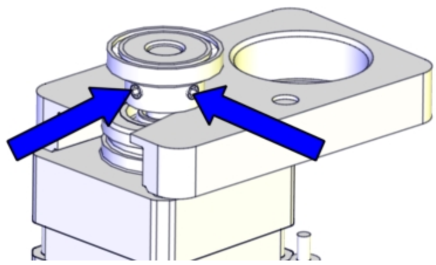
	Action	Note
4	Tighten the set screw.	
	Axis 1, axis 2, axis 3 and axis 7.	Screw: M3-set screw (1 pcs). Tightening torque: 0.6 Nm.  xx1500000518
	Axis 6.	Screw: M2-set screw (2 pcs). Tightening torque: 0.2 Nm.  xx1500001648
5	Remove the fixture.	

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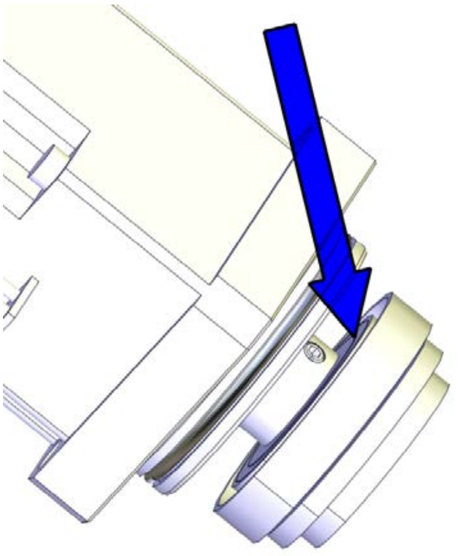
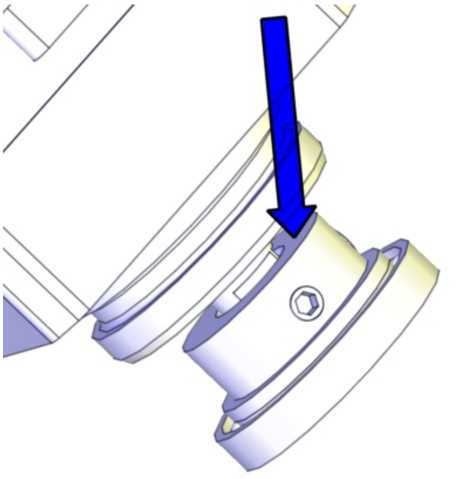
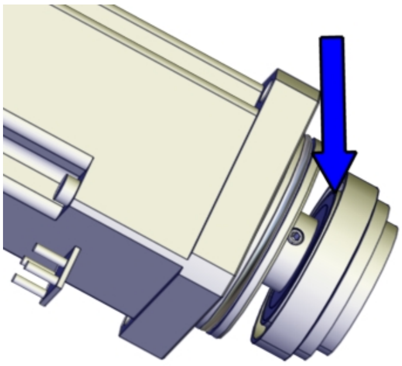
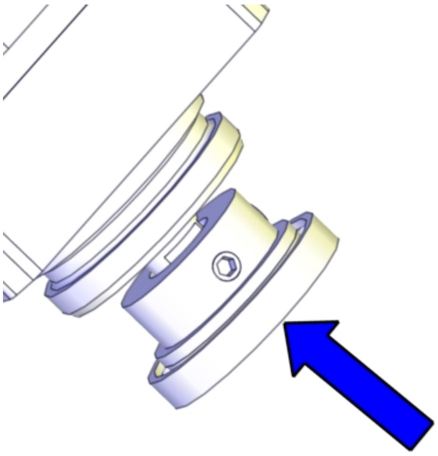
	Action	Note
6	Lubricate the wave generator with grease.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000557
	Axis 6.	 xx1500001649

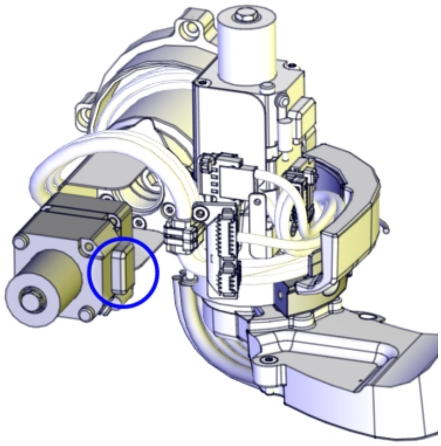
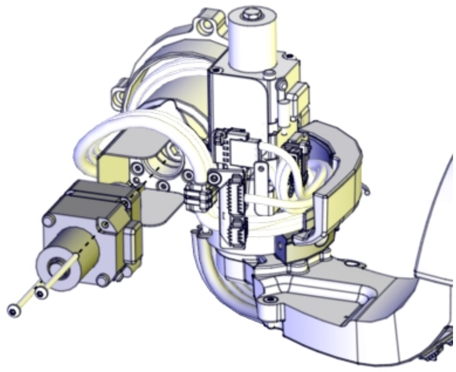
Continues on next page

	Action	Note
7	Spread the grease on the end plane of the bearing to make sure the balls in the bearing are lubricated as well.	Type of grease and total amount is described in *Technical reference manual - Lubrication in gearboxes*.
	Axis 1, axis 2, axis 7, axis 3.	 xx1500000556
	Axis 6.	 xx1500001650

Refitting the axis-6 motor

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
2	Check the PTFE film. Replace if damaged.	PTFE film on axis-5 and axis-6 motors: 3HAC051316-001

Continues on next page

	Action	Note
3	Orient the motor correctly and fit it into the arm. Secure with the screws. **CAUTION** The motor must be inserted gently. If the gears do not mate, rotate the axis carefully back and forth until the gears are mated.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1500000570 Screws: 3HAC050367-039 (2 pcs). Tightening torque: 0.3 Nm.  xx1500000542
4	Connect the motor connectors: • R1.MP6 • R1.FB6	

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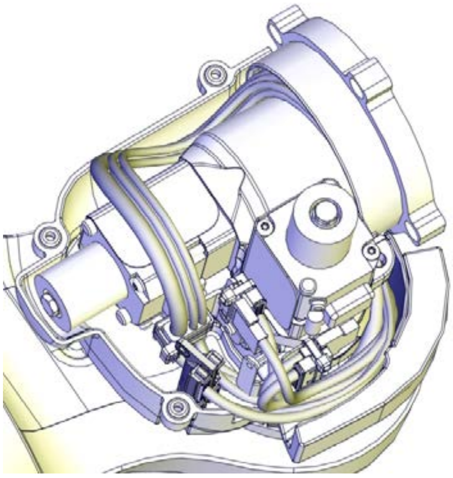
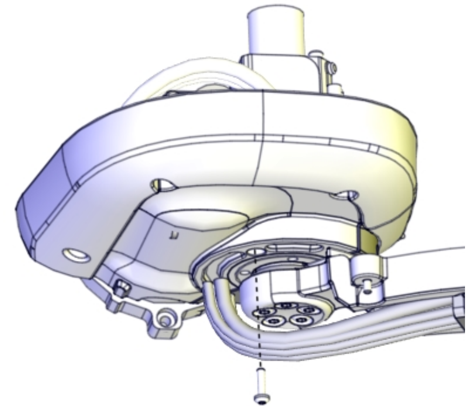
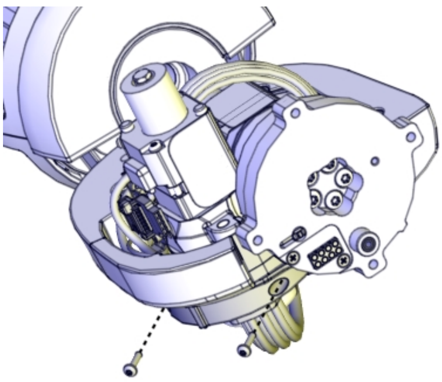
	Action	Note
5	Route and secure the cabling according to the figure.  **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	 xx1500000584

Refitting the covers

	Action	Note
1	Refit the cooling flange.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.2 Nm.  xx1500000602  xx1400002867

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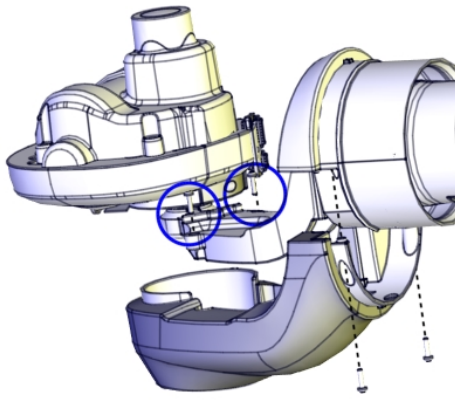
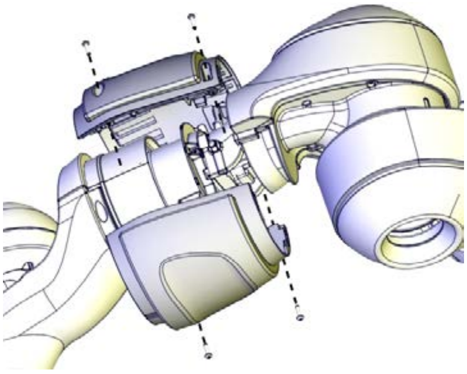
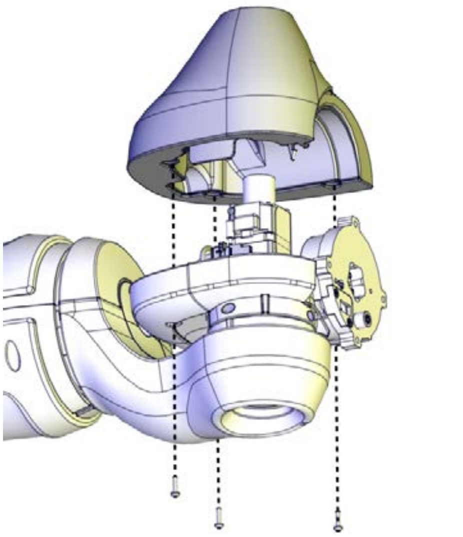
	Action	Note
2	Refit the upper axis-4 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1500001735
3	Refit the lower axis-4 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1500000360
4	Refit the axis-6 cover.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.2 Nm.  xx1400002760

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Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.4 Hall sensors

4.4.1 Replacing the axis-1 hall sensor

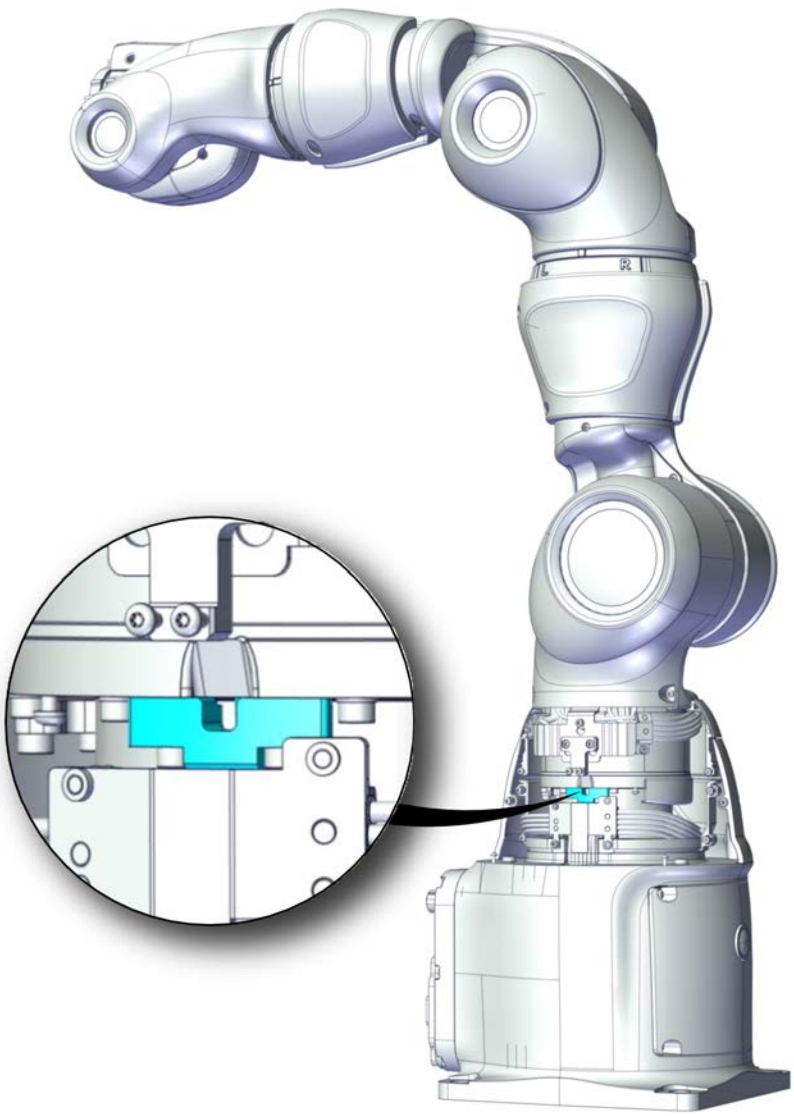
Note

For robots without Absolute Accuracy option, replace the hall sensor by following the instructions specified in this section.

For robots with Absolute Accuracy option, it is recommended to exchange the complete manipulator in case of a broken hall sensor; otherwise, the hall sensor must be replaced by ABB. Contact your local ABB for more information.

Location of the hall sensor

The hall sensor is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Hall sensor with attachment for axis 1	3HAC052445-001	
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAB3409-233	M2.5x6 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Nut	9ADA267-1	M2 DIN934 8 ELZN

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

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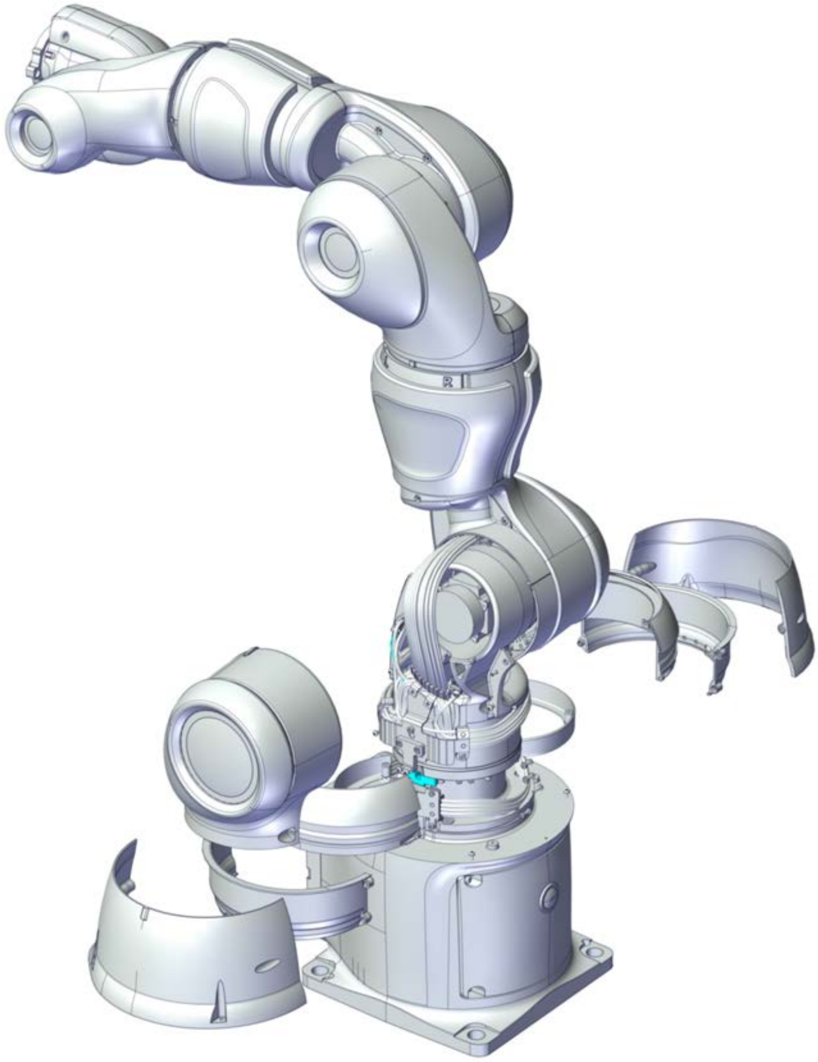
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



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Removing the hall sensor

Use these procedures to remove the hall sensor.

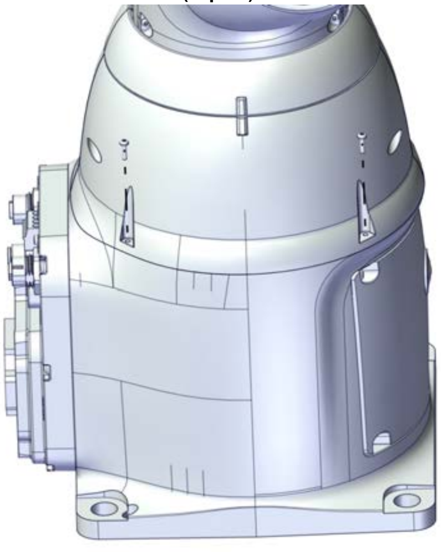
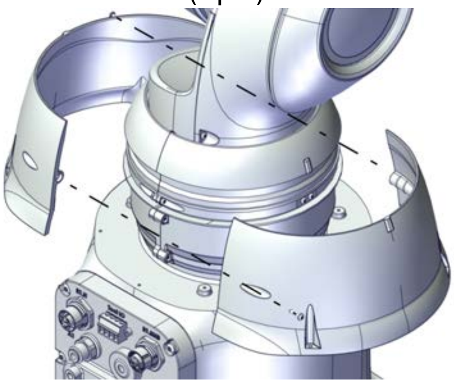
Preparations before removing the hall sensor

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	

Continues on next page

	Action	Note
2	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	

Removing the axis-1 covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Remove the outer axis 1 cover screws.	Screws:M2x8 8.8 (4 pcs).  xx1800001240 Screws:M2x8 8.8 (2 pcs).  xx1800001241

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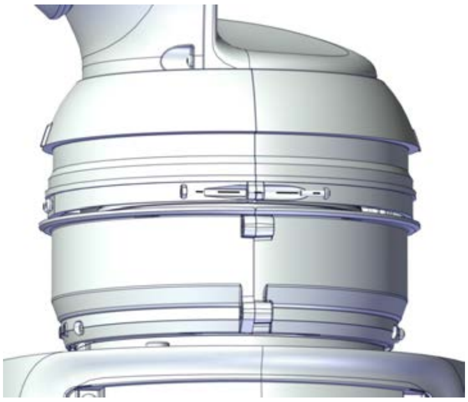
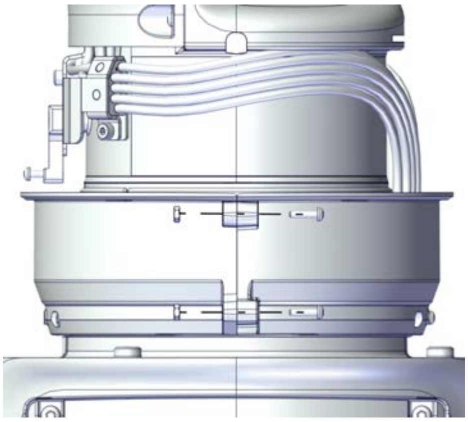
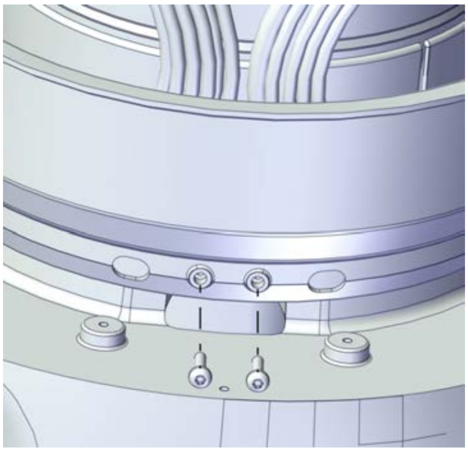
	Action	Note
3	Remove the upper axis-1 cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.	Screws:M2x8 8.8 (2 pcs).  xx1800001242
4	Turn the lower axis-1 cover in order to access all screws properly and remove the lower axis-1 cover.	Screws:M2x8 8.8 (4 pcs).  xx1800001243  xx1800001252

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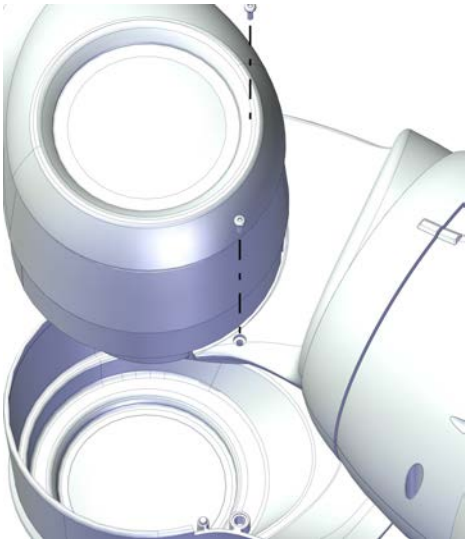
Removing the remaining covers

	Action	Note
1	Remove the lower axis-2 cover.	Screws:M2x8 8.8 (4 pcs).  xx1800001489  xx1800001490

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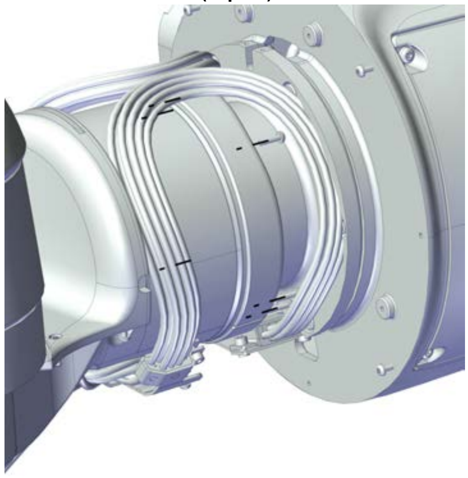
	Action	Note
2	Remove the axis-1 cable protection. **Tip** In order to access the screws it is helpful to release the brakes and manually move the robot arm. Temporarily turn on the power to the robot and release the brakes.	Screws:M2x8 8.8 (6 pcs).  xx1800003326

Removing the axis-1 hall sensor

	Action	Note
1	Turn on the power to the robot temporarily.	

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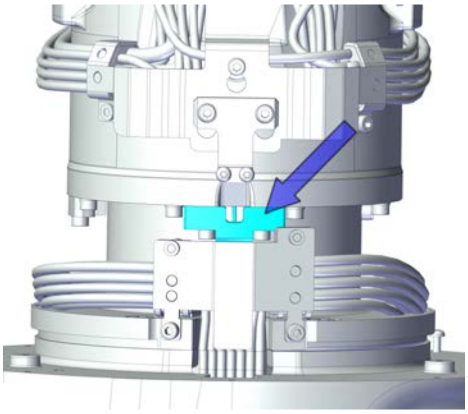
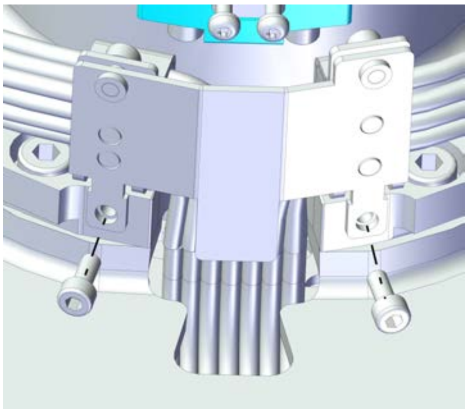
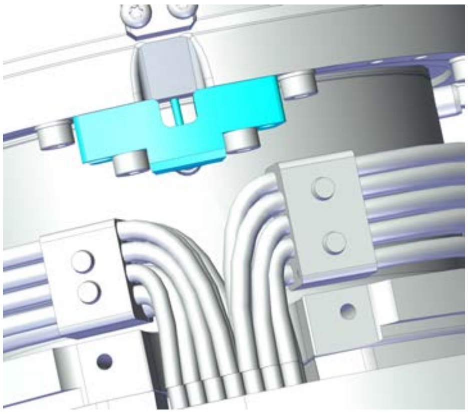
	Action	Note
2	Release the brakes and rotate axis 1 in order to access the hall sensor.	 xx1800003327  xx1800003328  xx1800003329
3	**DANGER** Turn off the electric power supply again.	

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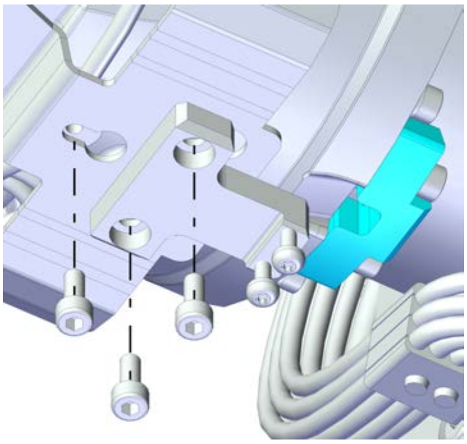
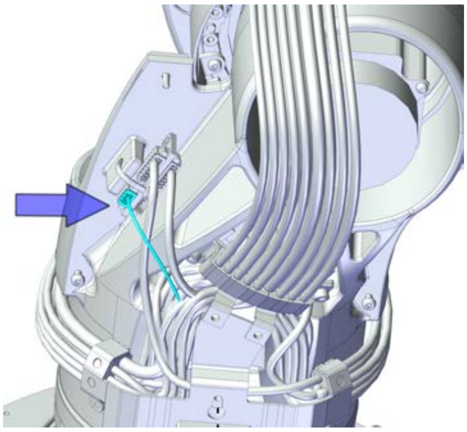
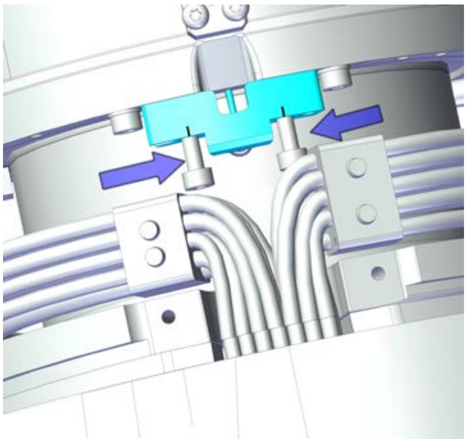
	Action	Note
4	Remove the cable bracket.	 xx1800003330
5	Disconnect the hall sensor connector P3.	 xx1800003331
6	Move the cabling to access the hall sensor attachment screws. Remove the hall sensor by removing the two screws and washers.	 xx1800003332

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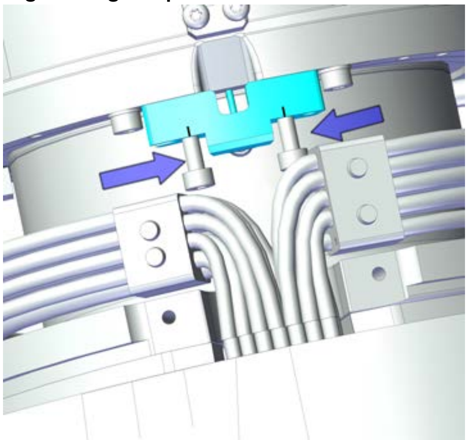
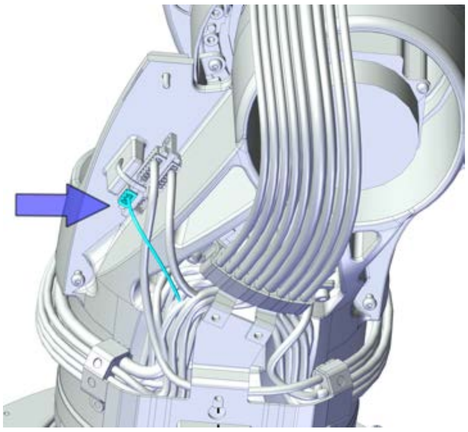
Refitting the hall sensor

Use these procedures to refit the hall sensor.

Refitting the axis-1 hall sensor

	Action	Note
1	Refit the hall sensor with the screws and washers.	Hall sensor with attachment for axis 1: 3HAC052445-001. Screws: 3HAB3409-241 (2 pcs). Tightening torque: 0.8 Nm.  xx1800003332
2	Connect the hall sensor connector P3.	 xx1800003331

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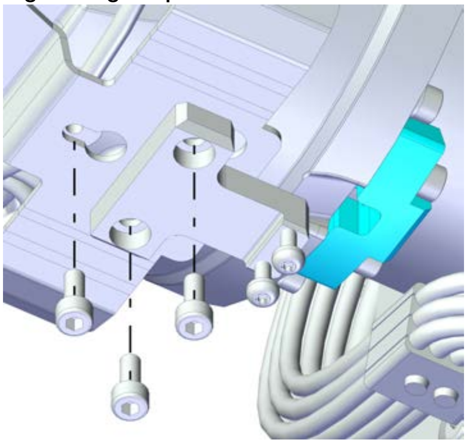
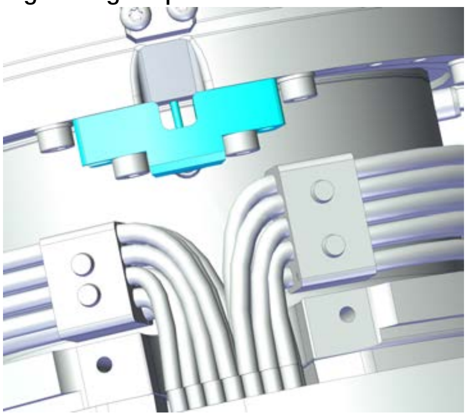
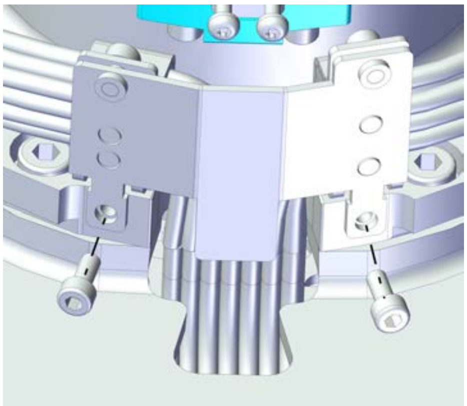
	Action	Note
3	Refit the cable bracket with the screws. **Note** Make sure to orient the bracket correctly and to position it parallel.	Screws: 3HAB3409-233 (3 pcs). Tightening torque: 0.8 Nm.  xx1800003330
4	Refit the bracket with the screws.	Screws: 3HAB3409-233 (2 pcs). Tightening torque: 0.8 Nm.  xx1800003329  xx1800003328

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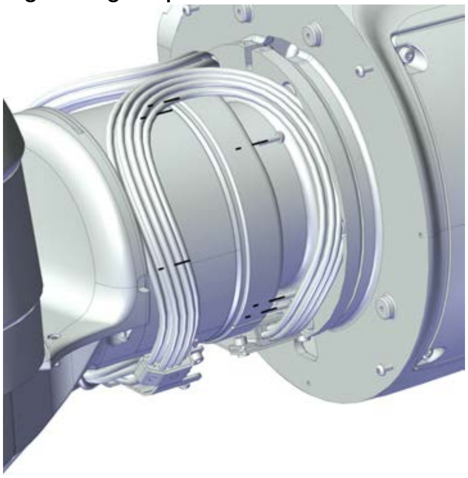
Refitting the covers

	Action	Note
1	Refit the axis-1 cable protection. **Tip** In order to access the screws it is helpful to release the brakes and manually move the robot arm. Temporarily turn on the power to the robot and release the brakes.	Screws: 3HAC050368-005 (6 pcs). Tightening torque: 0.14 Nm.  xx1800003326

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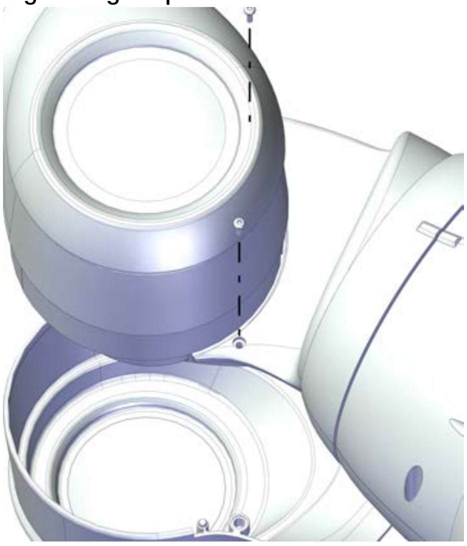
	Action	Note
2	Refit the lower axis-2 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001490  xx1800001489

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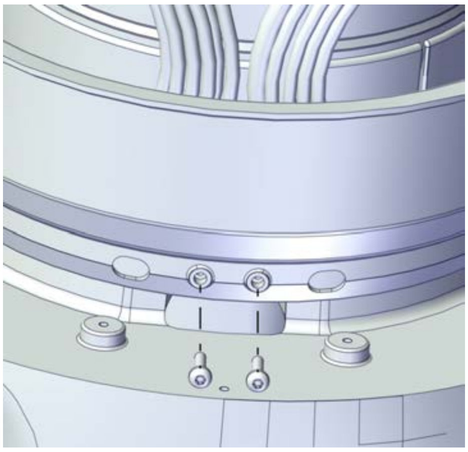
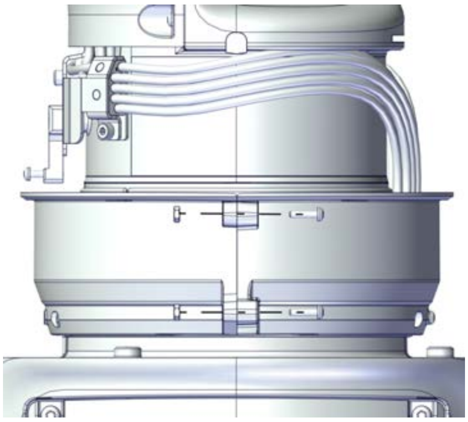
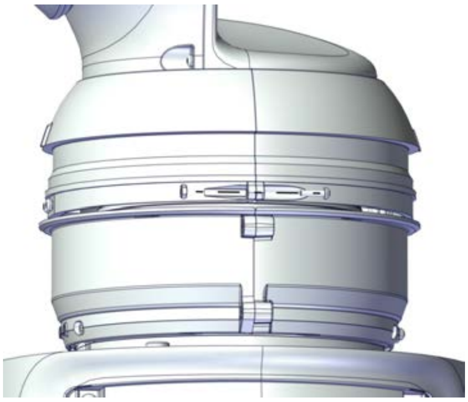
Refitting the axis-1 covers

	Action	Note
1	Refit the lower axis-1 cover.	Screws: 3HAC050368-005 (4 pcs). Nuts: 9ADA267-1 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001252  xx1800001243
2	Refit the upper axis-1 cover.	Screws: 3HAC050368-005 (2 pcs). Nuts: 9ADA267-1 (2 pcs). Tightening torque: 0.14 Nm.  xx1800001242

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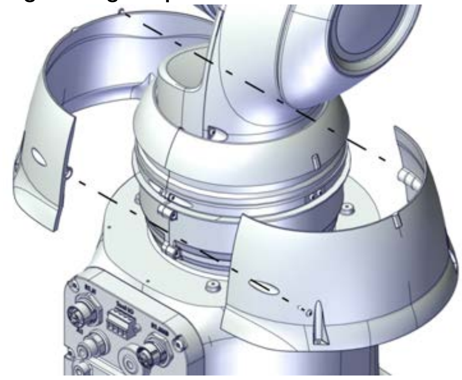
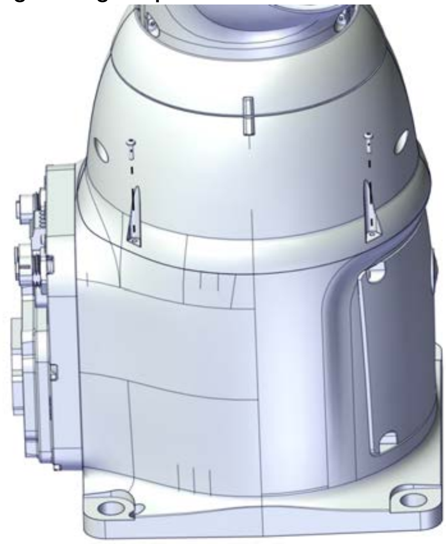
	Action	Note
3	Refit the outer axis-1 padding.	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1800001241 Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001240

Concluding procedure

	Action	Note
1	Recalibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.4.2 Replacing the axis-2 hall sensor

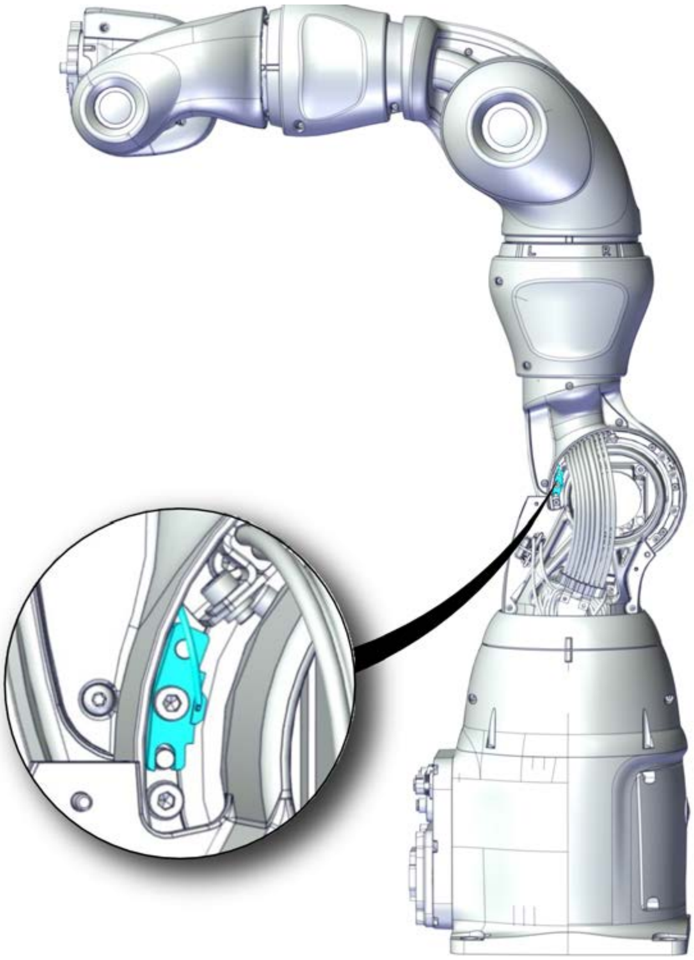
Note

For robots without Absolute Accuracy option, replace the hall sensor by following the instructions specified in this section.

For robots with Absolute Accuracy option, it is recommended to exchange the complete manipulator in case of a broken hall sensor; otherwise, the hall sensor must be replaced by ABB. Contact your local ABB for more information.

Location of the hall sensor

The hall sensor is located as shown in the figure.



xx1800001500

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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Hall sensor with attachment for axis 2	3HAC052446-001	
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9
Torx pan head screw	3HAC050367-005	M3x12 8.8 Gleitmo 605

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

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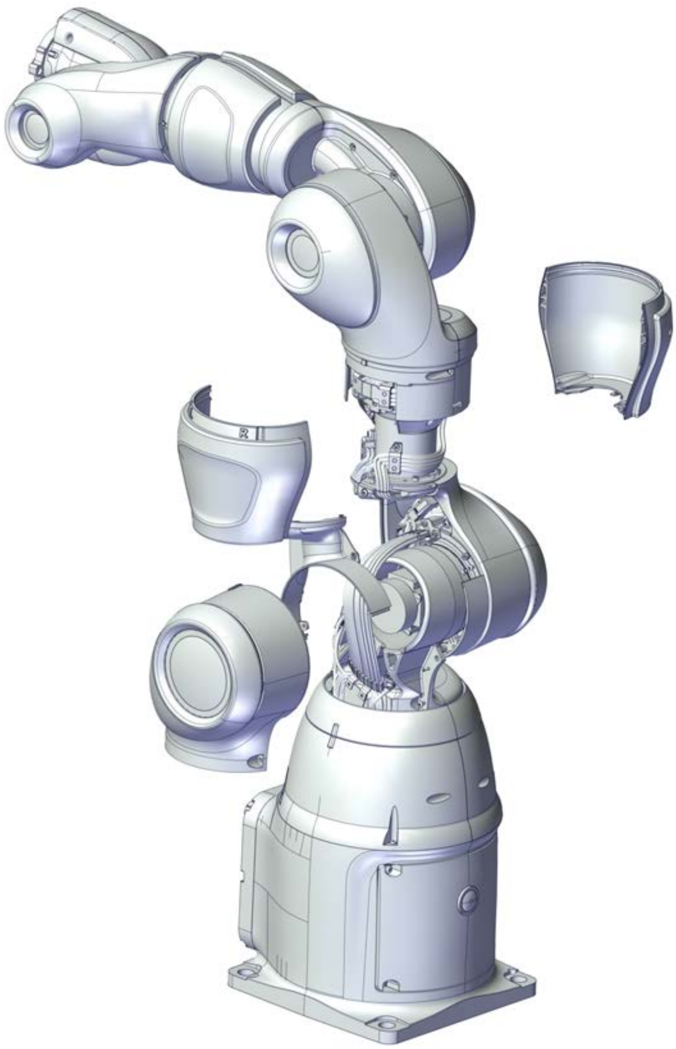
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1800003334

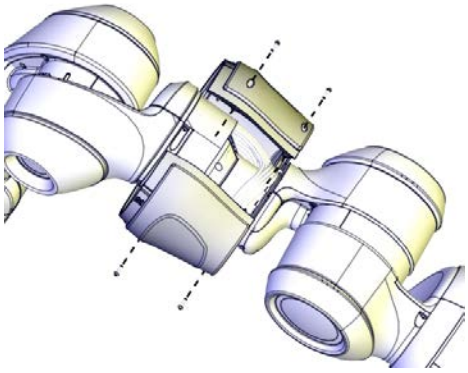
Removing the hall sensor

Use these procedures to remove the hall sensor.

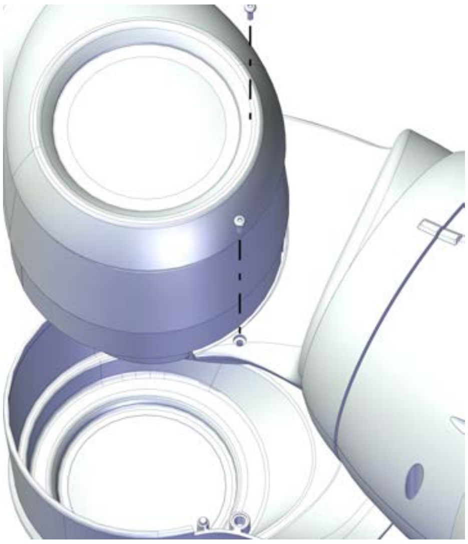
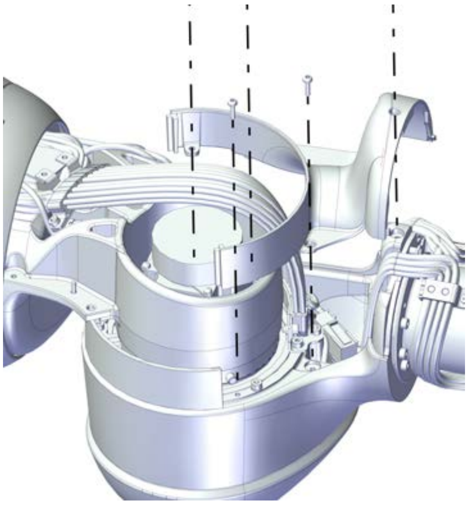
Preparations before removing the hall sensor

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	

Continues on next page

	Action	Note
2	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
3	Remove the axis-7 cover.	 xx1400002691

Continues on next page

	Action	Note
4	Remove the lower axis-2 cover.	 xx1800001489  xx1800001490
5	Remove the axis-2 cable cover.	 xx1800001491

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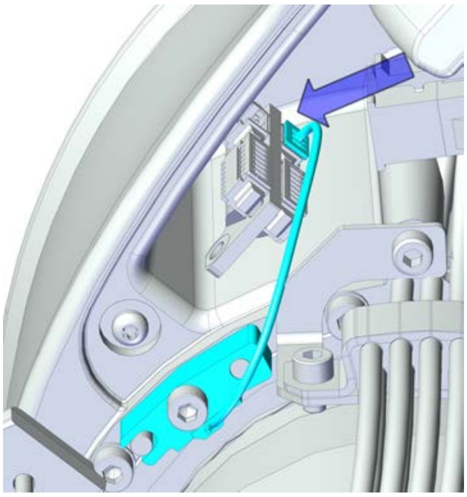
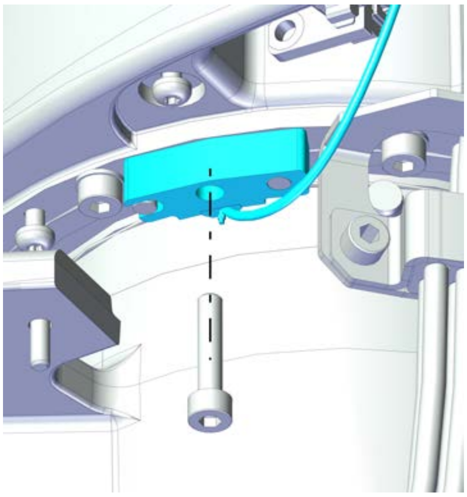
Removing the axis-2 hall sensor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Gently pull out the hall sensor interface board (HSIB). Disconnect the hall sensor connector P3.	 xx1800003335
3	Remove the hall sensor by removing the screw.	 xx1800003336

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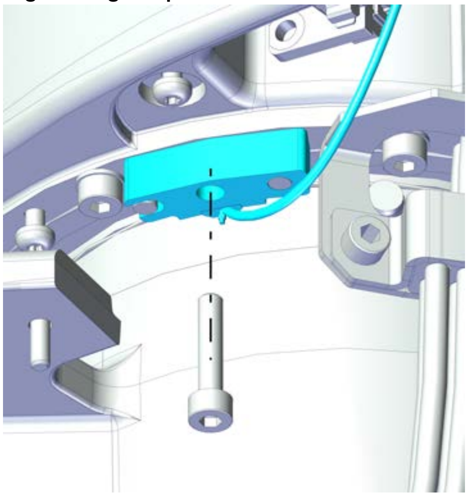
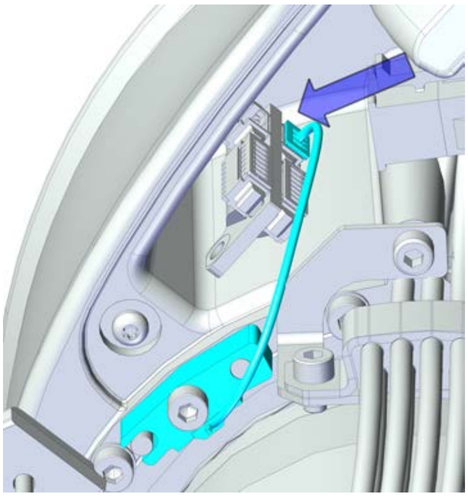
Refitting the hall sensor

Use these procedures to refit the hall sensor.

Refitting the axis-2 hall sensor

	Action	Note
1	Refit the hall sensor with the screw.	Hall sensor with attachment for axis 2: 3HAC052446-001 Screws: 3HAB3409-241 (1 pcs). Tightening torque: 0.8 Nm.  xx1800003336
2	Connect the hall sensor connector P3. Put back the hall sensor interface board (HSIB) in place.	 xx1800003335

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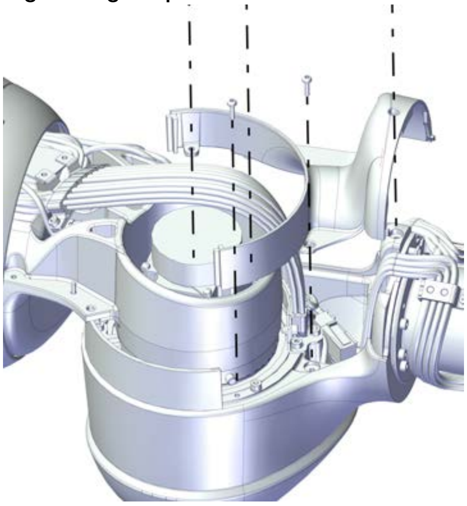
Refitting the covers

	Action	Note
1	Refit the axis-2 cable cover.	Screws: 3HAC050367-005 (5 pcs). Tightening torque: 0.14 Nm.  xx1800001491

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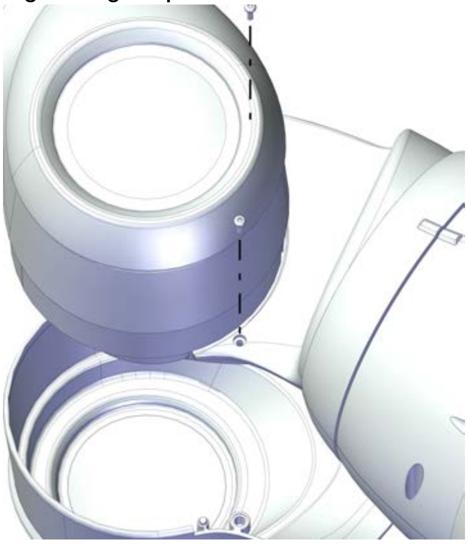
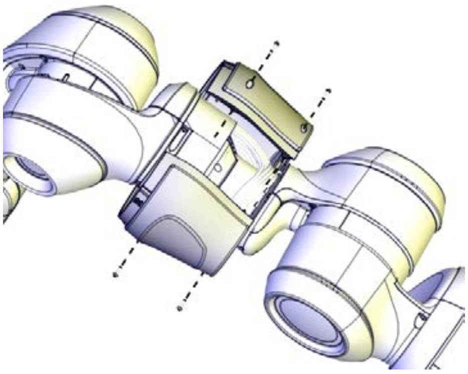
	Action	Note
2	Refit the lower axis-2 cover.	Screws: 3HAC050367-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001490  xx1800001489
3	Refit the axis-7 cover.	Screws: 3HAC050367-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002691

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Concluding procedure

	Action	Note
1	Recalibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.4.3 Replacing the axis-7 hall sensor

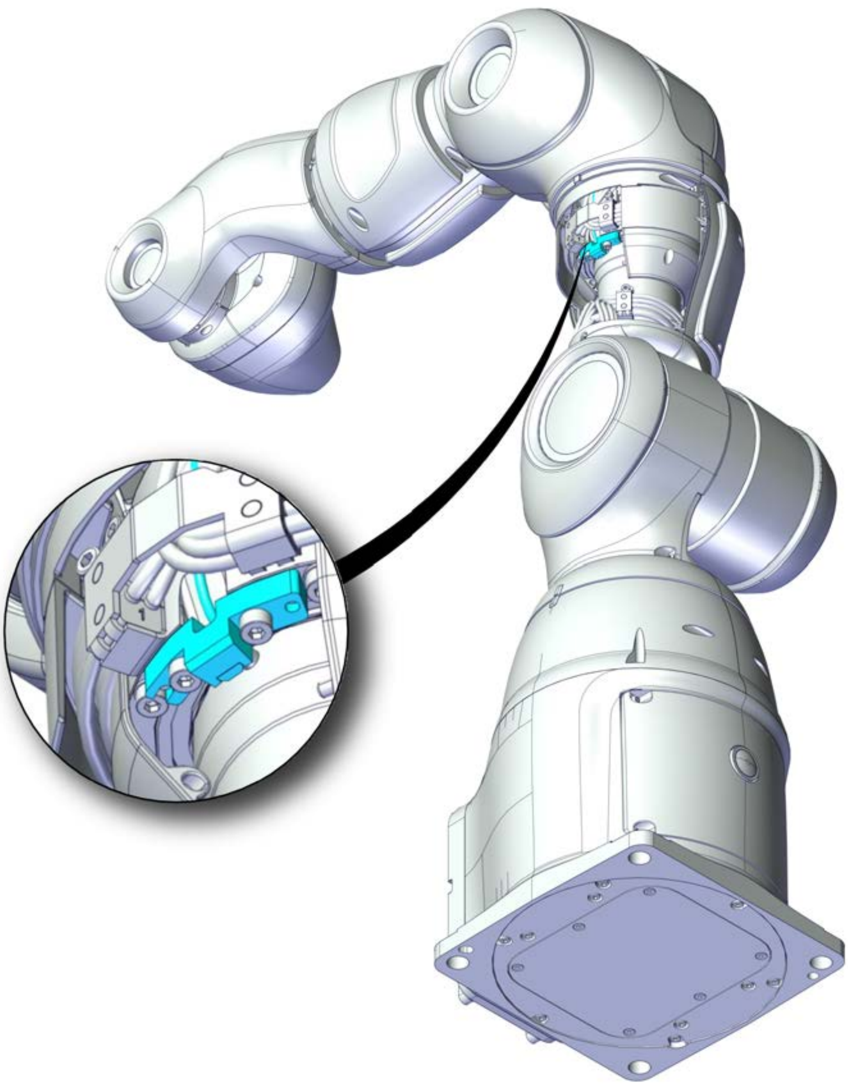
Note

For robots without Absolute Accuracy option, replace the hall sensor by following the instructions specified in this section.

For robots with Absolute Accuracy option, it is recommended to exchange the complete manipulator in case of a broken hall sensor; otherwise, the hall sensor must be replaced by ABB. Contact your local ABB for more information.

Location of the hall sensor

The hall sensor is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Hall sensor with attachment for axis 7	3HAC052447-001	
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAB3409-233	M2.5x6 12.9 Lafre 2C2B/FC6.9
Torx pan head screw	3HAC050367-005	M3x12 8.8 Gleitmo 605

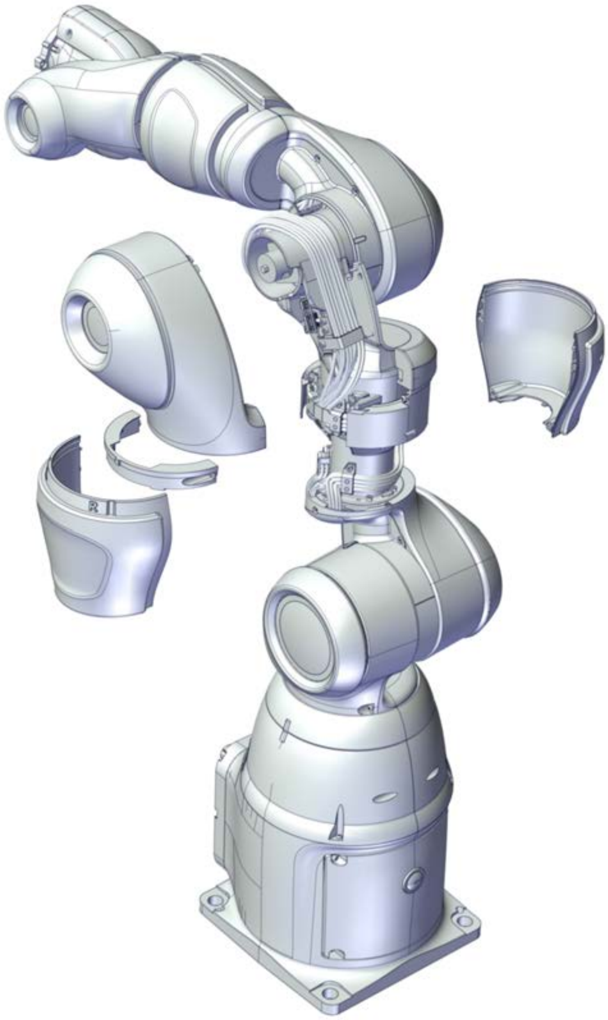
Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Continues on next page

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



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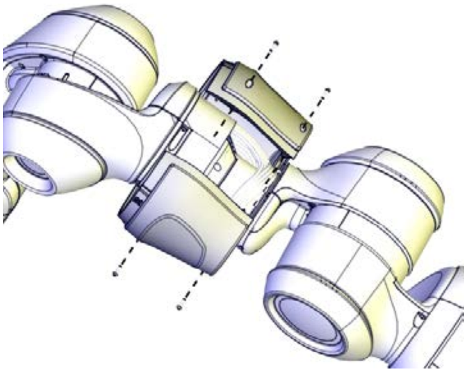
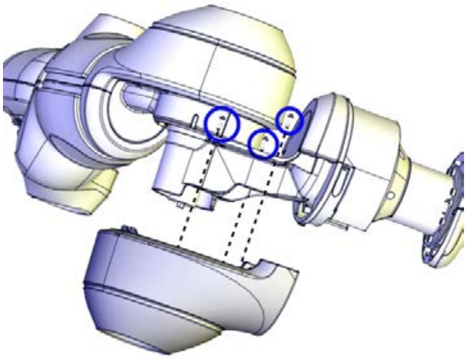
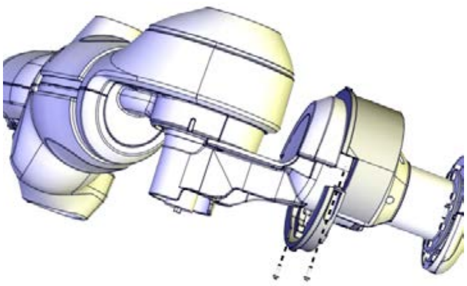
Removing the hall sensor

Use these procedures to remove the hall sensor.

Preparations before removing the hall sensor

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	

Continues on next page

	Action	Note
2	 **DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
3	Remove the axis-7 cover.	 xx1400002691
4	Remove the axis-3 cover.	 xx1500000458
5	Remove the axis-7 ring (two parts).	 xx1500000460

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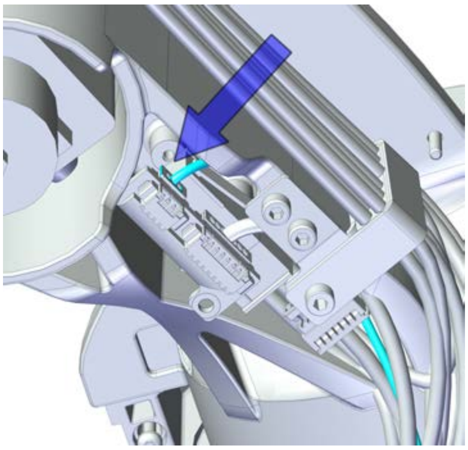
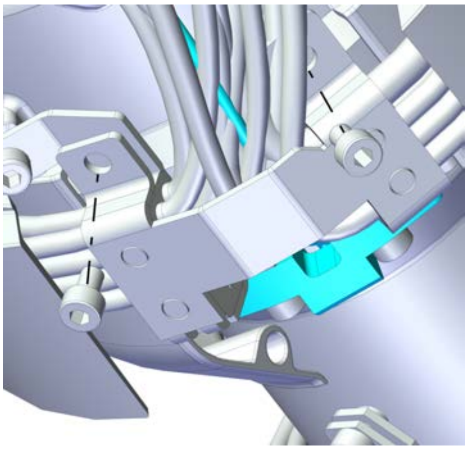
Removing the axis-7 hall sensor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Gently pull out the hall sensor interface board (HSIB). Disconnect the hall sensor connector P3.	 xx1800003338
3	Remove the cable bracket by removing the two screws.	 xx1800003339

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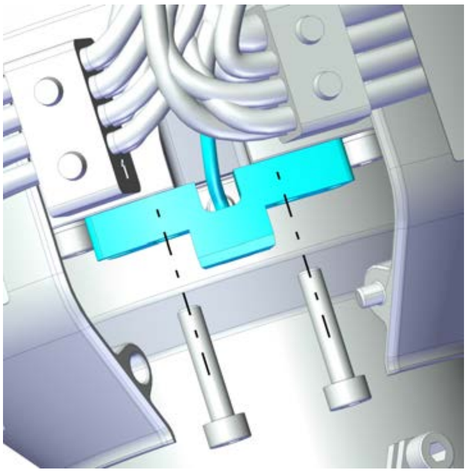
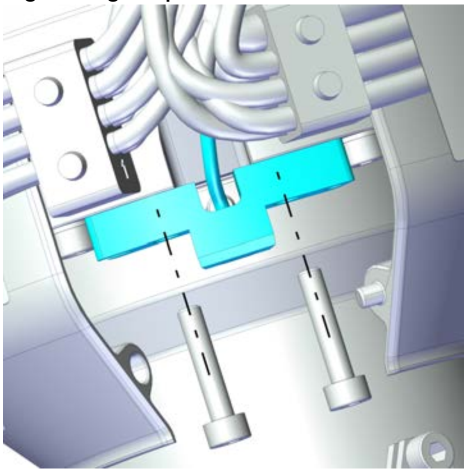
	Action	Note
4	Remove the hall sensor by removing the two screws and washers.	 xx1800003340

Refitting the hall sensor

Use these procedures to refit the hall sensor.

Refitting the axis-7 hall sensor

	Action	Note
1	Refit the hall sensor with two screws and washers.	Hall sensor with attachment for axis 7: 3HAC052447-001 Screws: 3HAB3409-241 (2 pcs). Tightening torque: 0.8 Nm.  xx1800003340

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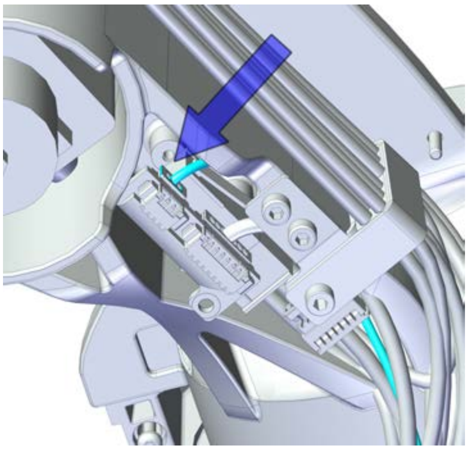
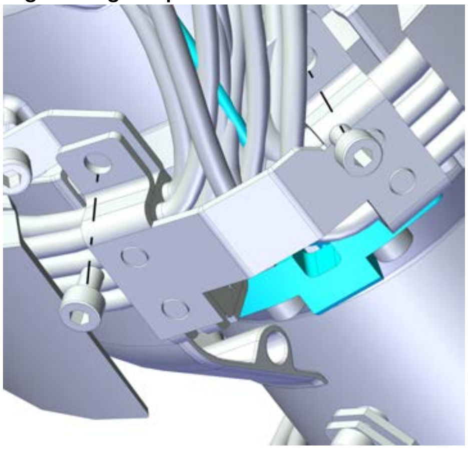
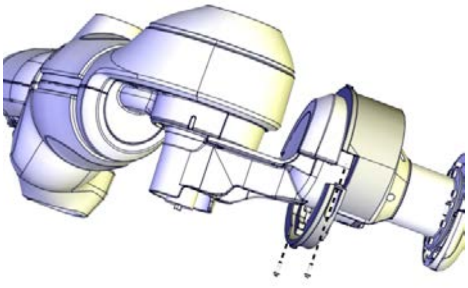
	Action	Note
2	Connect the hall sensor connector P3. Put back the hall sensor interface board (HSIB) in place.	 xx1800003338
3	Refit the cable bracket.	Screws: 3HAB3409-233 (2 pcs). Tightening torque: 0.8 Nm.  xx1800003339

Refitting the covers

	Action	Note
1	Refit the axis-7 ring (two parts).	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1500000460

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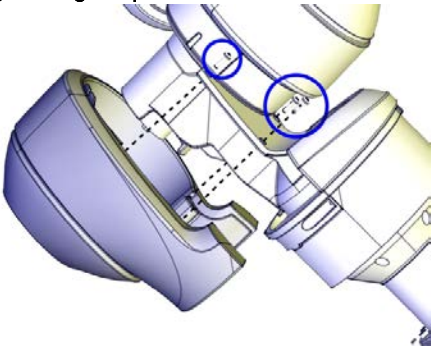
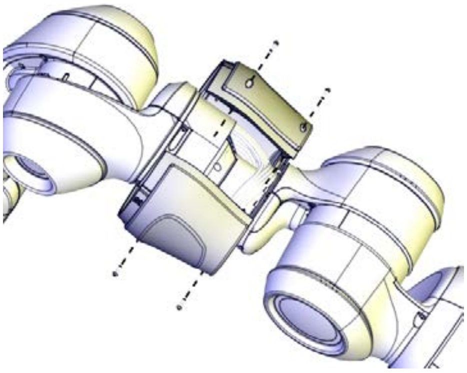
	Action	Note
2	Refit the axis-3 cover. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Screws: 3HAC050367-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1500000459
3	Refit the axis-7 cover.	Screws: 3HAC050367-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002691

Concluding procedure

	Action	Note
1	Recalibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.4.4 Replacing the axis-3 hall sensor

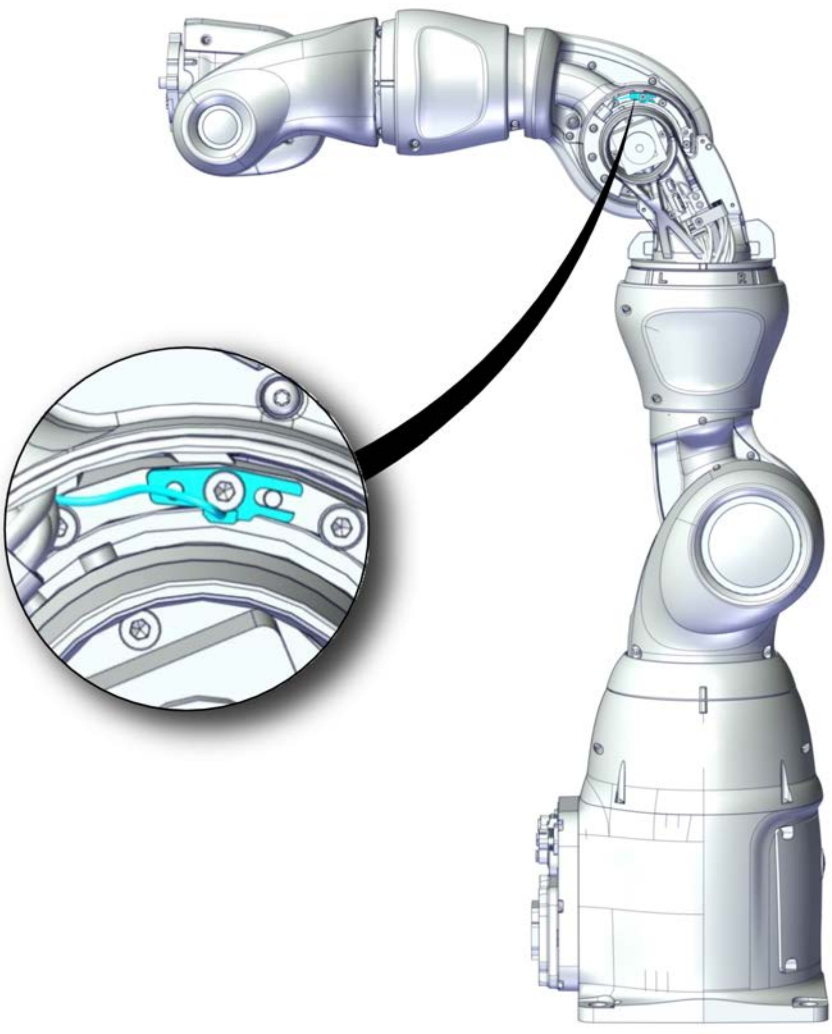
Note

For robots without Absolute Accuracy option, replace the hall sensor by following the instructions specified in this section.

For robots with Absolute Accuracy option, it is recommended to exchange the complete manipulator in case of a broken hall sensor; otherwise, the hall sensor must be replaced by ABB. Contact your local ABB for more information.

Location of the hall sensor

The hall sensor is located as shown in the figure.



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Required spare parts

> **Note**
>
> The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Hall sensor with attachment for axis 3	3HAC052448-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

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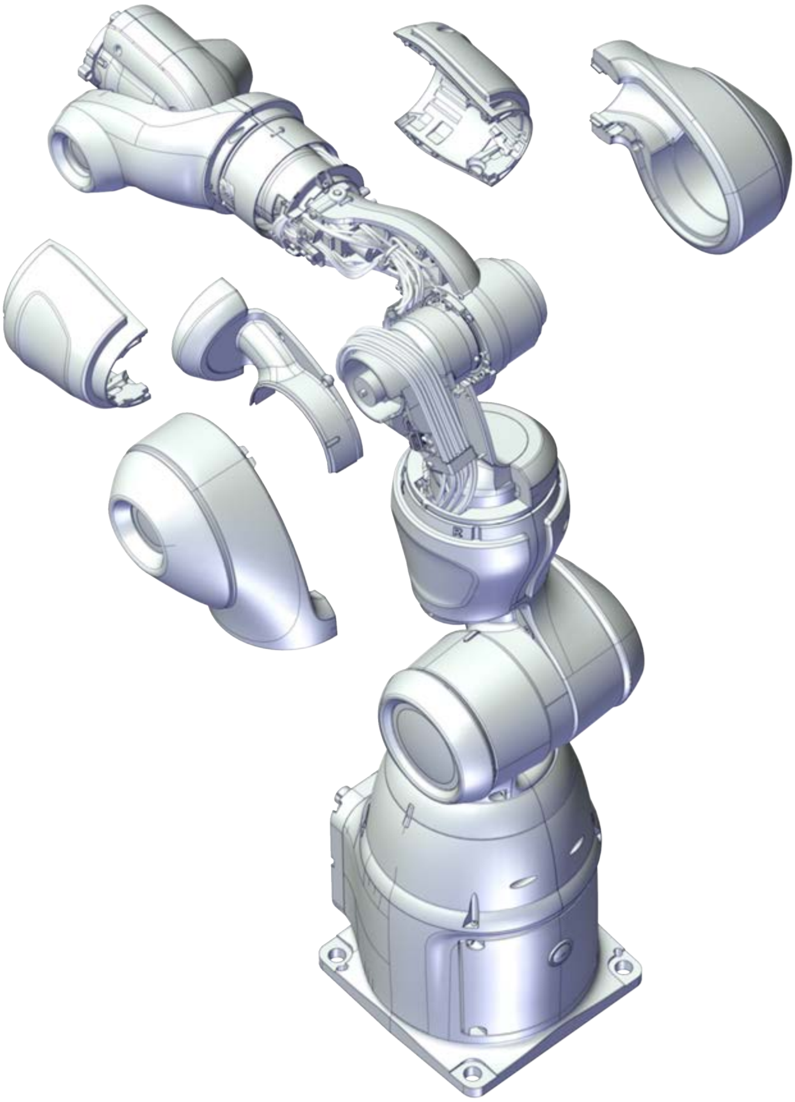
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1900000701

Removing the hall sensor

Use these procedures to remove the hall sensor.

Preparations before removing the hall sensor

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	

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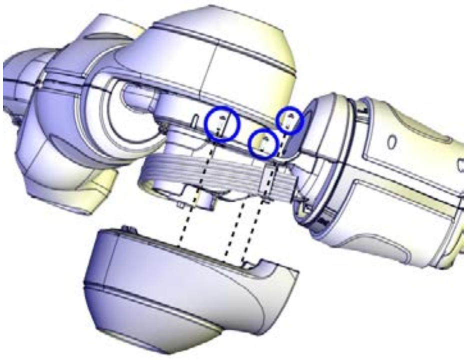
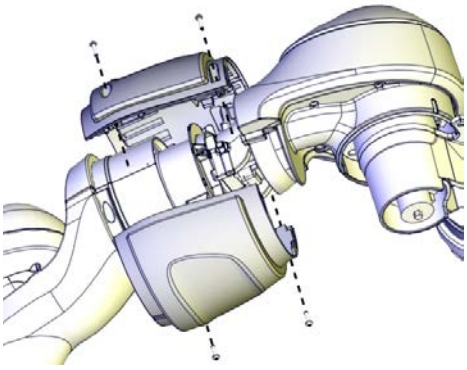
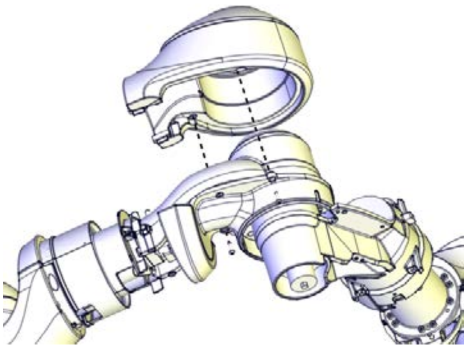
	Action	Note
2	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
3	Remove the axis-3 cover.	 xx1400002751
4	Remove the lower axis-4 cover.	 xx1400002756
5	Remove the axis-3 body cover.	 xx1500000091

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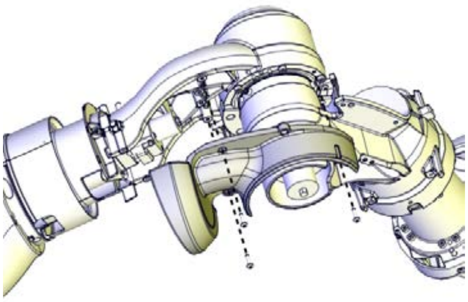
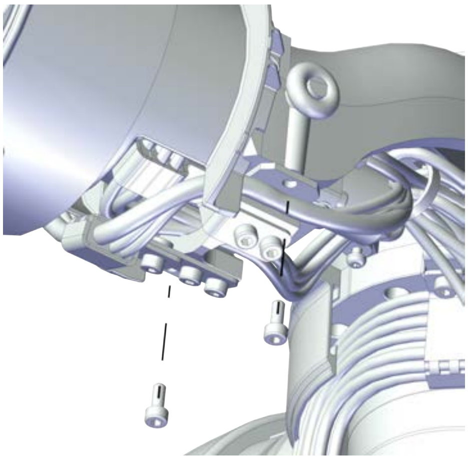
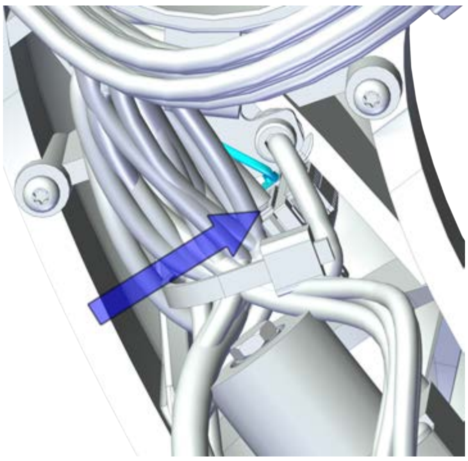
	Action	Note
6	Remove the upper axis-3 cover.	 xx1500000093

Removing the axis-3 hall sensor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	
2	Loosen the cable bracket by removing the screws. This is done in order to access the hall sensor interface board (HSIB).	 xx1900000703
3	Gently pull out the hall sensor interface board (HSIB). Disconnect the hall sensor connector P3.	 xx1900000704

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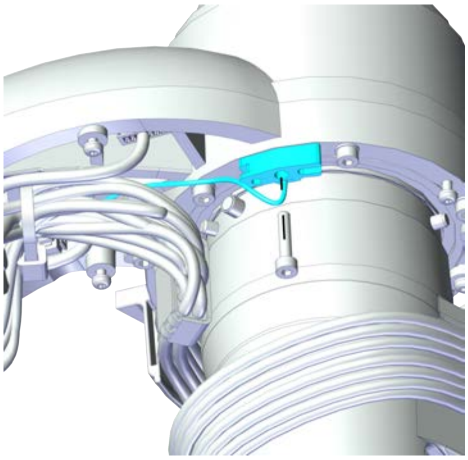
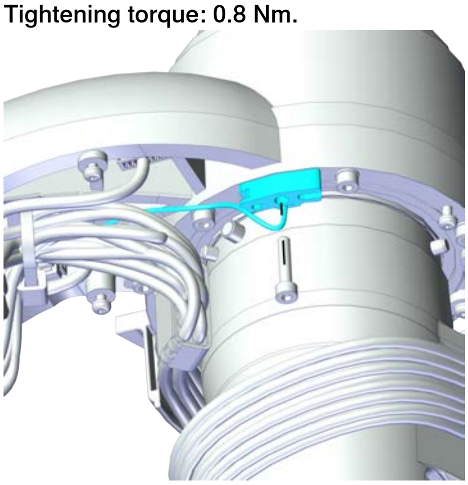
	Action	Note
4	Remove the hall sensor by removing the screw and washer.	 xx1900000705

Refitting the hall sensor

Use these procedures to refit the hall sensor.

Refitting the axis-3 hall sensor

	Action	Note
1	Refit the hall sensor with the screw and washer.	Hall sensor with attachment for axis 3: 3HAC052448-001 Screws: 3HAB3409-241 (1 pcs). Tightening torque: 0.8 Nm.  xx1900000705

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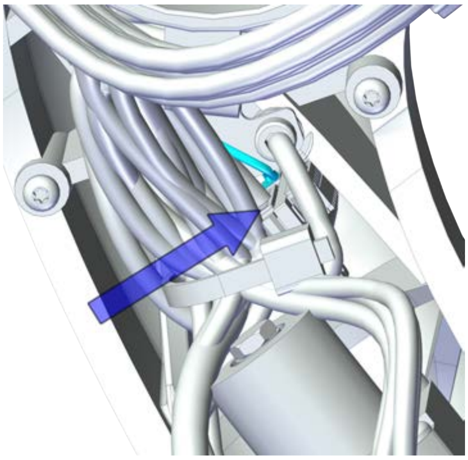
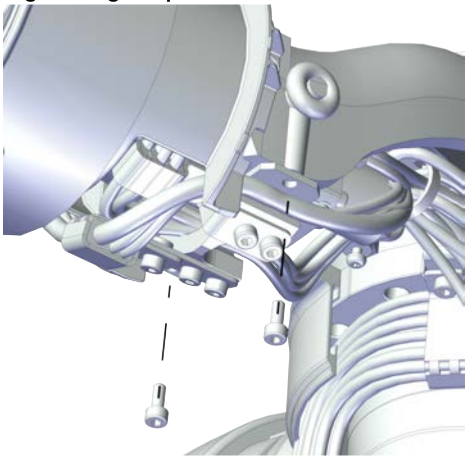
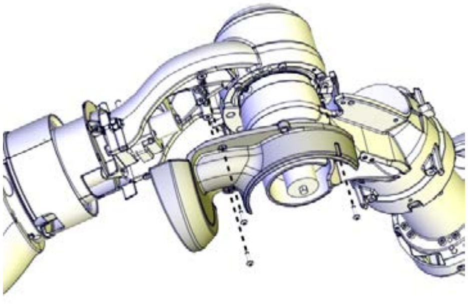
	Action	Note
2	Connect the hall sensor connector P3. Put back the HSIB in place.	 xx1900000704
3	Refit the cable bracket.	Screws: 3HAB3409-233 (2 pcs). Tightening torque: 0.8 Nm.  xx1900000703

Refitting the covers

	Action	Note
1	Refit the upper axis-3 cover.	Screws: 3HAC050367-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1500000093

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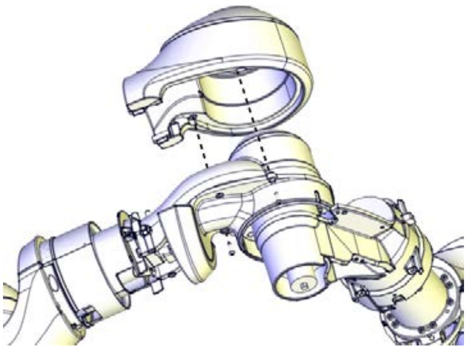
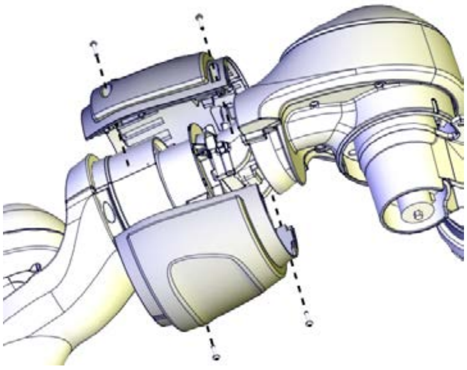
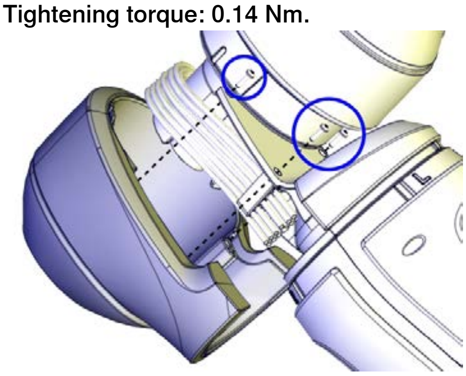
	Action	Note
2	Refit the axis-3 body cover.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1500000091
3	Refit the lower axis-4 cover.	Screws: 3HAC050367-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002756
4	Refit the axis-3 cover. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Screws: 3HAC050367-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1400002753

Concluding procedure

	Action	Note
1	Recalibrate the robot.	See *Calibration on page 329*.

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	Action	Note
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.4.5 Replacing the axis-4 hall sensor

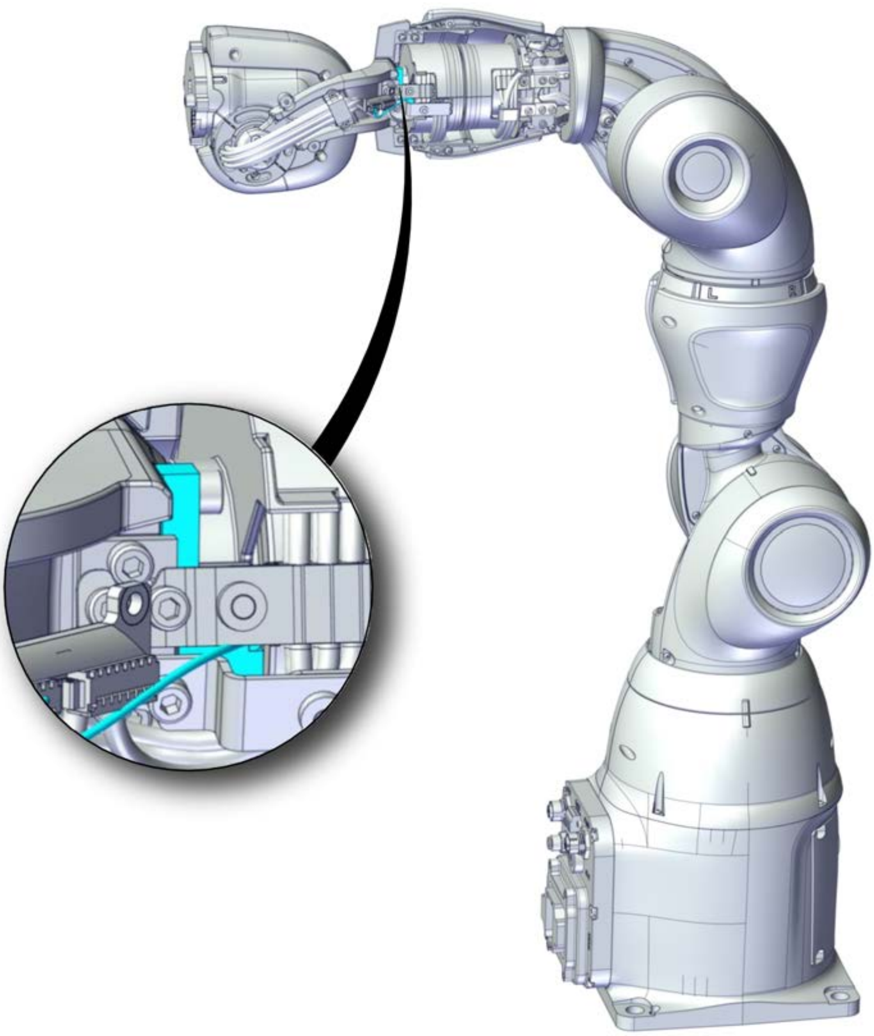
Note

For robots without Absolute Accuracy option, replace the hall sensor by following the instructions specified in this section.

For robots with Absolute Accuracy option, it is recommended to exchange the complete manipulator in case of a broken hall sensor; otherwise, the hall sensor must be replaced by ABB. Contact your local ABB for more information.

Location of the hall sensor

The hall sensor is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Hall sensor with attachment for axis 4	3HAC052450-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

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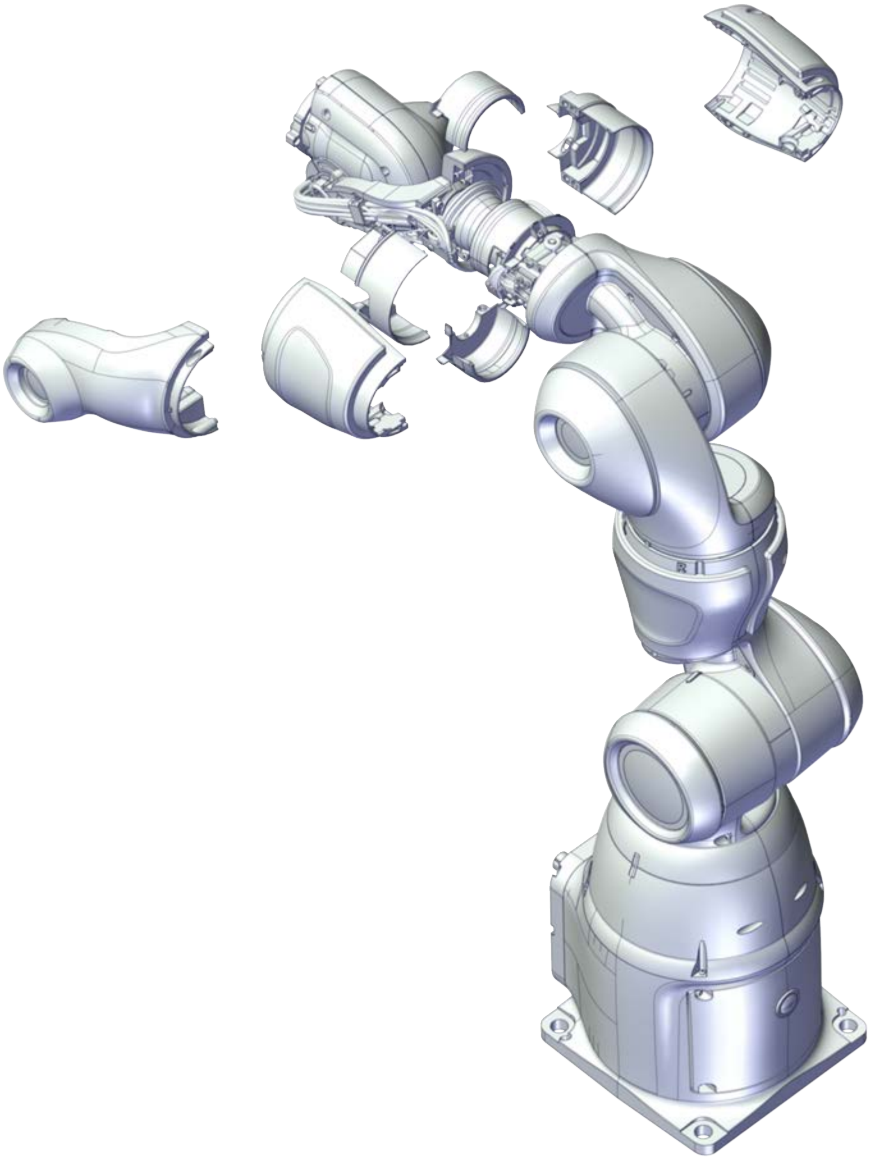
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1900000702

Removing the hall sensor

Use these procedures to remove the hall sensor.

Preparations before removing the hall sensor

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	

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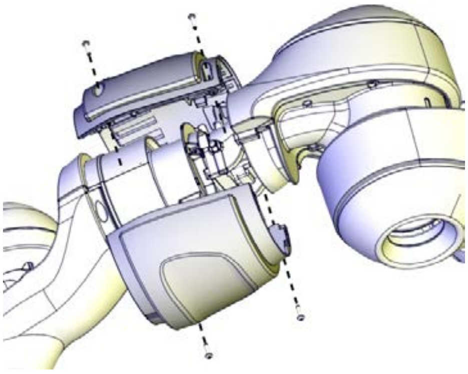
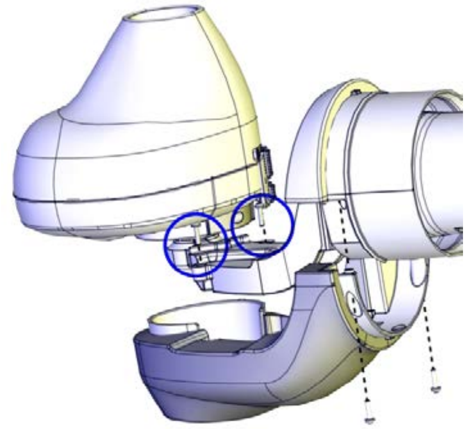
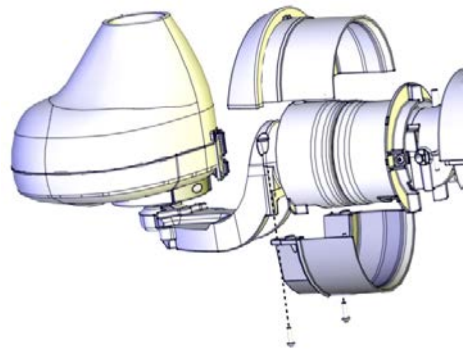
	Action	Note
2	**DANGER** Turn off all: • electric power supply • air pressure supply to the robot, before starting the repair work on the robot.	
3	Remove the lower axis-4 cover.	 xx1500000360
4	Remove the upper axis-4 cover.	 xx1500000095
5	Remove the outer axis-4 cable protection.	 xx1500000496

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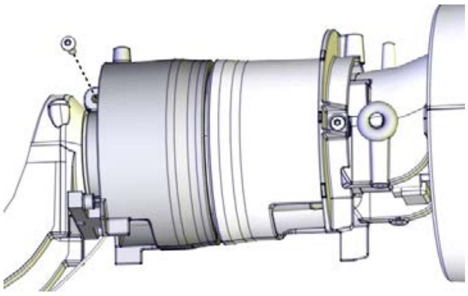
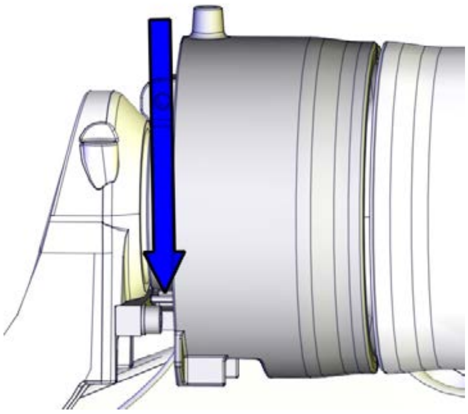
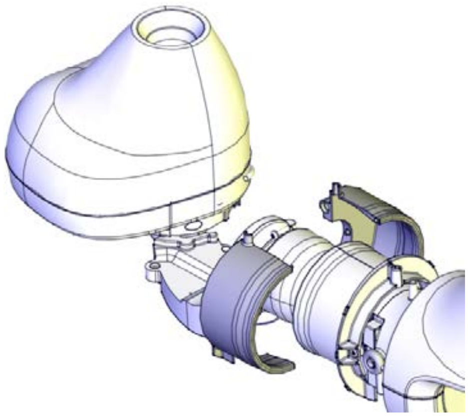
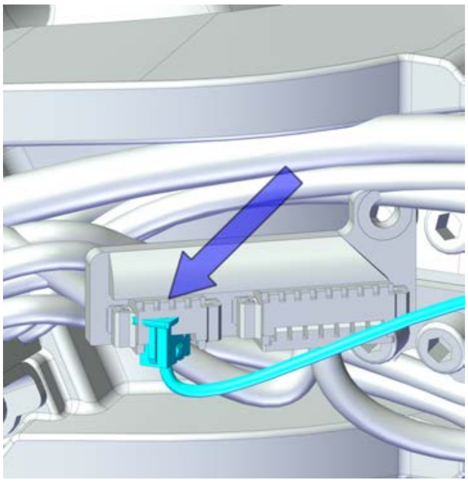
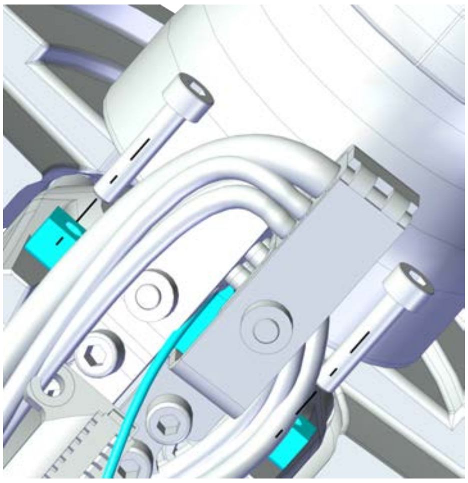
	Action	Note
6	Remove the screw that fastens the halves of the inner axis-4 cable protection together.	 xx1500000560
7	Release the latch that holds the two halves together by pressing the latch down with a screwdriver or similar. Remove the protection.	 xx1500000562  xx1500000497

Removing the axis-4 hall sensor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

Continues on next page

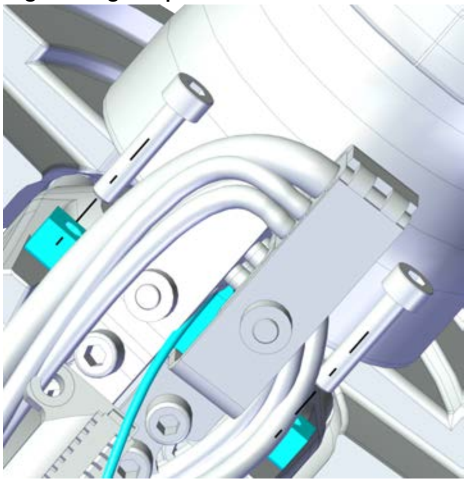
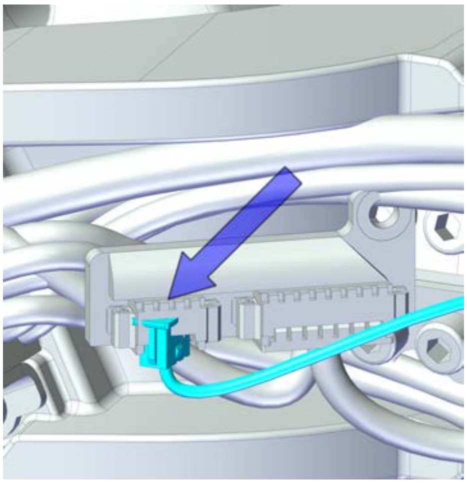
	Action	Note
2	Gently pull out the hall sensor interface board (HSIB). Disconnect the hall sensor connector P3.	 xx1900000706
3	Remove the hall sensor by removing the screws and washers.	 xx1900000707

Continues on next page

Refitting the hall sensor

Use these procedures to refit the hall sensor.

Refitting the axis-4 hall sensor

	Action	Note
1	Refit the hall sensor with the screws and washers.	Hall sensor with attachment for axis 4: 3HAC052450-001 Screws: 3HAB3409-241 (2 pcs). Tightening torque: 0.4 Nm.  xx1900000707
2	Connect the hall sensor connector P3.	 xx1900000706
3	Put back the hall sensor interface board (HSIB) in place.	

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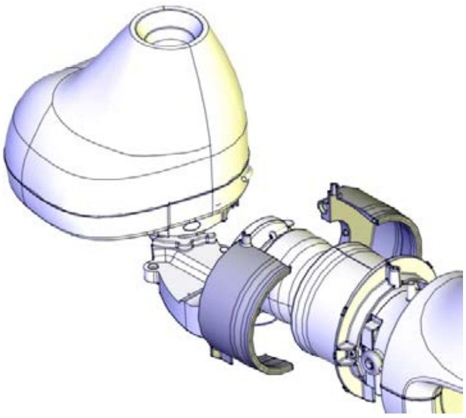
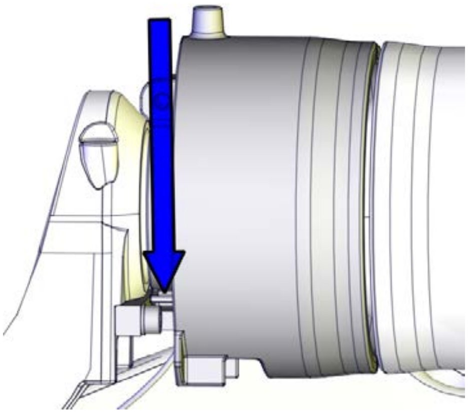
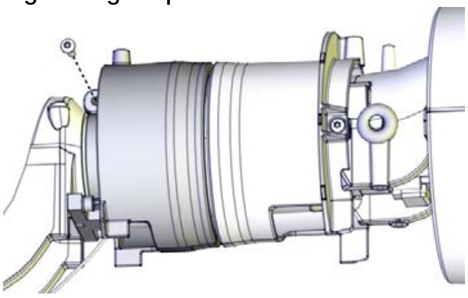
Refitting the covers

	Action	Note
1	Put the two halves of the inner axis-4 cable protection together around the axis and lock them with the latch.	 xx1500000497  xx1500000562
2	Refit the screw that fastens the halves of the inner axis-4 cable protection together.	Screws: 3HAC050367-005 (1 pcs). Tightening torque: 0.14 Nm.  xx1500000560

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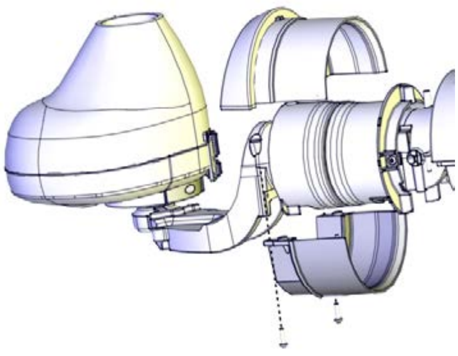
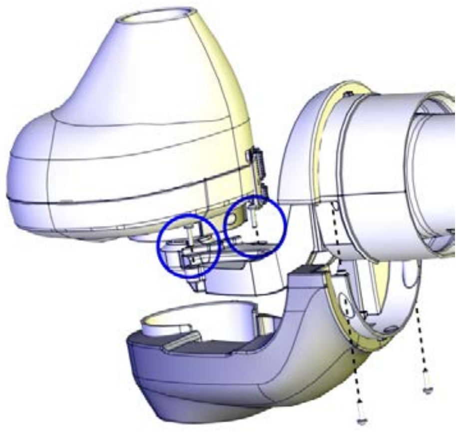
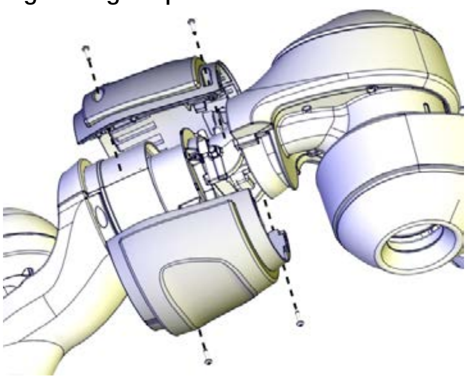
	Action	Note
3	Refit the outer axis-4 cable protection.	Screws: 3HAC050367-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1500000496
4	Refit the upper axis-4 cover.	Screws: 3HAC050367-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1500000095
5	Refit the lower axis-4 cover.	Screws: 3HAC050367-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1500000360

Concluding procedure

	Action	Note
1	Recalibrate the robot.	See *Calibration on page 329*.

Continues on next page

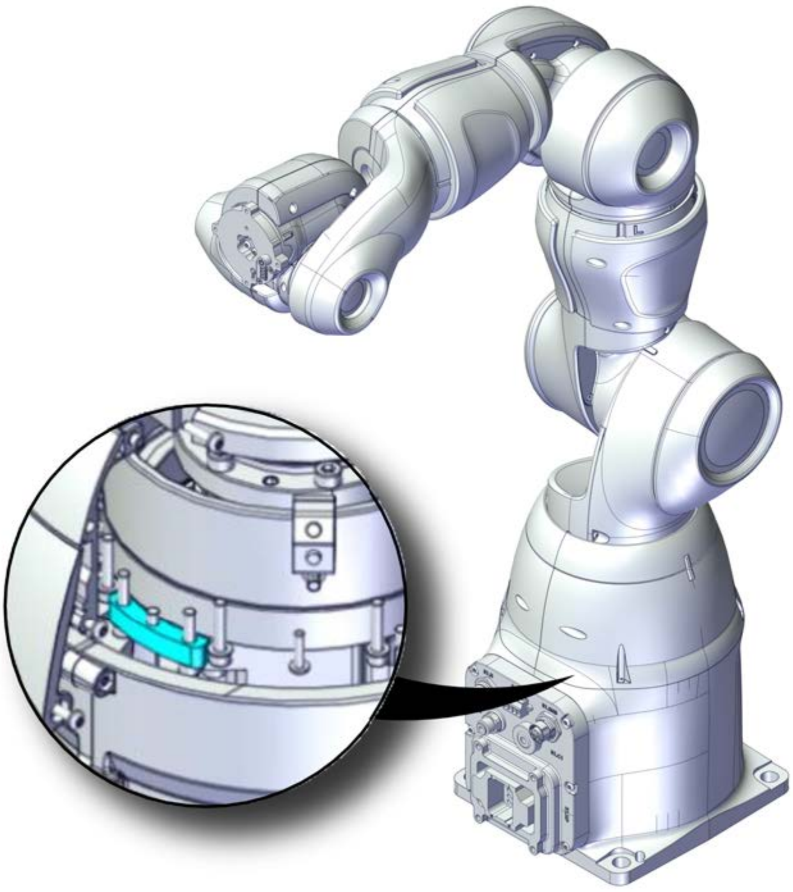
	Action	Note
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.5 Mechanical stops

4.5.1 Replacing the axis-1 mechanical stop

Location of the mechanical stop

The mechanical stop is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Mechanical stop for axis 1	3HAC047602-001	
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Torx pan head screw	3HAC050367-005	M3x12 8.8 Gleitmo 605
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9

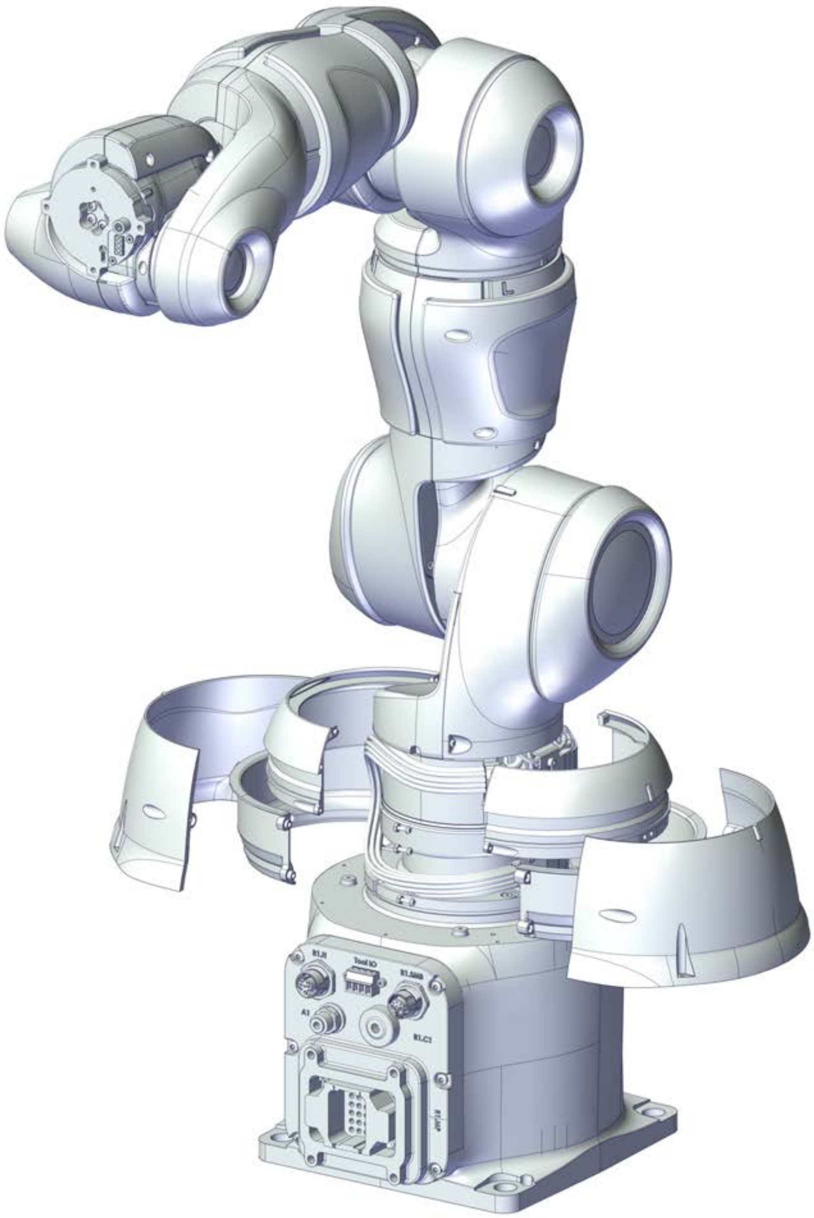
Continues on next page

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1800001247

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Removing the mechanical stop

Use these procedures to remove the mechanical stop.

Preparations before removing the mechanical stop

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Removing the axis-1 covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and air pressure are turned off.	

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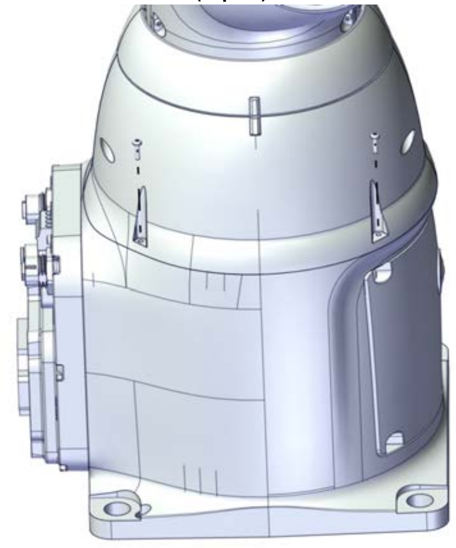
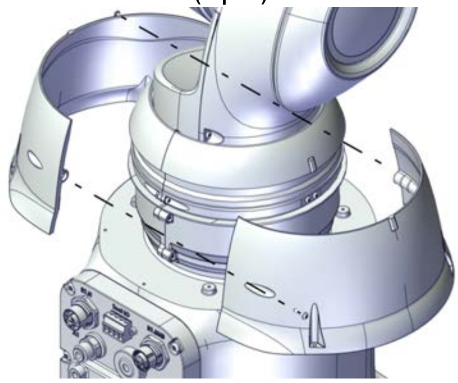
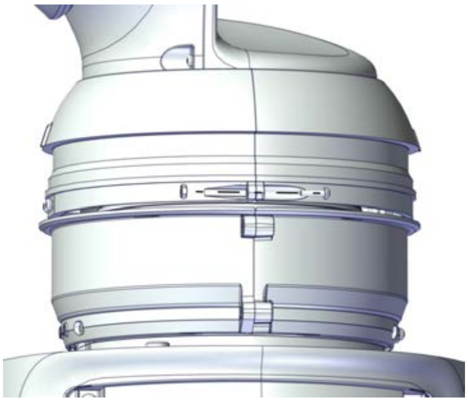
	Action	Note
2	Remove the outer axis 1 cover screws.	Screws:M2x8 8.8 (4 pcs).  xx1800001240 Screws:M2x8 8.8 (2 pcs).  xx1800001241
3	Remove the upper axis-1 cover. **Note** Be aware of the tab underneath the cover so it does not get damaged.	Screws:M2x8 8.8 (2 pcs).  xx1800001242

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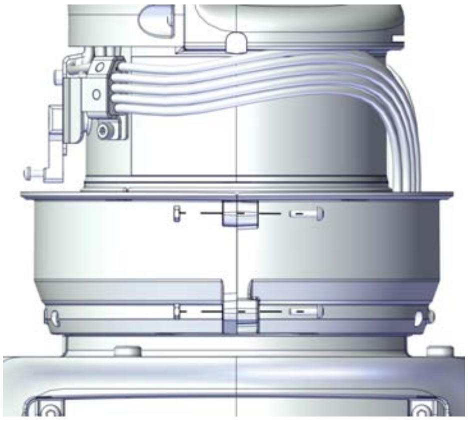
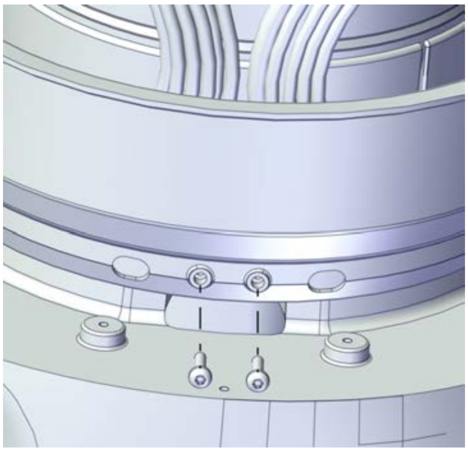
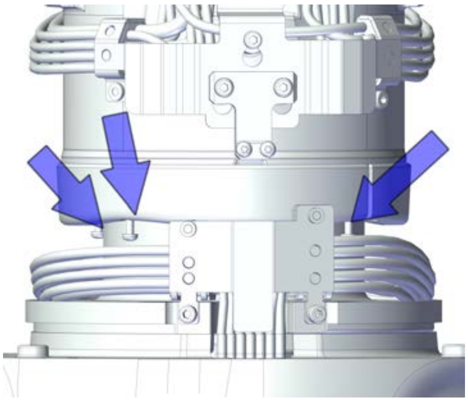
	Action	Note
4	Turn the lower axis-1 cover in order to access all screws properly and remove the lower axis-1 cover.	Screws:M2x8 8.8 (4 pcs).  xx1800001243  xx1800001252

Removing the remaining covers

	Action	Note
1	Remove the axis-1 cable protection.  **Tip** In order to access the screws it is helpful to release the brakes and manually move the robot arm. Temporarily turn on the power to the robot and release the brakes.	Screws:3HAC050368-005 (6 pcs).  xx1800001245

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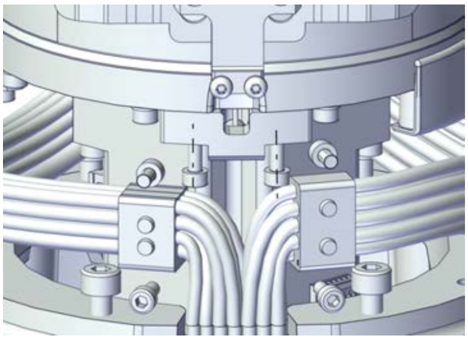
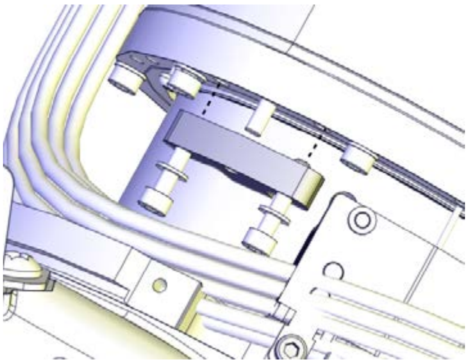
Removing the axis-1 mechanical stop

	Action	Note
1	Turn on the power to the robot temporarily.	
2	Release the brakes and rotate axis 1 in order to access the mechanical stop.	 xx1800001246
3	**DANGER** Turn off the electric power supply again.	
4	Remove the mechanical stop by removing the two screws and washers.	 xx1500000738

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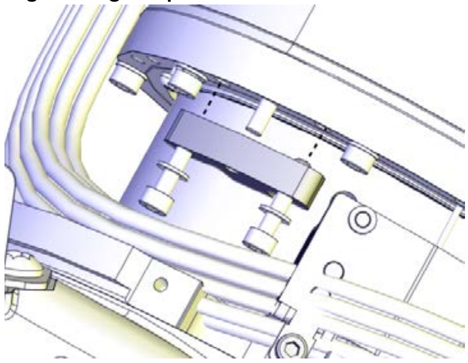
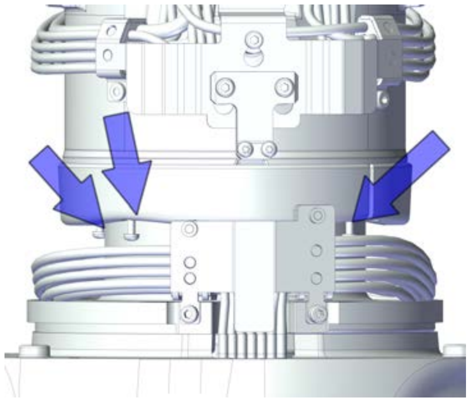
Refitting the mechanical stop

Use these procedures to refit the mechanical stop.

Refitting the axis-1 mechanical stop

	Action	Note
1	Refit the mechanical stop with the screws and washers.	Mechanical stop for axis 1: 3HAC047602-001 Screws: 3HAB3409-241 (2 pcs). Tightening torque: 0.4 Nm.  xx1500000738

Refitting the covers

	Action	Note
1	Refit the axis-1 cable protection. **Tip** In order to access the screws it is helpful to release the brakes and manually move the robot arm. Temporarily turn on the power to the robot and release the brakes.	Screws: 3HAC050367-005 (6 pcs). Tightening torque: 0.14 Nm.  xx1800001245

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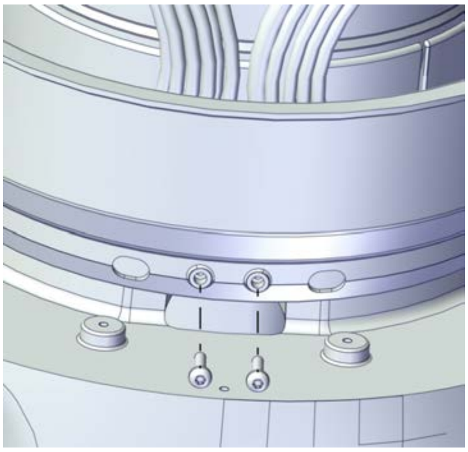
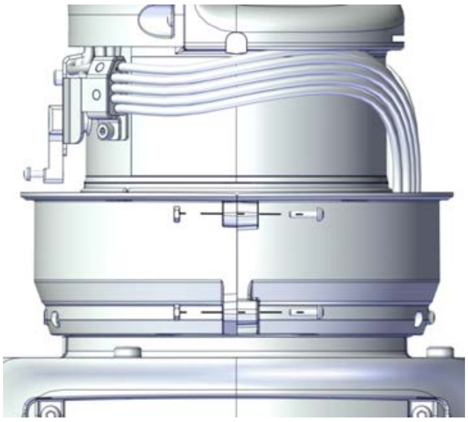
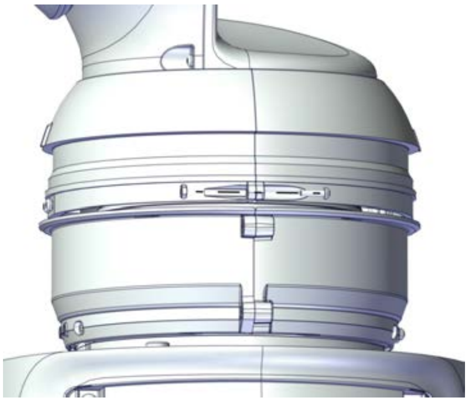
Refitting the axis-1 covers

	Action	Note
1	Refit the lower axis-1 cover.	Screws: 3HAC050368-005 (4 pcs). Nuts: 9ADA267-1 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001252  xx1800001243
2	Refit the upper axis-1 cover.	Screws: 3HAC050368-005 (2 pcs). Nuts: 9ADA267-1 (2 pcs). Tightening torque: 0.14 Nm.  xx1800001242

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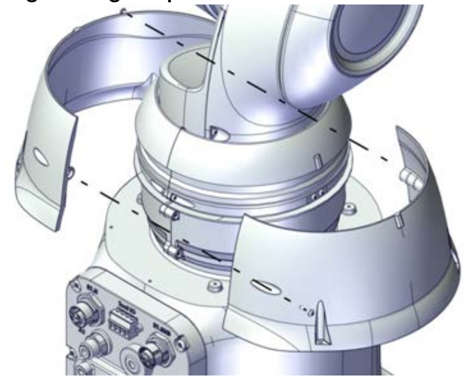
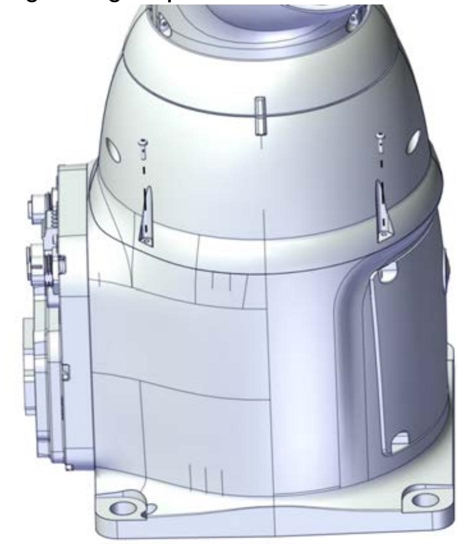
	Action	Note
3	Refit the outer axis-1 padding.	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1800001241 Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001240

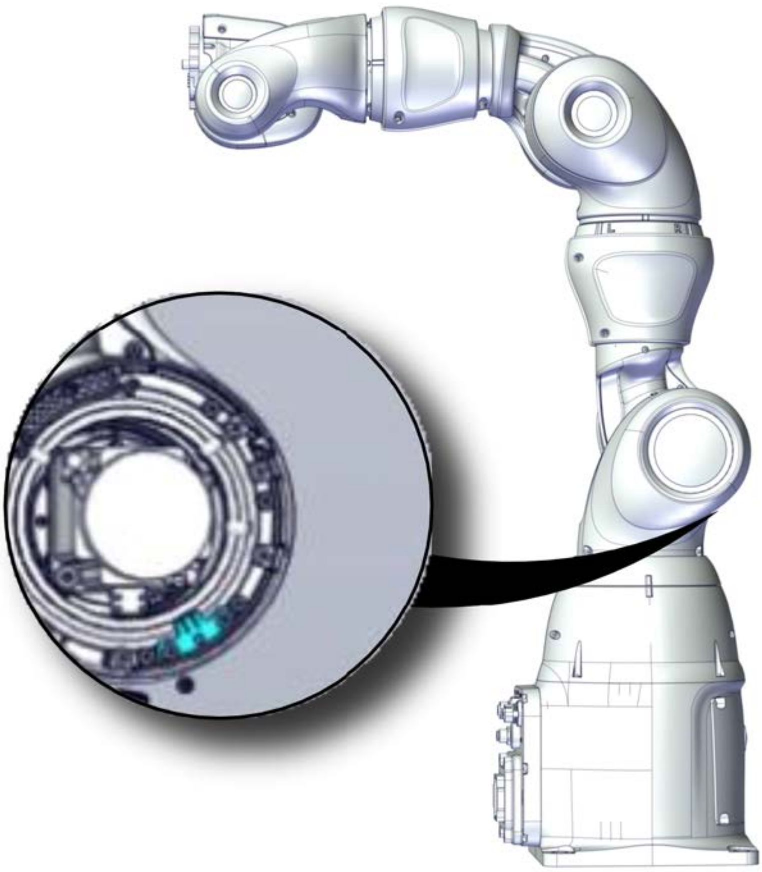
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.5.2 Replacing the axis-2 mechanical stop

Location of the mechanical stop

The mechanical stop is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Mechanical stop for axis 2	3HAC047602-001	
Hex socket head cap screw	3HAC050368-005	M2x8 8.8
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9

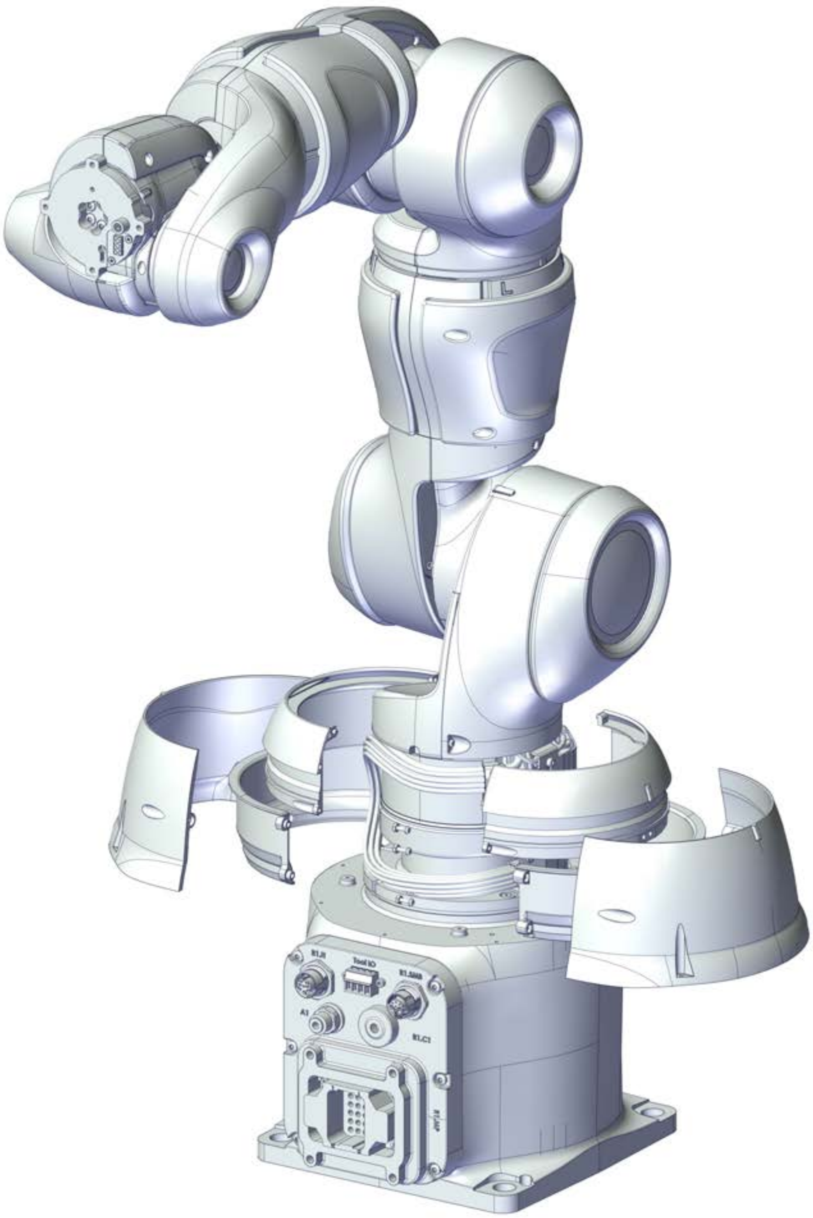
Continues on next page

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1800001247

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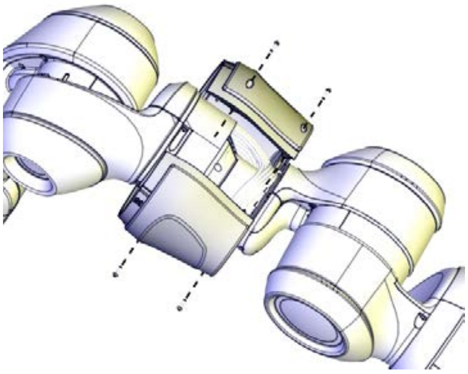
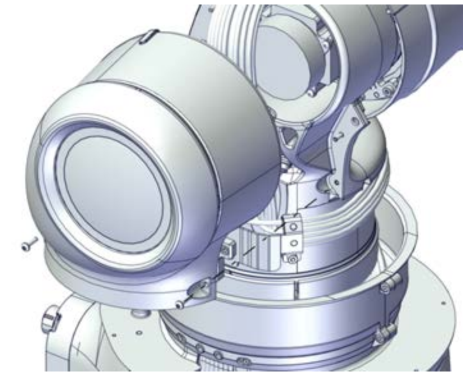
Removing the mechanical stop

Use these procedures to remove the mechanical stop.

Preparations before removing the mechanical stop

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
3	Remove the axis-7 cover.	 xx1400002691
4	Remove the lower axis-2 cover.	 xx1800001248

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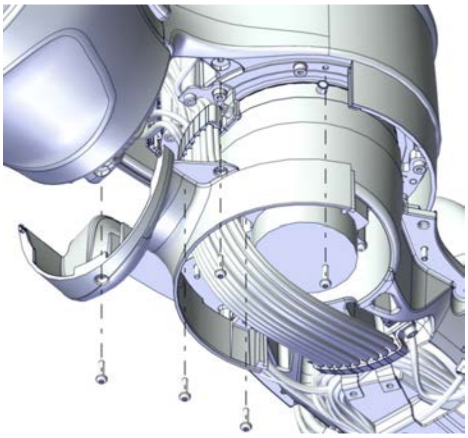
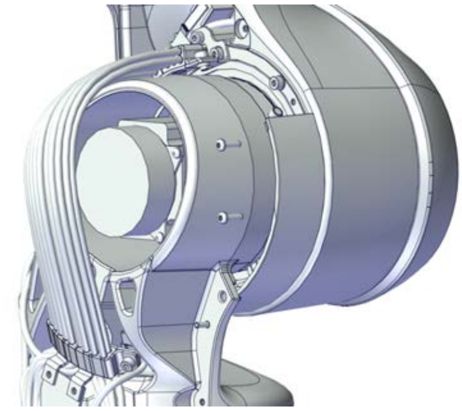
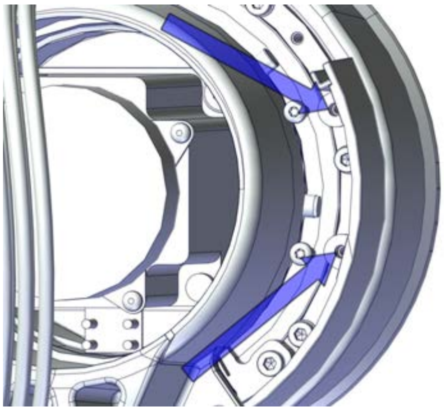
	Action	Note
5	Remove the axis-2 cable cover.	 xx1800001255

Removing the axis-2 cable collar

	Action	Note
1	Remove the two accessible screws of the axis-2 cable collar.	 xx1800001256
2	Turn on the power to the robot temporarily.	
3	Release the brakes and rotate axis 2 in order to access the two remaining axis-2 cable collar screws.	 xx1800001257
4	**DANGER** Turn off the electric power supply again.	

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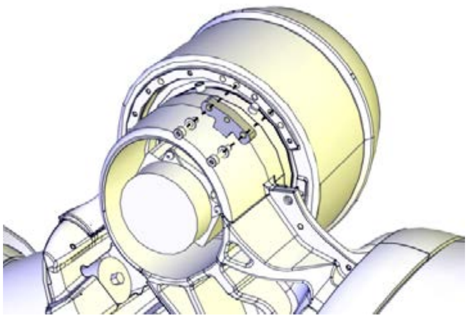
	Action	Note
5	Remove the two screws and remove the cable collar.	

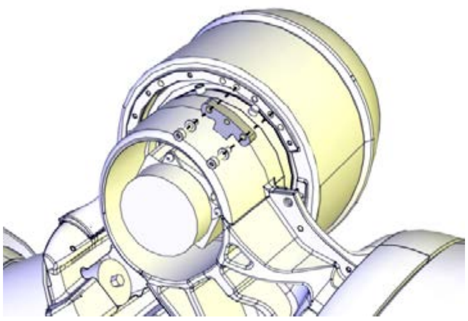
Removing the axis-2 mechanical stop

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Remove the mechanical stop by removing the two screws and washers.	 xx1500000488

Refitting the mechanical stop

Use these procedures to refit the mechanical stop.

Refitting the axis-2 mechanical stop

	Action	Note
1	Refit the mechanical stop with the screws and washers.	Mechanical stop for axis 2: 3HAC047602-001 Screws: 3HAB3409-241 (2 pcs). Tightening torque: 0.4 Nm.  xx1500000488

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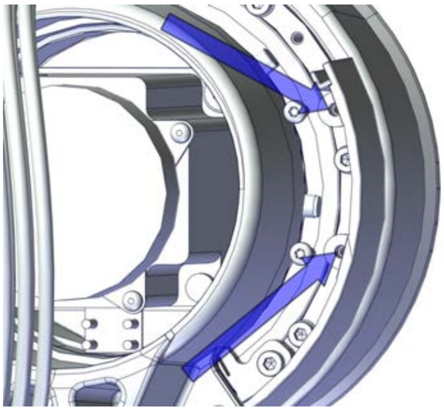
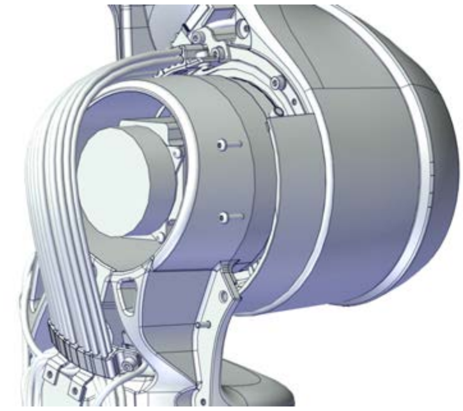
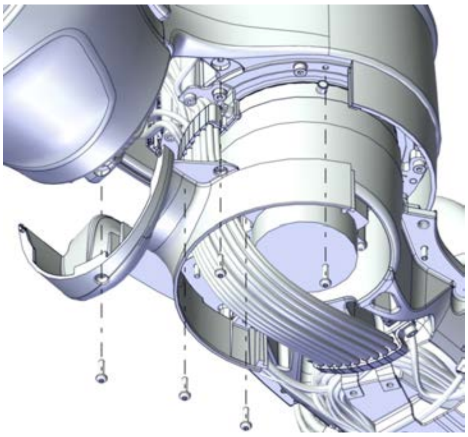
Refitting the axis-2 cable collar

	Action	Note
1	Refit the cable collar with the screws. **Tip** In order to access the screws it is helpful to release the brakes and manually move the robot arm. Temporarily turn on the power to the robot and release the brakes.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001257  xx1800001256

Refitting the covers

	Action	Note
1	Refit the axis-2 cable cover.	Screws: 3HAC050368-005 (5 pcs). Tightening torque: 0.14 Nm.  xx1800001255

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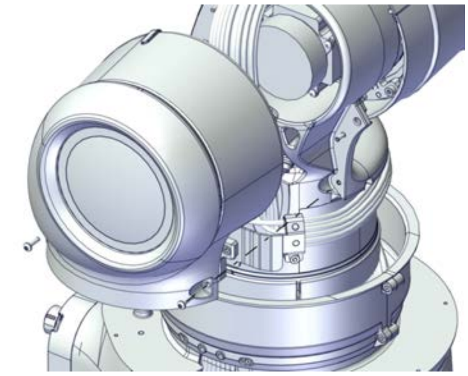
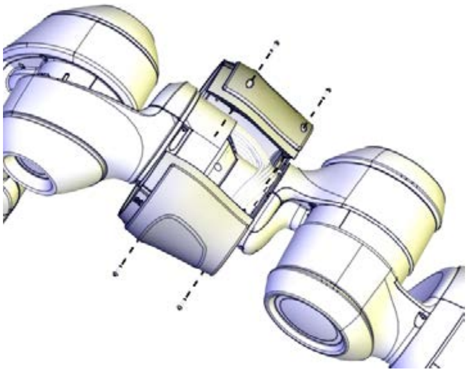
	Action	Note
2	Refit the lower axis-2 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1800001248
3	Refit the axis-7 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002691

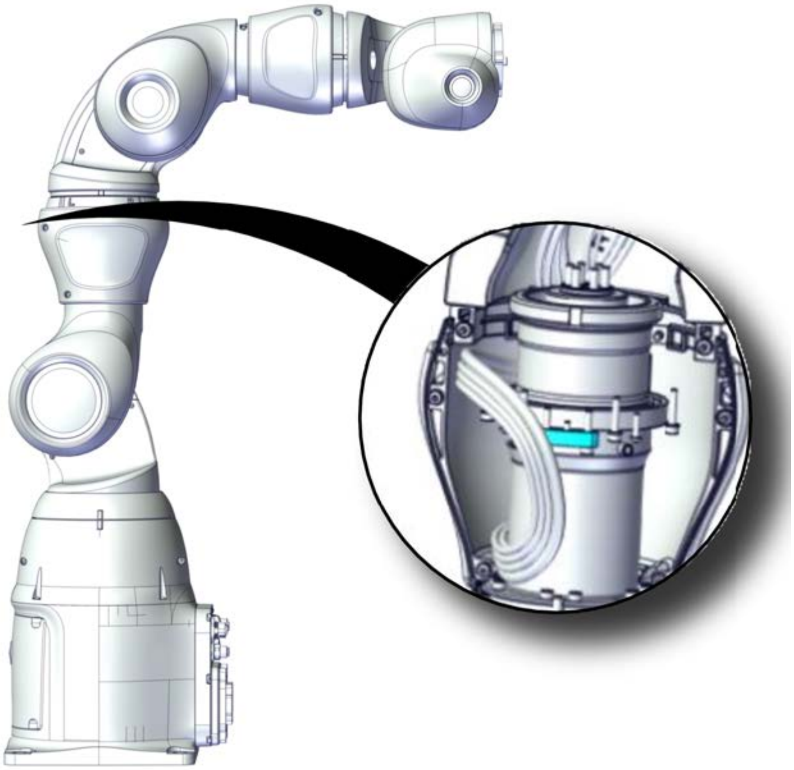
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.5.3 Replacing the axis-7 mechanical stop

Location of the mechanical stop

The mechanical stop is located as shown in the figure.



xx1800001238

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Mechanical stop for axis 7	3HAC047603-001	
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAC050368-005	M2x8 8.8

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

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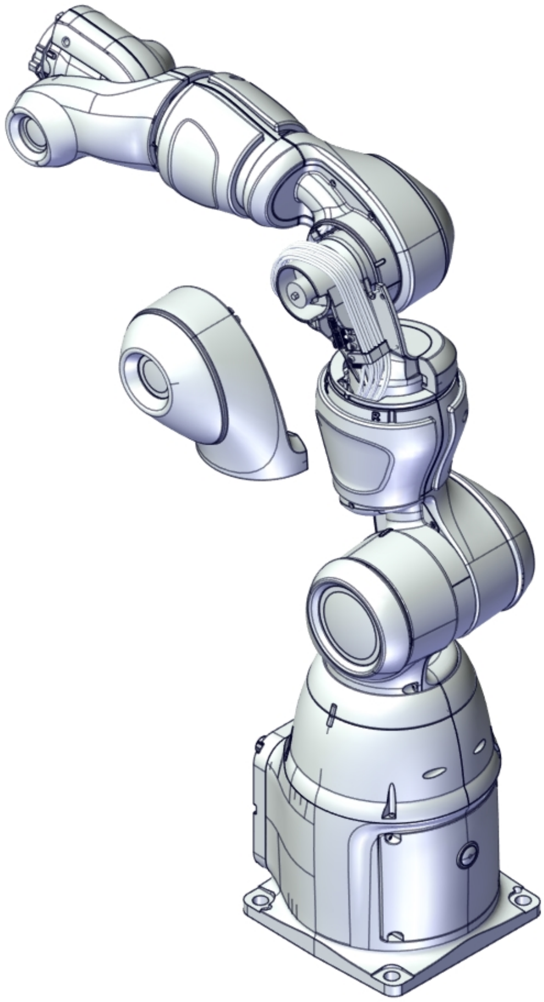
Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1800001258

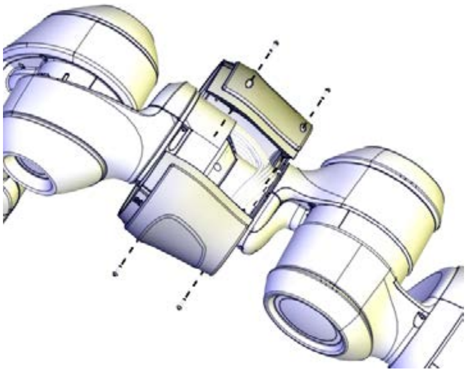
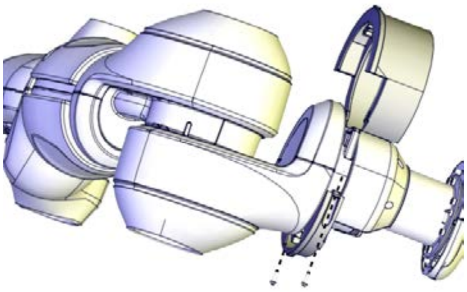
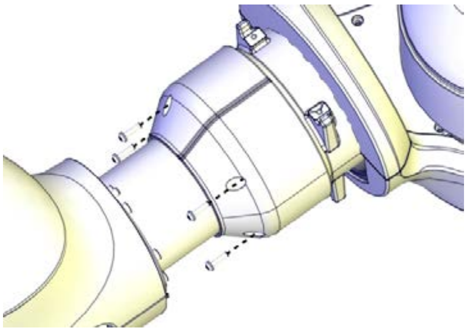
Removing the mechanical stop

Use these procedures to remove the mechanical stop.

Preparations before removing the mechanical stop

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

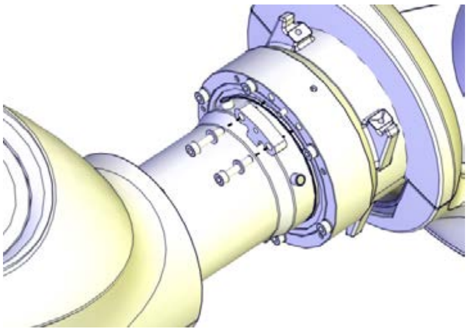
Continues on next page

	Action	Note
3	Remove the axis-7 cover.	 xx1400002691
4	Remove the axis-7 ring (two parts).	 xx1500000742
5	Remove the axis-7 inner cable protection.	 xx1500000743

Removing the axis-7 mechanical stop

	Action	Note
1	 **DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

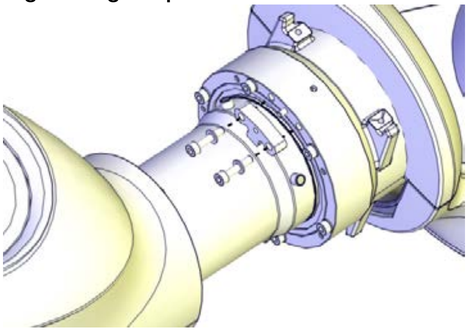
Continues on next page

	Action	Note
2	Remove the mechanical stop by removing the two screws and washers.	 xx1500000747

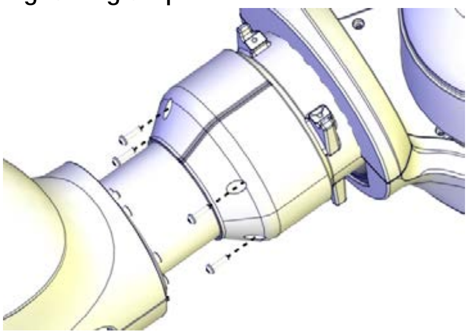
Refitting the mechanical stop

Use these procedures to refit the mechanical stop.

Refitting the axis-7 mechanical stop

	Action	Note
1	Refit the mechanical stop with the screws and washers.	Mechanical stop for axis 7: 3HAC047603-001 Screws: 3HAB3409-241 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000747

Refitting the covers

	Action	Note
1	Refit the axis-7 inner cable protection.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1500000743

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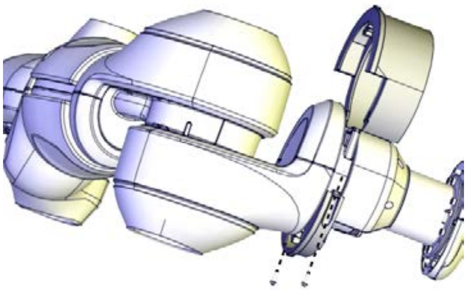
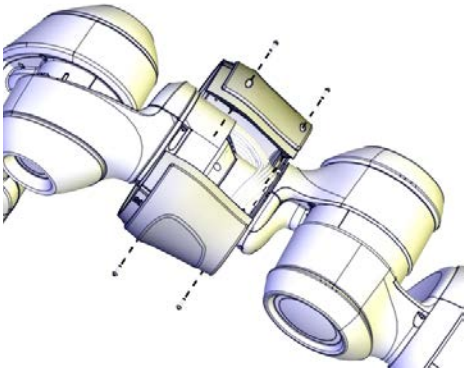
	Action	Note
2	Refit the axis-7 ring (two parts).	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1500000742
3	Refit the axis-7 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002691

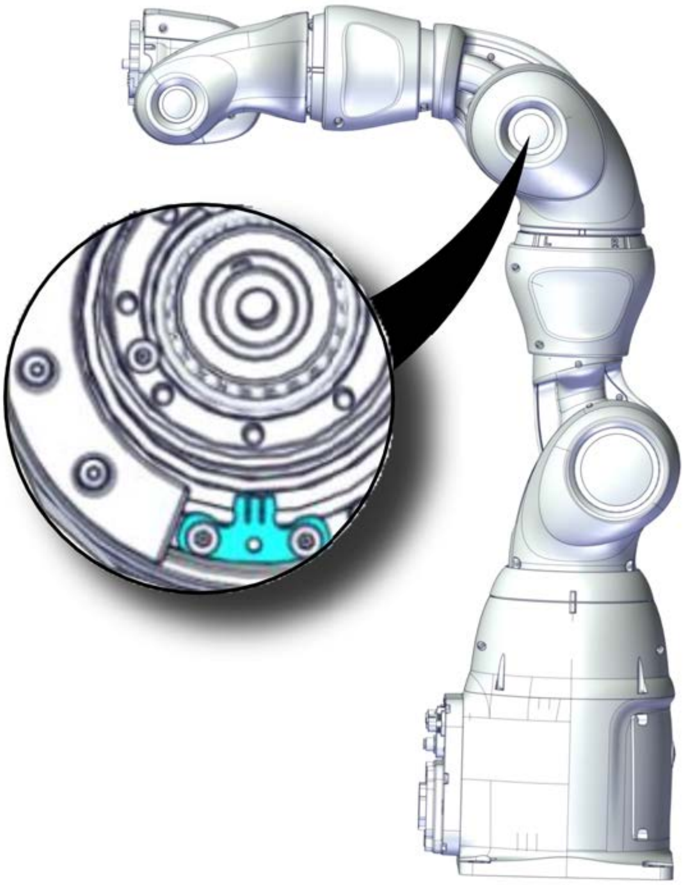
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.5.4 Replacing the axis-3 mechanical stop

Location of the mechanical stop

The mechanical stop is located as shown in the figure.



xx1800001239

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Mechanical stop for axis 3	3HAC047603-001	
Hex socket head cap screw	3HAB3409-241	M2.5x12 12.9 Lafre 2C2B/FC6.9
Hex socket head cap screw	3HAC050368-005	M2x8 8.8

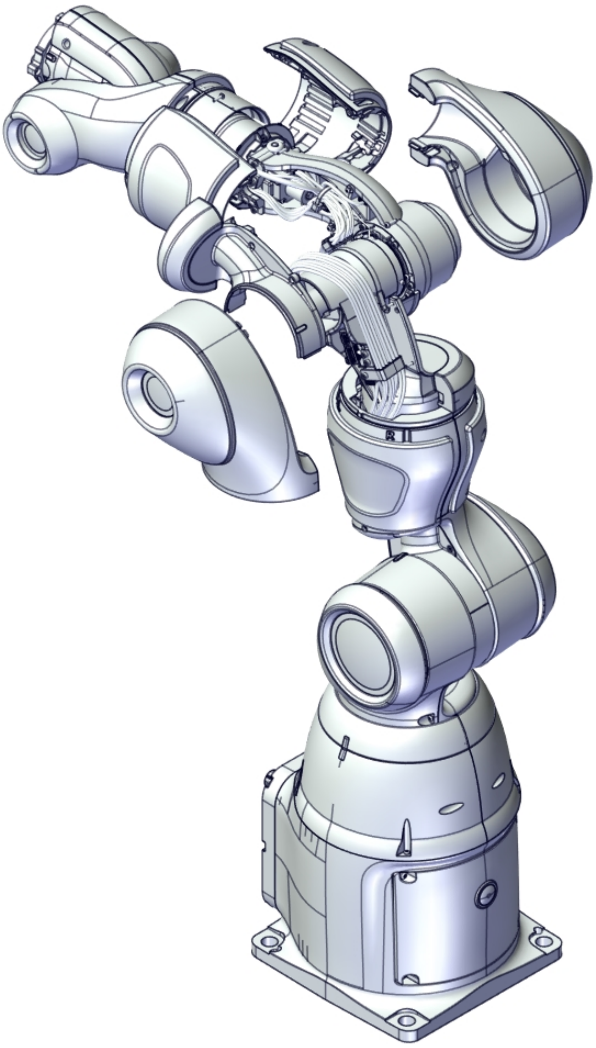
Continues on next page

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Covers to be removed for access

This figure shows an overview of which covers to remove to get access to the spare part. Detailed instructions of how to remove the covers are found in the removal procedure.



xx1800001259

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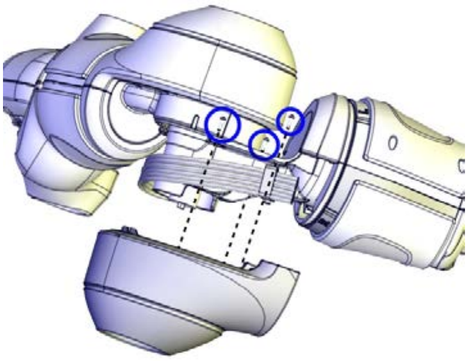
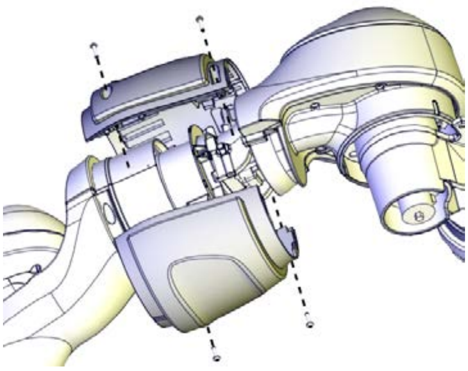
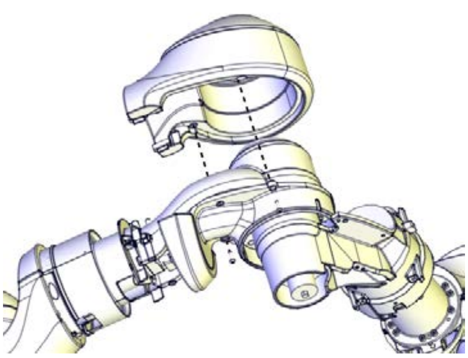
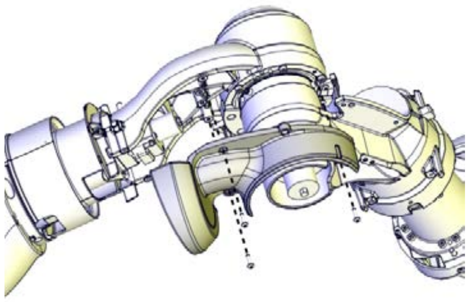
Removing the mechanical stop

Use these procedures to remove the mechanical stop.

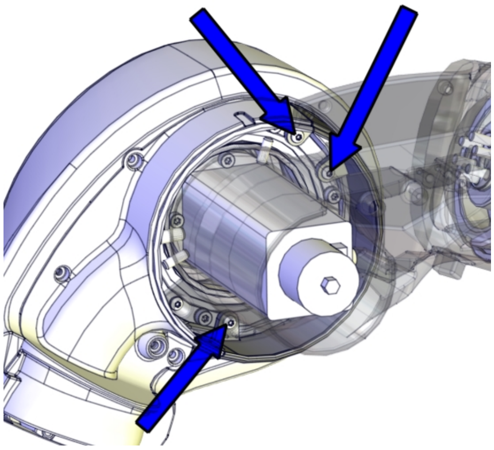
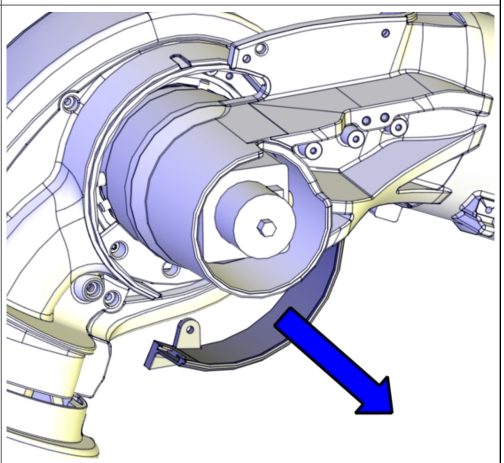
Preparations before removing the mechanical stop

	Action	Note
1	Jog the robot so that the covers can be easily accessed and removed.	
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
3	Remove the axis-3 cover.	 xx1400002751
4	Remove the lower axis-4 cover.	 xx1400002756
5	Remove the axis-3 body cover.	 xx1500000091

Continues on next page

	Action	Note
6	Remove the upper axis-3 cover.	 xx1500000093

Removing the axis-3 cable collar

	Action	Note
1	Turn on the power to the robot temporarily.	
2	Release the brakes and rotate axis 3 in order to access the axis-3 cable collar screws.	 xx1500000489
3	**DANGER** Turn off the electric power supply again.	
4	Remove the screws and remove the cable collar.	 xx1500000756

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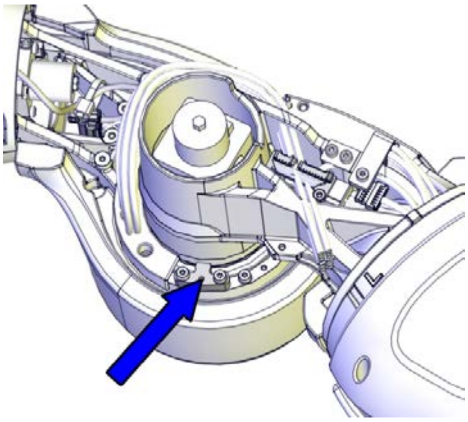
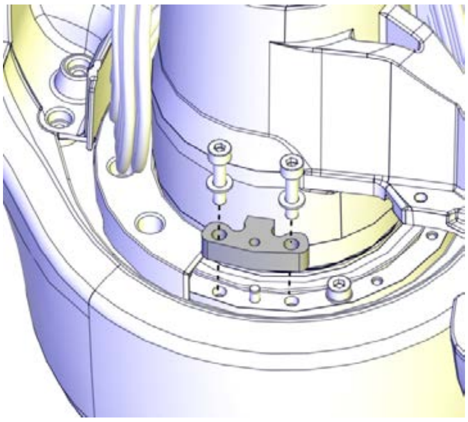
Removing the axis-3 mechanical stop

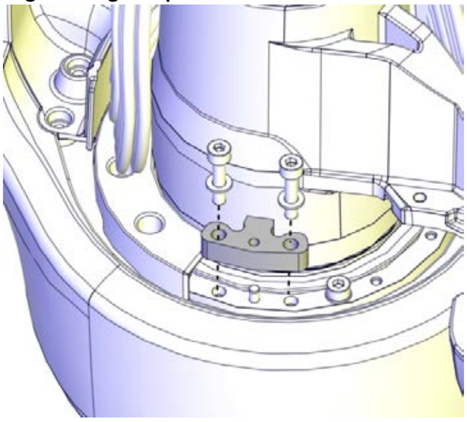
	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	Turn on the power to the robot temporarily.	
3	Release the brakes and rotate axis 3 in order to access the axis-3 mechanical stop.	 xx1500000755
4	**DANGER** Turn off the electric power supply again.	
5	Remove the mechanical stop by removing the two screws and washers.	 xx1500000753

Continues on next page

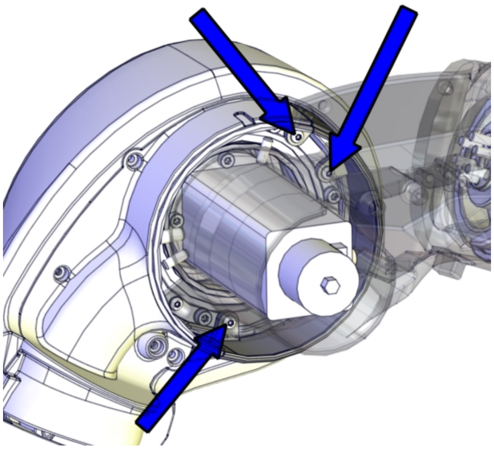
Refitting the mechanical stop

Use these procedures to refit the mechanical stop.

Refitting the axis-3 mechanical stop

	Action	Note
1	Refit the mechanical stop with the screws and washers.	Mechanical stop for axis 3: 3HAC047603-001 Screws: 3HAB3409-241 (2 pcs). Tightening torque: 0.2 Nm.  xx1500000753

Refitting the axis-3 cable collar

	Action	Note
1	Refit the cable collar.  **Tip** In order to access the screws it is helpful to release the brakes and manually move the robot arm. Temporarily turn on the power to the robot and release the brakes.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1500000489

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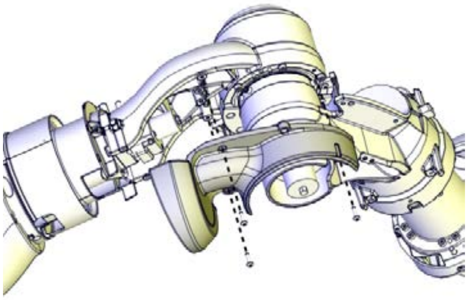
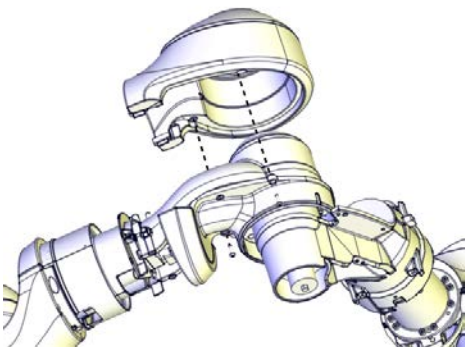
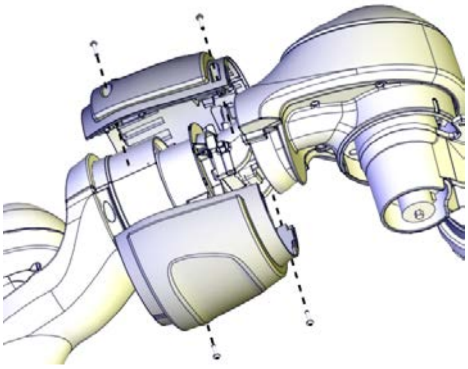
Refitting the covers

	Action	Note
1	Refit the upper axis-3 cover.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1500000093
2	Refit the axis-3 body cover.	Screws: 3HAC050368-005 (2 pcs). Tightening torque: 0.14 Nm.  xx1500000091
3	Remove the lower axis-4 cover.	Screws: 3HAC050368-005 (4 pcs). Tightening torque: 0.14 Nm.  xx1400002756

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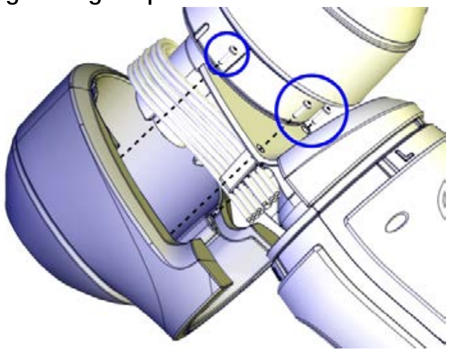
	Action	Note
4	Refit the axis-3 cover. **CAUTION** Be careful not to squeeze any cabling during the refitting procedure.	Screws: 3HAC050368-005 (3 pcs). Tightening torque: 0.14 Nm.  xx1400002753

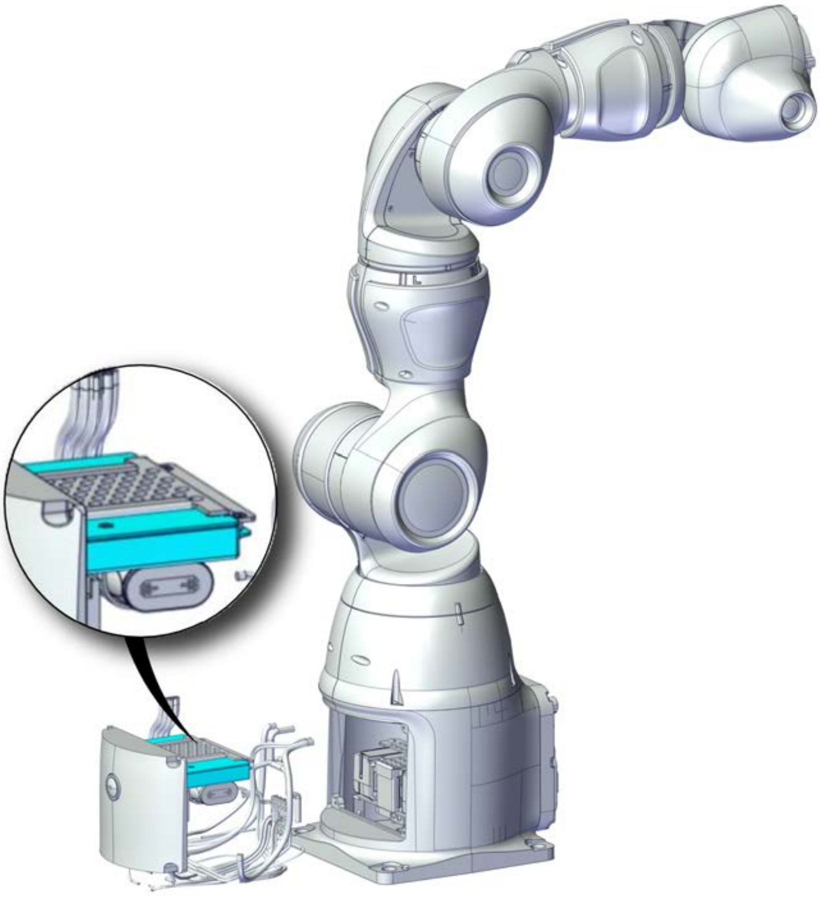
Concluding procedure

	Action	Note
1	Re-calibrate the robot.	See *Calibration on page 329*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.6 SMB unit

Location of SMB unit

The SMB unit is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
SMB unit	3HAC063968-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Continues on next page

Removing the SMB unit

Use this procedure to remove the SMB unit.

Preparations before removing the SMB unit

	Action	Note
1	Move the robot to its calibration position.	This is done in order to facilitate updating of the revolution counter.
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Removing the battery pack

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	**WARNING** The unit is sensitive to ESD. Before handling the unit, see *The unit is sensitive to ESD on page 51*.	

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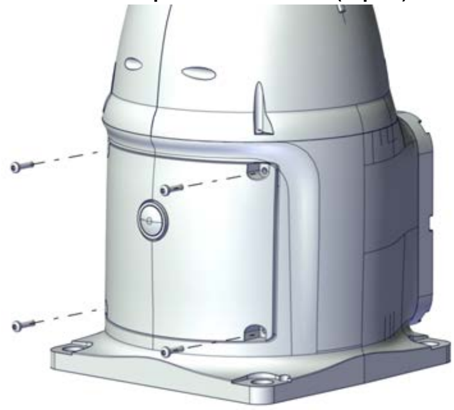
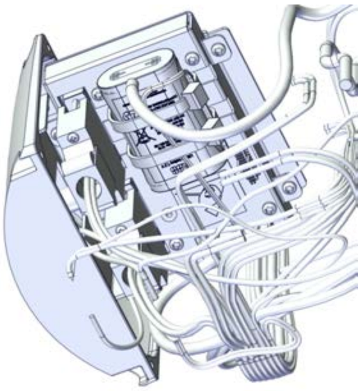
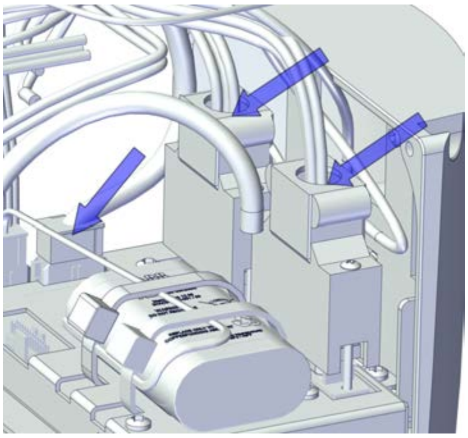
	Action	Note
3	Remove the base cover.	Screws: Torx pan head screw (4 pcs).  xx1800001145  xx1800001148
4	Disconnect the SMB cables: • SMB.J1 • SMB.J2 • SMB	 xx1800001149
5	Disconnect the brake release connectors to ensure enough room for further activities. • BR	

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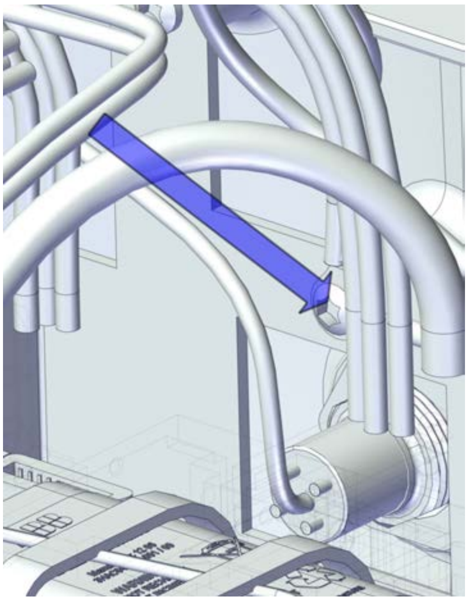
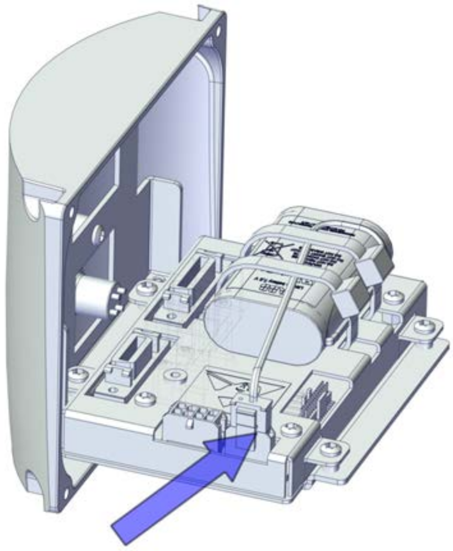
	Action	Note
6	Disconnect the ground cable to ensure enough room for further activities.	 xx1800001151
7	Disconnect the battery unit connector.	 xx1800001152

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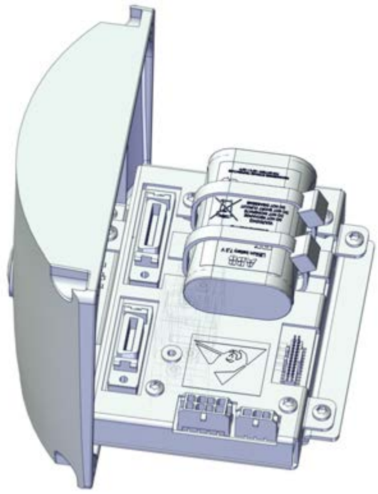
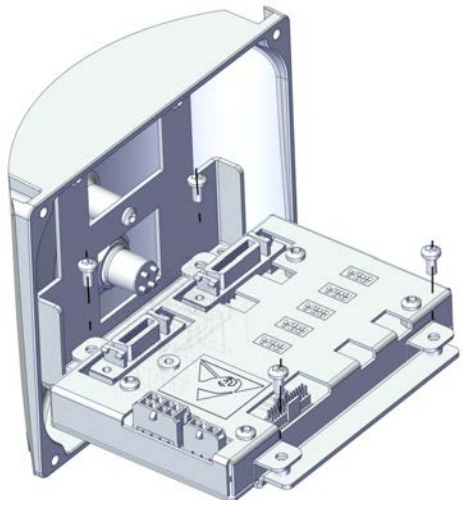
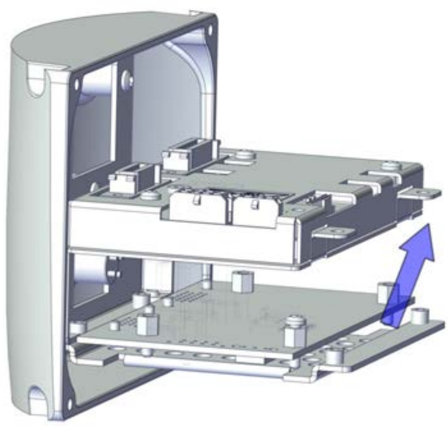
	Action	Note
8	Cut the cable ties and remove the battery.	 xx1800001156

Removing the SMB unit

	Action	Note
1	Remove the screws.	Screws: Torx pan head screw (4 pcs).  xx1800001160
2	Remove the SMB unit.	 xx1800001159

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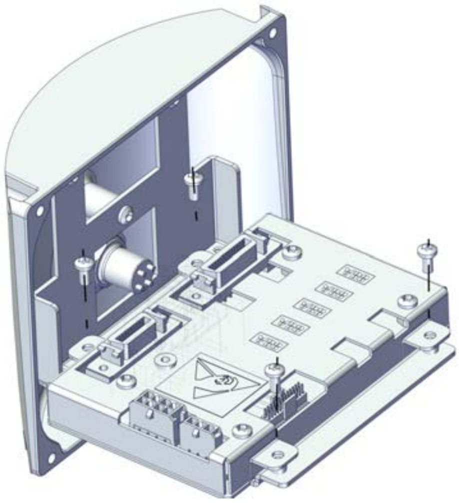
Refitting the SMB unit

Use these procedures to refit the SMB unit.

Refitting the SMB unit

	Action	Note
1	**WARNING** The unit is sensitive to ESD. Before handling the unit, see *The unit is sensitive to ESD on page 51*.	
2	Fit the SMB unit and and secure it with the screws.	 xx1800001160

Refitting the battery pack

	Action	Note
1	**WARNING** The unit is sensitive to ESD. Before handling the unit, see *The unit is sensitive to ESD on page 51*.	

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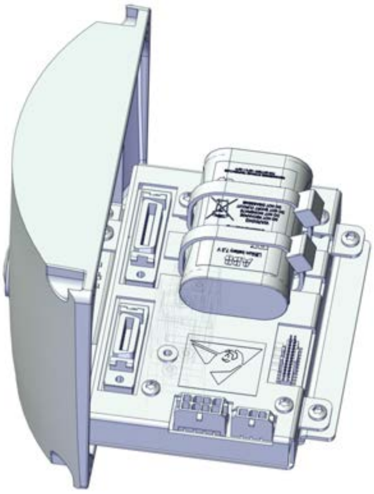
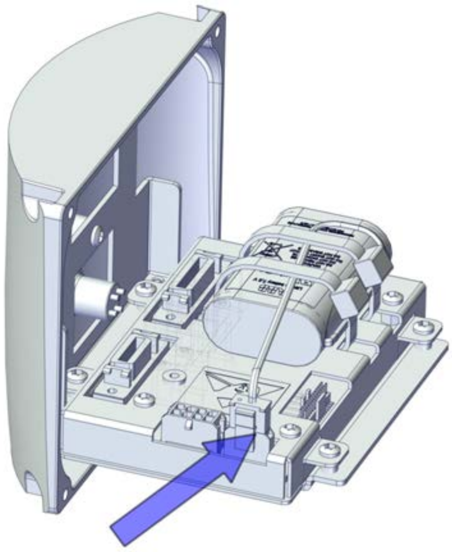
	Action	Note
2	Fit the battery and and secure it with two cable ties. **Note** Battery includes protection circuits. Only replace with a specified spare part or with an ABB-approved equivalent.	 xx1800001156
3	Connect the battery connector.	 xx1800001152

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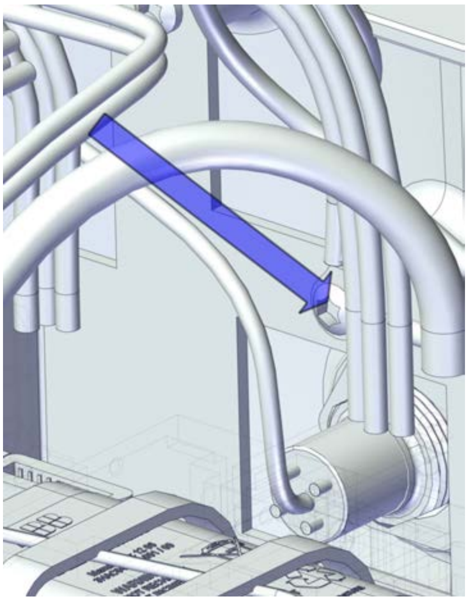
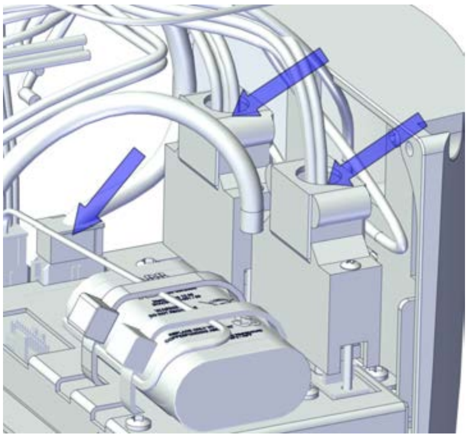
	Action	Note
4	Connect the ground cable.	 xx1800001151
5	Connect the cable connector to ensure enough room for further activities. • BR	
6	Connect the SMB connectors: • SMB.J1 • SMB.J2 • SMB	 xx1800001149

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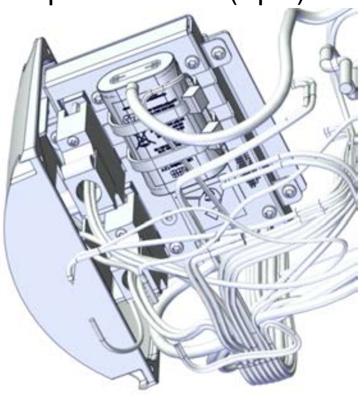
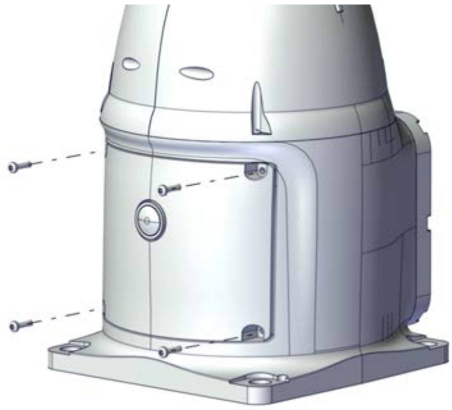
	Action	Note
7	Refit the base cover.	Screws: Torx pan head screw (4 pcs).  xx1800001148  xx1800001145

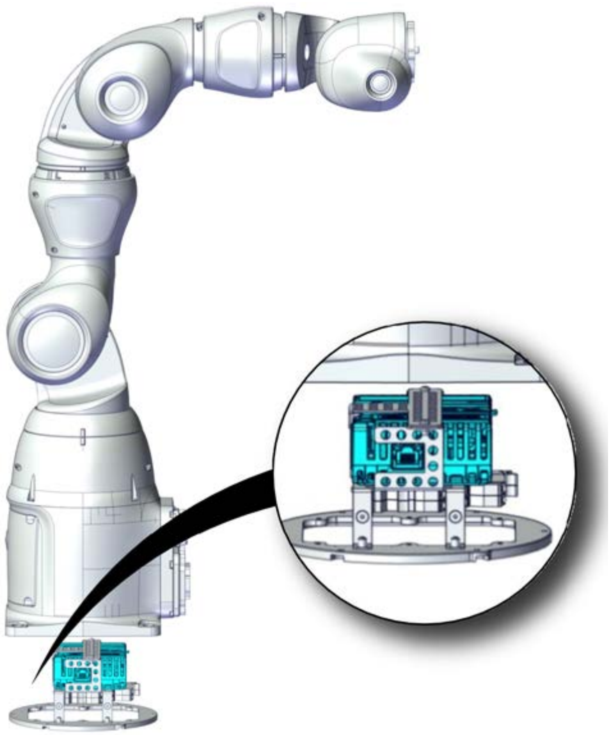
Concluding procedure

	Action	Note
1	Update the revolution counters.	See *Updating revolution counters on page 339*.
2	 **CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.7 Digital base

Location of digital base (DSQC1030)

The digital base is located as shown in the figure.



xx1800001167

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
DSQC1030 Digital base	3HAC058663-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Continues on next page

Removing the digital base

Use this procedure to remove the digital base.

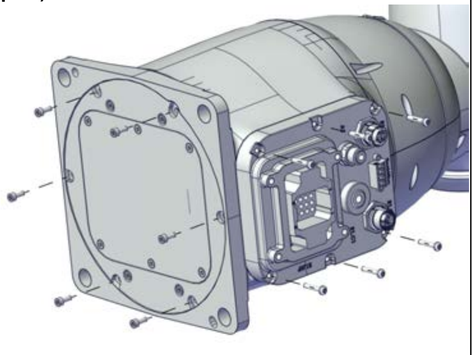
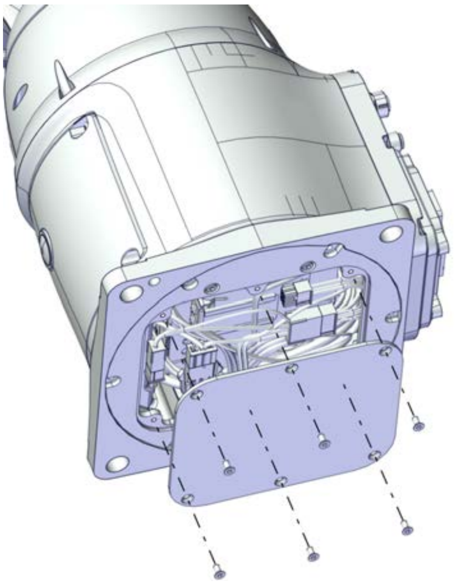
Preparations before removing the digital base

	Action	Note
1	Move the robot to its calibration position.	This is done in order to facilitate updating of the revolution counter.
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Removing the digital base and single relay unit

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	**WARNING** The unit is sensitive to ESD. Before handling the unit, see *The unit is sensitive to ESD on page 51*.	

Continues on next page

	Action	Note
3	Remove the front base cover and the bottom shell.	Screws: M3x16 8.8 Gleitmo 605 (6 pcs). Screws: M3x10 8.8-A2F (6 pcs). Screws: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs).  xx1800001162  xx1800001163

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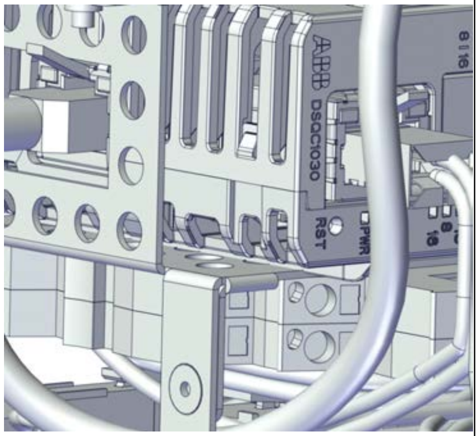
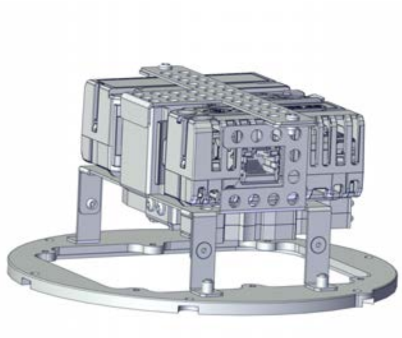
	Action	Note
4	Disconnect the digital base connectors. • M12.X1 • M12.X2 • M12.Eth • M12.Pw.1 • M12.Pw.2	 xx1800001164  xx1800001165

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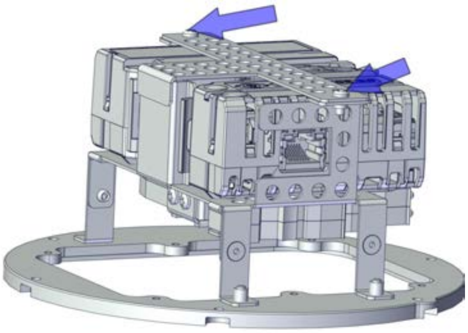
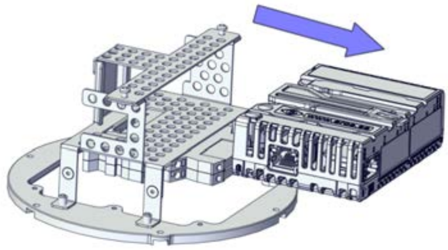
Removing the digital base

	Action	Note
1	Remove the screws on the bracket, and remove the digital base from the slot.	 xx1800001265  xx1800001166

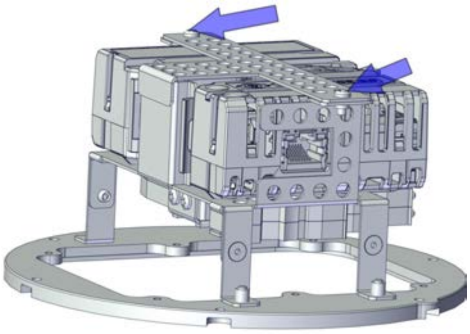
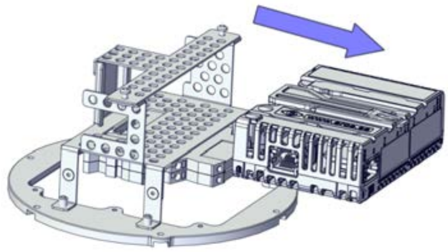
Refitting the digital base

Use these procedures to refit the digital base.

Refitting the digital base

	Action	Note
1	**WARNING** The unit is sensitive to ESD. Before handling the unit, see *The unit is sensitive to ESD on page 51*.	

Continues on next page

	Action	Note
2	Connect the digital base into the bracket, and tighten the screws on the bracket.	 xx1800001265  xx1800001166

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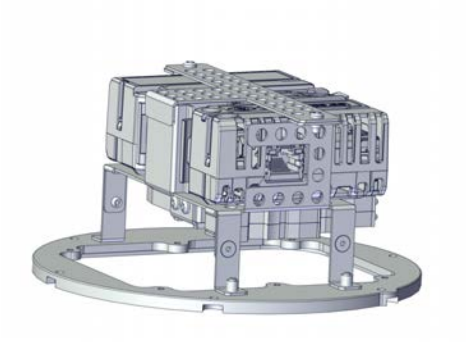
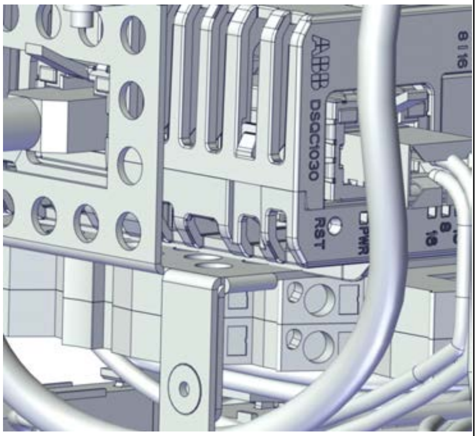
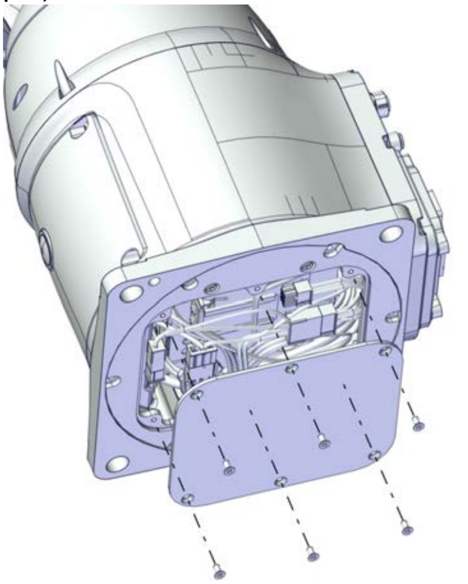
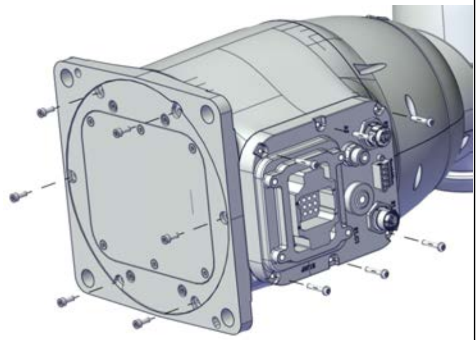
Refitting the digital base and single relay unit

	Action	Note
1	Connect the digital base connectors: • M12.X1 • M12.X2 • M12.Eth • M12.Pw.1 • M12.Pw.2	 xx1800001165  xx1800001164
2	Place the cables in the base, and make sure they are not being squeezed or damaged.	

Continues on next page

	Action	Note
3	Refit the front base cover and the bottom shell.	Screws: M3x16 8.8 Gleitmo 605 (6 pcs). Screws: M3x10 8.8-A2F (6 pcs). Screws: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs).  xx1800001163  xx1800001162

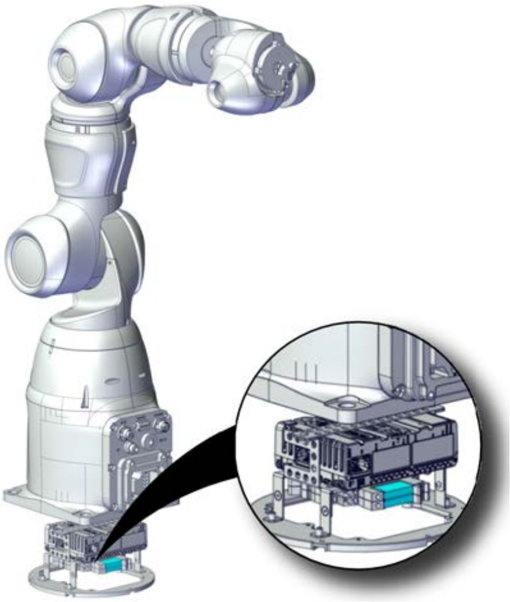
Concluding procedure

	Action	Note
1	Update the revolution counters.	See *Updating revolution counters on page 339*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

4.8 Single relay

Location of single relay

The single relay is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 14050 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Single relay (DC24V)	3HAC065024-001	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 367*.

Removing the single relay

Use this procedure to remove the single relay.

Preparations before removing the single relay

	Action	Note
1	Move the robot to its calibration position.	This is done in order to facilitate updating of the revolution counter.

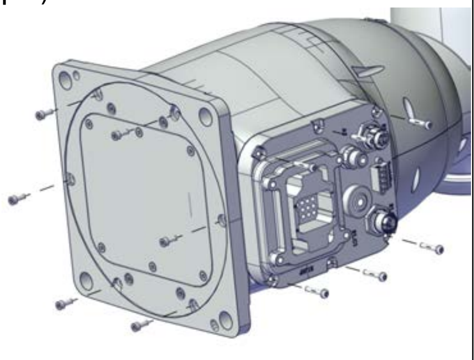
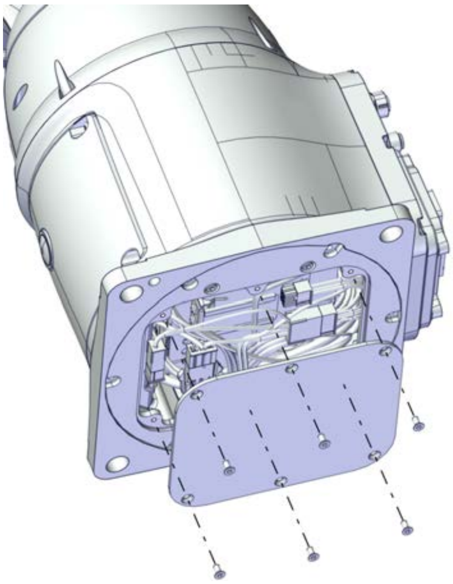
Continues on next page

	Action	Note
2	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	

Removing the digital base and single relay unit

	Action	Note
1	**DANGER** Turn off all electric power supply to the robot, before entering the safeguarded space.	
2	**WARNING** The unit is sensitive to ESD. Before handling the unit, see *The unit is sensitive to ESD on page 51*.	

Continues on next page

	Action	Note
3	Remove the front base cover and the bottom shell.	Screws: M3x16 8.8 Gleitmo 605 (6 pcs). Screws: M3x10 8.8-A2F (6 pcs). Screws: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs).  xx1800001162  xx1800001163

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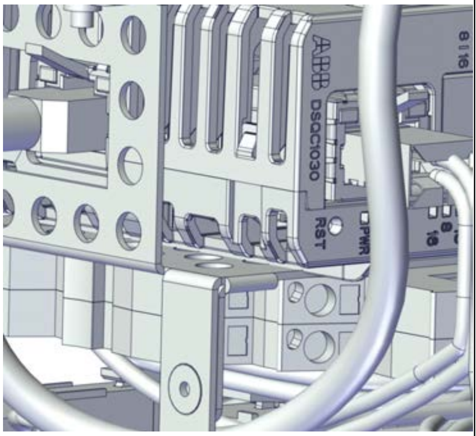
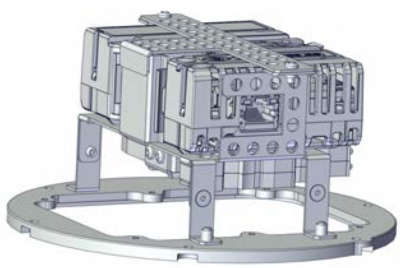
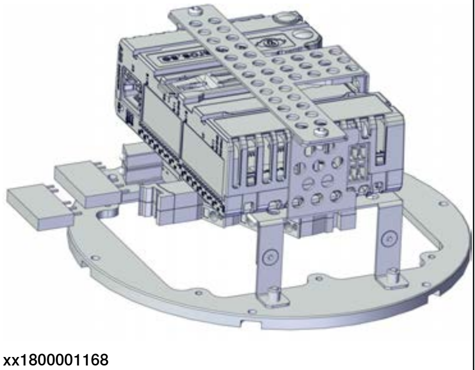
	Action	Note
4	Disconnect the digital base connectors. • M12.X1 • M12.X2 • M12.Eth • M12.Pw.1 • M12.Pw.2	 xx1800001164  xx1800001165

Removing the single relay

	Action	Note
1	Remove the single relay from the slot.	 xx1800001168

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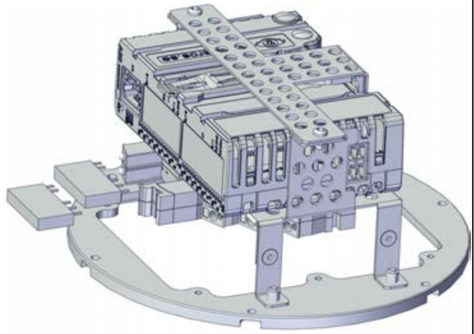
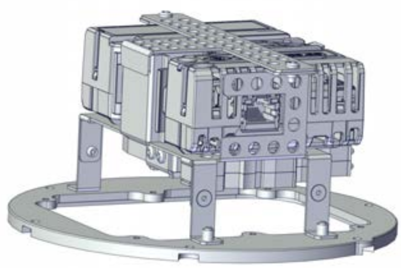
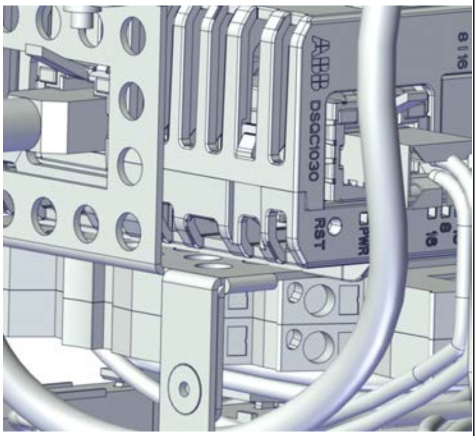
Refitting the single relay

Use these procedures to refit the single relay.

Refitting the single relay

	Action	Note
1	**WARNING** The unit is sensitive to ESD. Before handling the unit, see *The unit is sensitive to ESD on page 51*.	
2	Connect the single relay into the slot.	 xx1800001168

Refitting the digital base and single relay unit

	Action	Note
1	Connect the digital base connectors: • M12.X1 • M12.X2 • M12.Eth • M12.Pw.1 • M12.Pw.2	 xx1800001165  xx1800001164

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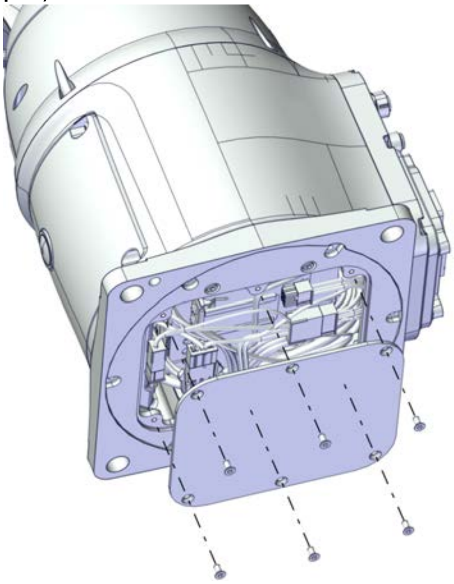
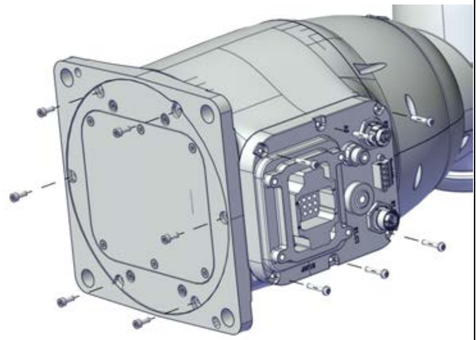
	Action	Note
2	Place the cables in the base, and make sure they are not being squeezed or damaged.	
3	Refit the front base cover and the bottom shell.	Screws: M3x16 8.8 Gleitmo 605 (6 pcs). Screws: M3x10 8.8-A2F (6 pcs). Screws: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs).  xx1800001163  xx1800001162

Concluding procedure

	Action	Note
1	Update the revolution counters.	See *Updating revolution counters on page 339*.
2	**CAUTION** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 74*.	

5 Calibration

5.1 Introduction

General

This chapter includes information about the calibration method.

When the robot system must be re-calibrated, it is done with special calibration tools and according to this section.

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 re-calibrated using the calibration method described in section *Calibrating the robot on page 333*.

If the robot has *Absolute Accuracy* calibration, it is also recommended, but not always necessary to calibrate for new absolute accuracy.

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 339*. 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, replacing hall sensor or when the reach ability of a robot is changed, it needs to be re-calibrated for new resolver values.

If the robot has *Absolute Accuracy* calibration, it needs to be calibrated for new absolute accuracy after fine calibration has been performed.

5.2 Calibration method

Overview

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

Type of calibration

Type of calibration	Description	Calibration method
Standard calibration	The calibrated robot is positioned with the TCP linked to the calibration surface at the robot base, with hall sensor technology.	Fine calibration
Absolute Accuracy calibration	Based on standard calibration, and besides positioning the robot at home position, the Absolute Accuracy calibration also compensates for: • Mechanical tolerances in the robot structure • Deflection due to load Absolute Accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot. Absolute Accuracy calibration data is found on the SMB in the robot. A robot calibrated with Absolute accuracy has the option information printed on its name plate. To regain 100% absolute accuracy performance, the robot must be re-calibrated for Absolute Accuracy!	CalibWareField

Fine calibration method

With the fine calibration method, the robot's TCP is linked to the robot base with hall sensor. Under this condition, all the seven joints' positions are pre-determined, and all of the axes can be calibrated at the same time.

The fine calibration method is used for all IRB 14050 robots and is the recommended method in order to achieve proper performance.

Calibration order of axes: axis 1-2-3-4-5-6-7.

How to calibrate a suspended or wall mounted robot

The IRB 14050 is fine calibrated floor standing in factory, prior to shipping.

To calibrate a suspended or wall mounted robot with the fine calibration routine, the robot must first be taken down and mounted standing on the floor.

CalibWareField

Absolute Accuracy calibration with CalibWareField requires specific laser equipment. Contact ABB Service for more information.

5.3 Calibration scale and correct axis position

Introduction

This section specifies the calibration scale positions and/or correct axis positions.

Calibration scales/marks

This illustration shows the positions of the calibration scales and marks on the robot.

The number next to the enlargement corresponds to the axis number.

Note

To put axis 7 in correct synchronization position, the arm must be positioned according to the figure. There are double calibration marks on axis 7, and the axis can therefore be put in two positions, 180º apart.

The synchronization mark on axis 7 is aligned with the mark "R", when in synchronization position.

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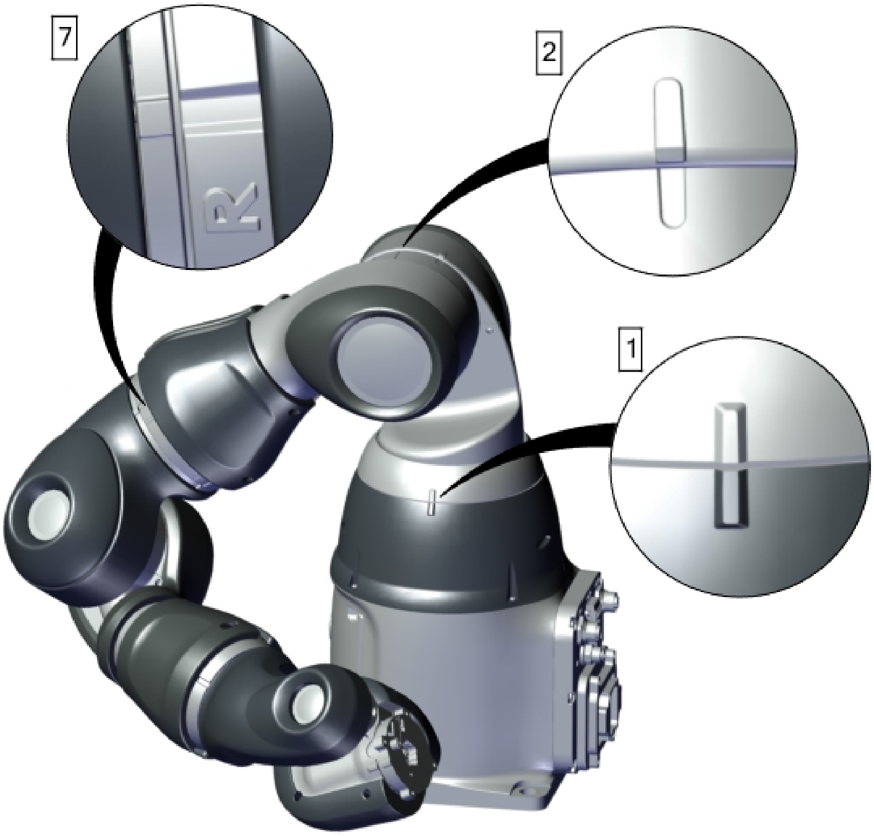

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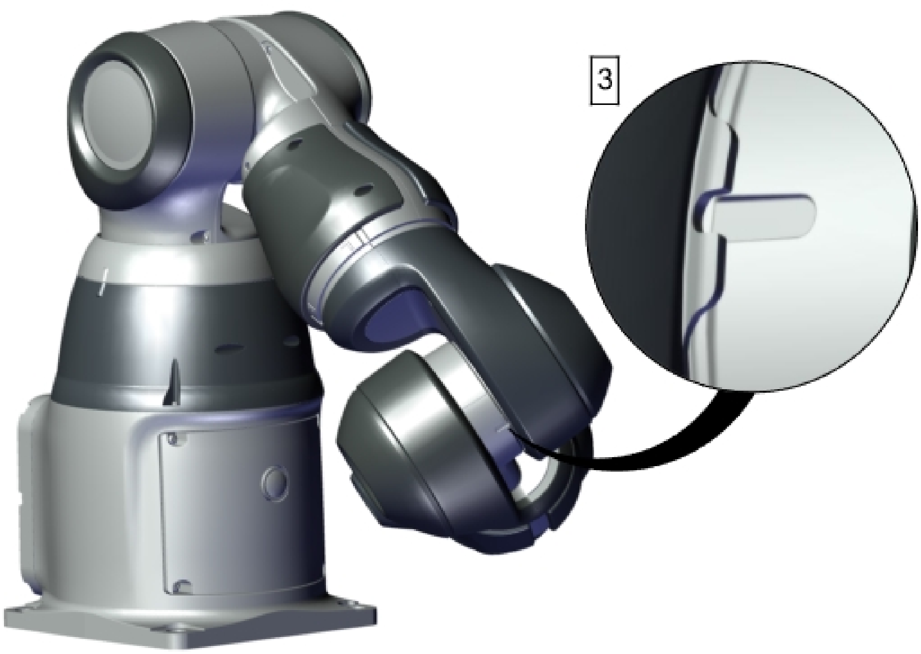

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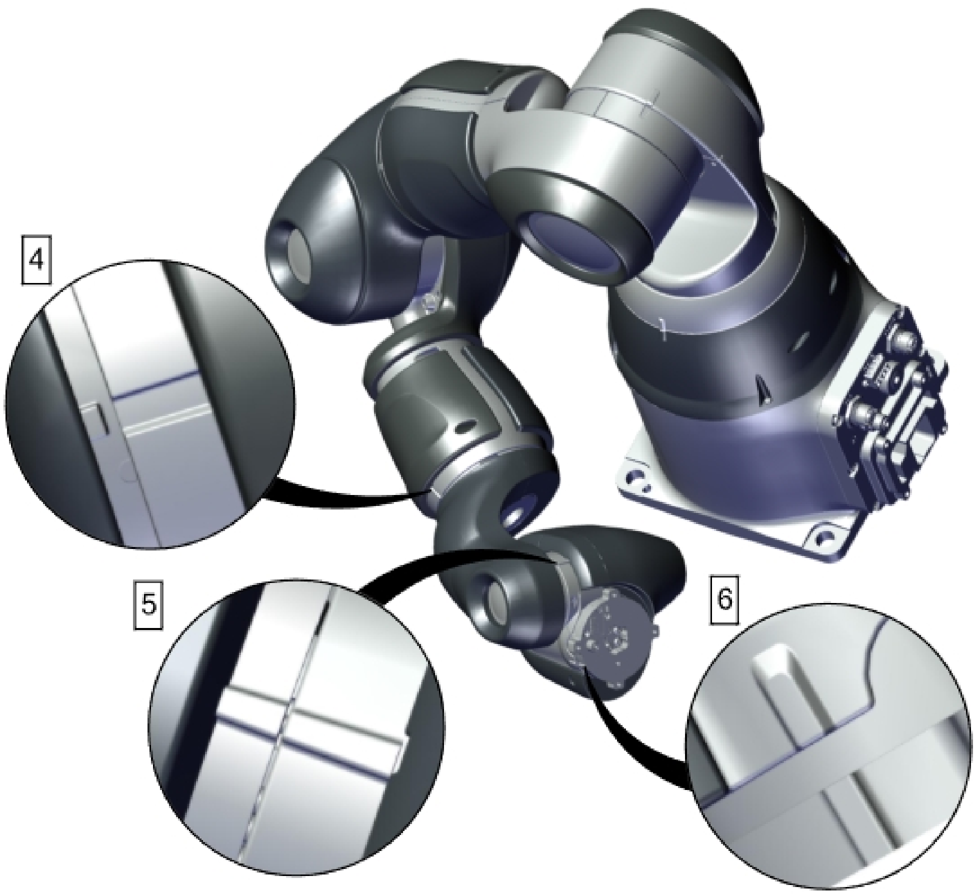

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5.4 Calibrating the robot

Exact axis positions in degrees

The table below specifies the exact axis positions in degrees.

See *Calibration scale and correct axis position on page 331* for figures.

Axis	IRB 14050 ROB_1
1	0°
2	-130°
3	30°
4	0°
5	40°
6	0°
7	-135°

Calibrating the robot with fine calibration procedure

Note

Fine calibration should only be done without any tool mounted.

Perform the fine calibration of the robot when the calibration status is **Not calibrated.**

Calibration is only possible when the SafeMove configuration is deactivated.

Moving the robot to its calibration position

	Action	Note
1	**CAUTION** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways!	
2	Release the brakes of the robot arm to be calibrated and move the arm manually so that the synchronization mark of each joint is aligned. The robot now stands in its calibration position.	The synchronization marks are shown in *Calibration scale and correct axis position on page 331*. There is a tolerance for the joint position. The edge of a mark should be at least within the area of the opposite mark.

Setting the running speed to 100%

	Action	Note
1	Set the running speed to 100%.	

Running the fine calibration procedure

	Action	Note
1	On the start screen, tap **Calibrate**.	

Continues on next page

	Action	Note
2	Select **Calibration** from the menu. The **Mechanical Units** page displays a list of available mechanical units. **Note** This step is required only if you are not already in the **Mechanical Unit** page when you open **Calibrate**. **Note** The **Mechanical Unit** page is displayed only if there are more than one mechanical unit available. Otherwise, the calibration summary page for the available mechanical unit is displayed.	
3	Select the unit that needs to be calibrated from the **Mechanical Unit** list. The calibration summary for the selected mechanical unit is displayed.	
4	On the right pane tap **Calibration Methods**.	
5	Tap **Calibration Parameters**. The calibration parameters are displayed.	
6	Tap **Fine Calibration**. A dialog box is displayed, urging you to use external equipment to perform the actual calibration. Make sure all necessary calibration equipment is fitted for the axis to be calibrated. A warning that performing fine calibration can change programmed robot positions is also displayed: • Tap **Yes** to proceed. • Tap **No** to cancel.	
7	Select the check-box for the current axis/axes to be calibrated. **Note** A warning is displayed prompting you to check whether the synchronization mark of axis 7 is aligned with the mark "R" before proceeding with the fine calibration for axis 7. See *Calibration scale and correct axis position on page 331*.	
8	Tap **Calibrate**. A dialog box is displayed, warning that calibration of the selected axes will be changed, which cannot be undone: • 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.	

Continues on next page

	Action	Note
9	Tap **OK**. The fine calibration process is complete.	

Checking the synchronization position of all axes

	Action	Note
1	Jog each axis to its exact synchronization position in degrees using the FlexPendant.	Degrees are specified in *Exact axis positions in degrees on page 333*.
2	Check that the synchronization marks on each axis are aligned with each other. Are they aligned within the tolerances? The edge of a mark should be at least within the area of the opposite mark. • If yes, the calibration is verified and the robot is correctly calibrated. No more action needed. • If no, then move the robot to calibration position again and repeat the fine calibration procedure. *Moving the robot to its calibration position on page 333* *Running the fine calibration procedure on page 333*	

After calibration

	Action	Note
1	Refit any tools or customer cables previously removed from the arm.	

5.5 Calibrating the robot for Absolute Accuracy

Description of Absolute Accuracy option

The Absolute Accuracy option is integrated in the controller algorithms for compensation of the difference between the ideal and the real robot, and does not need external equipment or calculation. Absolute Accuracy is a RobotWare option and includes an individual calibration of the robot (mechanical arm). Absolute Accuracy is a TCP calibration to reach a good positioning in the Cartesian coordinate system.

The Absolute Accuracy option varies according to the robot mounting position. Always refer to the robot name plate for the available Absolute Accuracy option. The robot must be in the correct mounting position when it is recalibrated for absolute accuracy.

Calibration is only possible when the SafeMove configuration is deactivated.

Methods for Absolute Accuracy calibration

If parts of the mechanical structure of a robot with Absolute Accuracy option are replaced, the robot needs to be re-calibrated for Absolute Accuracy, after fine calibration has been performed.

Method for Absolute Accuracy calibration	When to use
CalibWare	After replacement of part of the arm structure. Requires specific laser equipment. Contact ABB Service for more information.

5.6 Calibrating with Wrist Optimization method

When to run Wrist Optimization

Wrist Optimization routine is run to improve TCP reorientation performance.

Calibrating the robot with standard calibration method overwrites the optimized positions of axes 4, 5. Re-run the **Wrist Optimization** routine after standard calibration to re-achieve the optimized positions of the wrist axes.

Overview of the calibration procedure on the FlexPendant

The actual instructions of how to perform the calibration procedure and what to do at each step is given on the FlexPendant. You will be guided through the calibration procedure, step by step.

Use the following list to learn about the calibration procedure before running the RobotWare program on the FlexPendant. It gives you a brief overview of the calibration procedure sequence.

After the calibration method has been called for on the FlexPendant, the following sequence will be run.

1. Choose calibration routine Wrist Optimization.
2. Modify targets for 4-point tool frame definition, in Wrist Optimization routine.

   > **Tip**
   >
   > Select positions with large reorientations around the TCP. For best results, make sure that axis 4 and 5 have large movements.

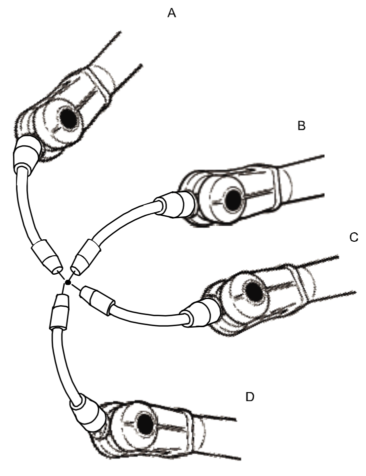
   a. Jog the robot to an appropriate position, A, for the first approach point.

      Use small increments to accurately position the tool tip as close to the reference point as possible.

   b. Tap **Modify Position** to define the point.

   c. Repeat for each approach point to be defined, positions B, C, and D.

      Jog away from the fixed world point to achieve the best result. Just changing the tool orientation will not give as good a result.

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3. Improved calibration data to the wrist axes is identified and presented.
4. Optimized positions for the wrist axes are presented.

Continues on next page

5 The robot moves to the optimized positions for the wrist axes and automatically overwrites previous calibration data.

> **WARNING**
>
> Robot moves automatically when pressing **Calibrate**.

6 Wrist optimization is finished.

7 Redefine / verify TCP for all tools.

5.7 Updating revolution counters

Introduction

This section describes how to do a rough calibration of each robot axis, which updates the revolution counter value for each axis using the FlexPendant when the calibration status is **Not updated**. This may be done:

- Using the **Calibration** function
- Using the **Revolution Counter** function (not recommended)

It is recommended to use the **Calibration** function to update the revolution counters of the IRB 14050 because it will check against the hall sensors and verify the robot position.

Note

For IRB 14050 if you use **Calibration** when the calibration status is **Calibrated**, the calibration procedure will be unsuccessful. So for IRB 14050 you can use **Calibration** to have a more precise revolution update, only when its calibration status is **Not updated**.

Step 1 - Manually moving the manipulator to the calibration position

	Action	Note
1	**CAUTION** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways!	
2	Release the brakes of the robot arm to be calibrated and move the arm manually so that the synchronization mark of each joint is aligned. The robot now stands in its calibration position.	The synchronization marks are shown in *Calibration scale and correct axis position on page 331*. There is a tolerance for the joint position. The edge of a mark should be at least within the area of the opposite mark.

Step 2 - Performing revolution counter update

Note

The procedure may vary according to different RobotWare versions. Always perform the calibration by following the actual instructions displayed on the FlexPendant.

It is recommended to use the **Calibration** function to update revolution counters for IRB 14050.

	Action
1	On the start screen, tap **Calibrate**. The calibration summary page for the mechanical unit is displayed.

Continues on next page

	Action
2	In the **Calibration Methods** menu, select **Calibration**.
3	Select the axes for which revolution counters need to be updated. **Note** By default, all the axes that are not calibrated are selected. **Note** A warning is displayed prompting you to check whether the synchronization mark of axis 7 is aligned with the mark "R" before proceeding with the revolution counter update for axis 7. See *Calibration scale and correct axis position on page 331*.
4	Tap **Calibrate selected axes**.
5	An instruction window is displayed, providing the visualized 3D view showing how to match the notches for the selected axes. Follow the guide to position the robot in calibration position. It is also possible to start calibration directly by tapping **Skip guide and Start Calibration**.
6	Tap **Start Calibration** when the robot is in calibration position. The calibration process runs.
7	Tap **Finish**. The calibration process is complete.
8	**CAUTION** If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury! Check the synchronization position very carefully after each update. See *Verifying the calibration position on page 342*.

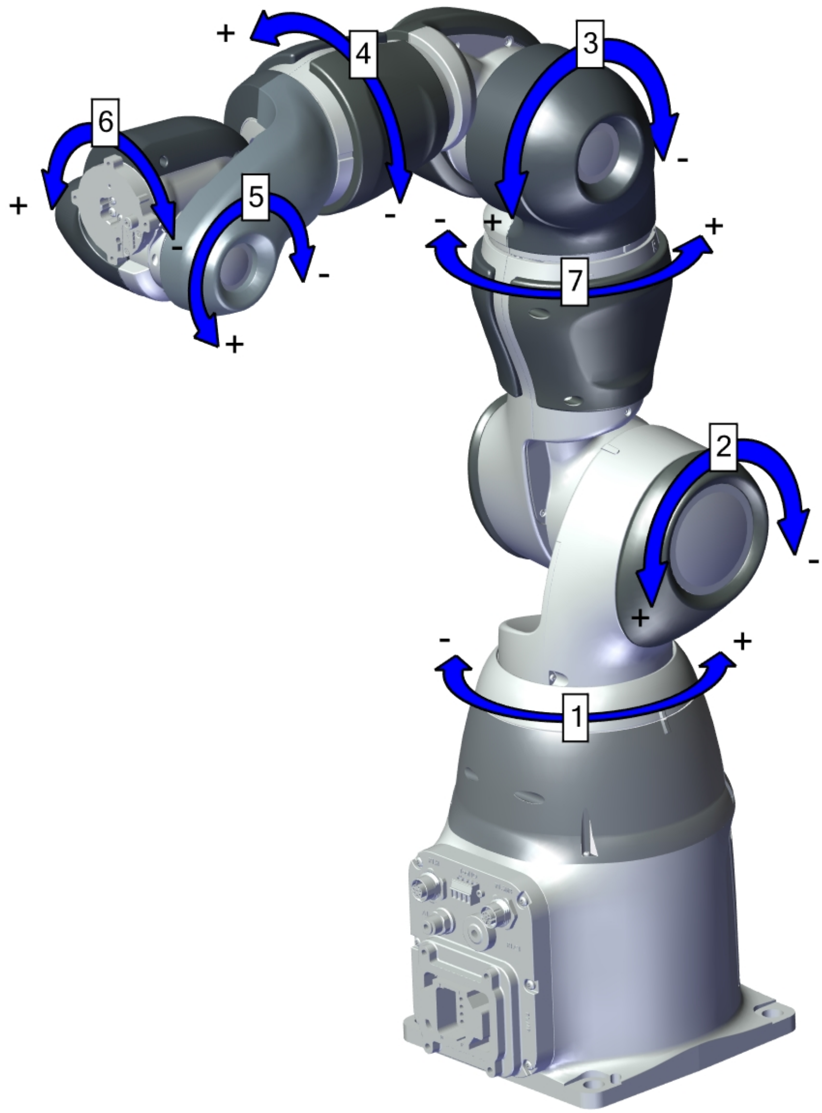
5.8 Calibration movement directions for all axes

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.

This is normally handled by the robot calibration software.

Calibration movement directions, 7 axes



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5.9 Verifying the calibration position

Introduction

Verify the calibration position of the robot before beginning any programming of the robot system. This may be done:

- Using a `MoveAbsJ` instruction with argument according to calibration position degrees on all axes.
- Using the **Jog** window on the FlexPendant.

Using a `MoveAbsJ` instruction

Use this procedure to create a program that runs all the robot axes to their synchronization position.

	Action	Note
1	Tap **Code**.	
2	Create a new program.	
3	Use **MoveAbsJ** in the **Add Instruction** menu.	
4	Create the following program: `MoveAbsJ [[0,-130,30,0,40,0], [-135,9E9,9E9,9E9,9E9,9E9]] \NoEOffs, v1000, fine, tool0;`	
5	Run the program in manual mode.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See *Calibration scale and correct axis position on page 331* and *Updating revolution counters on page 339*.

Using the jogging window

Use this procedure to jog the robot to the synchronization position of all axes.

	Action	Note
1	Tap **Jog**.	
2	From the **Mechanical unit** list select a mechanical unit.	
3	From the **Motion mode** section, select an axis-set that need to be jogged. For example, to jog axis 2, select the axis set **Axis 1-3**.	
4	Follow the screen instruction on joystick movements to understand the direction of the axis that you want to move and move the joystick.	
5	Manually run the robots axes to a position where the axis position value read on the FlexPendant, is equal to the calibration position degrees.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See *Calibration scale and correct axis position on page 331* and *Updating revolution counters on page 339*.

6 Troubleshooting

6.1 Introduction to troubleshooting

Introduction

The product manual and the circuit diagram contains information that can be good when troubleshooting.

For OmniCore, all event logs from the software can be seen on the FlexPendant, or in *Technical reference manual - Event logs for RobotWare 7*.

Make sure to read through the section *Safety on page 15* before starting.

Troubleshooting strategies

1. Isolate the fault to pinpoint the cause of the problem from consequential problems.
2. Divide the fault chain in two.
3. Check communication parameters and cables.
4. Check that the software version is compatible with the hardware.

Work systematically

1. Take a look around to make sure that all screws, connectors, and cables are secured, and that the robot and other parts are clean, not damaged, and correctly fitted.
2. Replace one thing at a time.
3. Do not replace units randomly.
4. Make sure that there are no loose screws, turnings, or other unexpected parts remaining after work has been performed.
5. When the work is completed, verify that the safety functions are working as intended.

Keep a track of history

- Make a historical fault log to keep track of problems over time.
- Consult those working with the robot when the problem occurred.

Basic scenarios

What to look for during troubleshooting depends on when the fault occurred. Was the robot recently installed or was it recently repaired? The following table gives hints on what to look for in specific situations.

The robot has recently been installed	Check: • the configuration files • connectors • options and their configuration • changes in the robot working space/movements.

Continues on next page

The robot has recently been repaired	Check: • all connections to the replaced part • power supplies • that the correct part has been fitted • the last repair documents.
The robot recently had a software upgrade	Check: • software versions • compatibilities between hardware and software • options and their configuration
The robot has recently been moved from one site to another (an already working robot)	Check: • connections • software versions

6.2 Oil and grease stains on motors and gearboxes

Description

The area surrounding the motor, gearbox or seal lip shows signs of oil leaks. This can be at the base, closest to the mating surface, at the furthest end of the motor at the resolver, or around the joints of the covers (closest to the edge) on the robot surface.

Consequences

Besides the dirty appearance, in most cases there are no serious consequences if the leaked amount of oil is very small.

Possible causes

The symptom can be caused by:

- Leakage of rust preventives or mounting grease. This should be wiped off.
- Leaking sealing between gearbox and motor.
- Gearbox overfilled with oil.
- Gearbox oil too hot.

Recommended actions

The following actions are recommended:

	Action	Information
1	**CAUTION** Allow hot parts to cool down.	
2	Wipe off the oil or grease, see *Cleaning the IRB 14050 on page 94*. Monitor the robot over time to see if new oil or grease occurs.	If the oil spill is small, this step is sufficient.
3	Too hot gearbox oil may be caused by: • Incorrect oil quality or level. • The robot work cycle runs a specific axis too hard. Investigate whether it is possible to program small "cooling periods" into the application. • Overpressure created inside gearbox.	Robots performing certain, extremely heavy duty work cycles may be fitted with vented oil plugs. These are not fitted to normal duty robots, but can be purchased from your local ABB representative.
4	Inspect all sealings and gaskets between motor and gearbox. Replace broken parts.	

6.3 Mechanical noise or dissonance

Description

Mechanical noise or dissonance that has not been observed before can indicate problems in bearings, motors, gearboxes, or similar. Be observant of changes over time.

A faulty bearing often emits scraping, grinding, or clicking noises shortly before failing.

Consequences

Failing bearings cause the path accuracy to become inconsistent, and in severe cases, the joint can seize completely.

Possible causes

The symptom can be caused by:

- Worn bearings.
- Contaminations have entered the bearing grooves.
- Loss of lubrication in bearings.
- Loose heat sinks, fans, or metal parts.

If the noise is emitted from a gearbox, the following can also apply:

- Overheating.

Recommended actions

The following actions are recommended:

	Action	Information
1	**CAUTION** Allow hot parts to cool down.	
2	Verify that the service is done according to the maintenance schedule.	
3	If a bearing is emitting the noise, determine which one and make sure that it has sufficient lubrication.	
4	If possible, disassemble the joint and measure the clearance.	
5	Bearings inside motors are not to be replaced individually, but the complete motor is replaced.	
6	Make sure the bearings are fitted correctly.	
7	Tighten the screws if a heat sink, fan, or metal sheet is loose.	

6.4 Manipulator collapses on power down

Description

The manipulator is able to work correctly while Motors ON is active, but when Motors OFF is active, one or more axes drops or collapses under its own weight.

The holding brakes (normally one in each motor), is not able to hold the weight of the manipulator arm.

Consequences

For a heavy robot, the collapse can cause severe injury to personnel working in the area or severe damage to the robot and/or surrounding equipment.

For a small robot, the collapse can cause injury to personnel working close to the robot or damage to the robot and/or surrounding equipment.

Possible causes

The symptom can be caused by:

- Faulty brake.
- Faulty power supply to the brake.
- For YuMi robots with SafeMove, the axes 4-5-6 can drop when entering manual mode and when the enabling device is released, because there are no holding brakes on these motors.
- For YuMi robots, axes 4-5-6 can drop when a robot stopping function triggers motors OFF status, because there are no holding brakes on these motors.

Recommended actions

The following actions are recommended:

	Action	Information
1	Determine which motor(s) causes the robot to collapse.	If the robot has SafeMove2, then the top axis can drop when releasing the enabling device. This is normal behavior. If any of the lower axes collapse, see next step.
2	Check the brake power supply to the collapsing motor during the Motors OFF state.	See the circuit diagram.
3	Remove the motor from the gearbox to inspect it from the drive side.	If found faulty, the motor must be replaced as a complete unit.

6.5 Problem releasing the robot brakes

Description

When starting robot operation or jogging the robot, the internal robot brakes must release in order to allow movement.

The troubleshooting procedure is described in the product manual for the robot controller.

7 Robot description

7.1 Robot type description

Type A of IRB 14050

The difference between IRB 14050 and IRB 14050 Type A is that the Type A has a reinforced design on the arm.

As a result of this, the following parts differ between types:

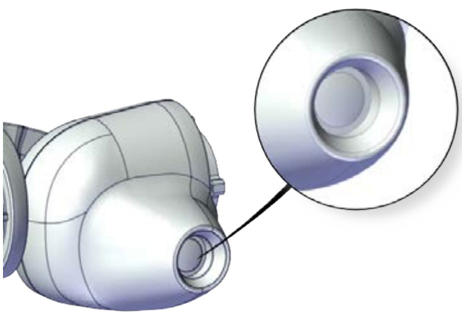
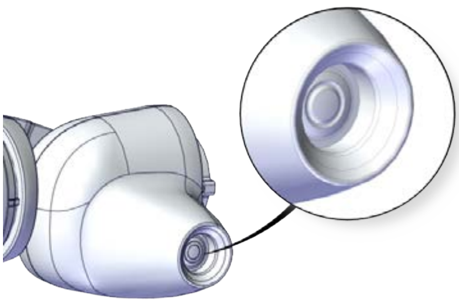
- Motor brake, axis 1 and axis 2
- Gearbox, axis 4 and axis 5
- Mechanical design, axis 4 and axis 5
- Cable harness design

Those robots in original design are simply named IRB 14050 (no-type-specified).

How to know which type the robot is?

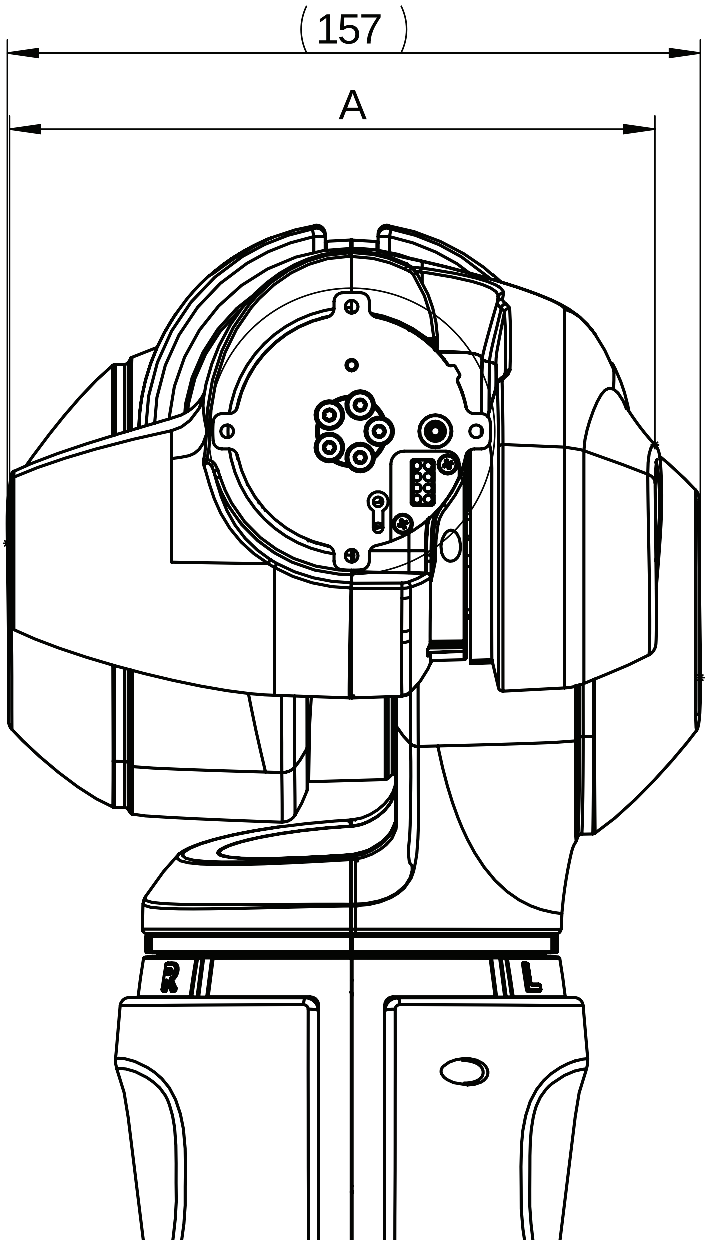
The following characteristics can be used to figure out the robot type.

Axis 5 appearance

IRB 14050 (no-type-specified)	IRB 14050 Type A
 xx1900001956	 xx1900001957

Continues on next page

Robot dimension



xx1900001958

	IRB 14050 (no-type-specified)	IRB 14050 Type A
A	137 mm	146 mm

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Arm configuration during system installation

The robot type must be correctly selected when setting the arm configuration during system installation, otherwise, unexpected motion error or performance issues may occur.

Type A is available for selection as below only in RobotStudio 2019.5.3 or later and RobotWare 7.0.3 or later.

xx2000002172

8 Decommissioning

8.1 Introduction to decommissioning

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.

Note

The decommissioning process shall be preceded by a risk assessment.

Disposal of materials used in the robot

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.

See also *Environmental information on page 354*.

Transportation

Prepare the robot or parts before transport, this to avoid hazards.

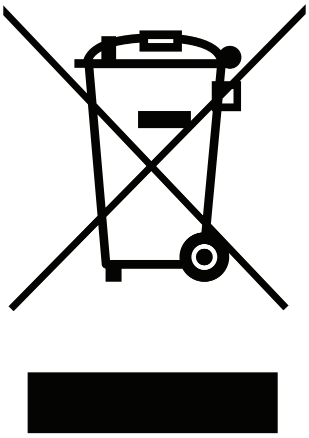
8.2 Environmental information

Introduction

ABB robots contain components in different materials. During decommissioning, all materials should be dismantled, recycled, or reused responsibly, according to the relevant laws and industrial standards. Robots or parts that can be reused or upcycled helps to reduce the usage of natural resources.

Symbol

The following symbol indicates that the product must not be disposed of as common garbage. Handle each product according to local regulations for the respective content (see table below).



xx1800000058

Materials used in the product

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

Dispose components properly according to local regulations to prevent health or environmental hazards.

Material	Example application
Aluminium	Base, body, arm, etc
Batteries, Lithium	Serial measurement board
Copper	Cables, motors
Foam	Covers
Magnesium	Wrist casting, upper arm, back cover, tool flange, etc
Neodymium	Brakes, motors
Oil, grease	Gears, cables, etc
Plastic/rubber	Cables, connectors, covers, etc
Steel	Gears, screws, washers, brackets

Continues on next page

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.

8.3 Scrapping of robot

Note

The decommissioning process shall be preceded by a risk assessment.

Important when scrapping the robot

DANGER

The risk assessment should consider hazards arising in the decommissioning, such as, but not limited to:

- Always remove all batteries. 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.
- A used robot does not have the same performance as on delivery. Springs, brakes, bearings, and other parts might be worn or broken.

9 Reference information

9.1 Introduction

General

This chapter includes general information, complementing the more specific information in the different procedures in the manual.

9.2 Applicable standards

General

The product is compliant with ISO 10218-1:2011, *Robots for industrial environments - Safety requirements - Part 1 Robots*, and applicable parts in the normative references, as referred to from ISO 10218-1:2011. In case of deviation from ISO 10218-1:2011, these are listed in the declaration of incorporation. The declaration of incorporation is part of the delivery.

Robot standards

Standard	Description
ISO 9283	Manipulating industrial robots – Performance criteria and related test methods
ISO 9787	Robots and robotic devices – Coordinate systems and motion nomenclatures
ISO 9946	Manipulating industrial robots – Presentation of characteristics

Other standards used in design

Standard	Description
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements, normative reference from ISO 10218-1
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments
IEC 61000-6-4	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
ISO 13849-1:2006	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design, normative reference from ISO 10218-1
IEC 61340-5-1	Protection of electronic devices from electrostatic phenomena - General requirements
ISO/TS 15066	Robots and robotic devices - Collaborative robots This Technical Specification specifies safety requirements for collaborative industrial robot systems and the work environment, and supplements the requirements and guidance on collaborative industrial robot operation given in ISO 10218-1 and ISO 10218-2.

Region specific standards and regulations

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 434-03	Industrial robots and robot Systems - General safety requirements
ANSI/ESD S20.20	Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

Continues on next page

Standard	Description
EN ISO 10218-1	Robots and robotic devices — Safety requirements for industrial robots — Part 1: Robots

Deviations

Deviations from ISO 10218-1:2011 for IRB 14050

The IRB 14050 is by default always in collaborative operation.

Requirement	Deviation for IRB 14050	Motivation
§5.7.3 & §5.8.3 Enabling device	The enabling device on FlexPendant is only active, when a SafeMove configuration is active.	The IRB 14050 robot is intended for collaborative applications where contact between robot and the operator is harmless. An enabling device does not further contribute to a risk reduction.

9.3 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	

9.4 Specification of screws

Screws handled as spare part

The screws listed have special treatment and must be ordered as spare parts if lost or damaged.

Article number	Screw	Dimension, class and treatment
3HAB3409-14	Hex socket head cap screw	M5x16 12.9 Lafre 2C2B/FC6.9
3HAB3409-212	Hex socket head cap screw	M4x16 12.9 Lafre 2C2B/FC6.9
3HAB3409-224	Hex socket head cap screw	M3x12 12.9 Lafre 2C2B/FC6.9
3HAB3409-232	Hex socket head cap screw	M4x12 12.9 Lafre 2C2B/FC6.9
3HAB3409-233	Hex socket head cap screw	M2.5x6 12.9 Lafre 2C2B/FC6.9
3HAB3409-241	Hex socket head cap screw	M2.5x12 12.9 Lafre 2C2B/FC6.9
3HAB3410-23	Hex socket head cap screw	M2x6 12.9 Gleitmo 605
3HAB3410-25	Hex socket head cap screw	M2x10 12.9 Gleitmo 605
3HAC050367-005	Torx pan head screw	M3x12 8.8 Gleitmo 605
3HAC050367-006	Torx pan head screw	M3x16 8.8 Gleitmo 605
3HAC050367-039	Torx pan head screw	M2x30 8.8 Gleitmo 605
3HAC050368-005	Hex socket head cap screw	M2x8 8.8
3HAC16446-4	Screw with flange	M3x6
3HAC052487-001	Torx head screw with flange	M3x16 8.8
3HAC072396-001	Small head screw	M2x16 12.9
3HAC073135-001	Washer	2.2x4.5x0.3

Screws not handled as spare parts

The screws listed have no special treatment and can be bought locally if lost or damaged.

Article number	Screw	Dimension, class and treatment
9ADA195-4	Torx pan head screw	
9ADA618-22	Torx pan head screw	M3x6 8.8-A2F
9ADA618-31	Torx pan head screw	M4x6 8.8-A2F
9ADA618-32	Torx pan head screw	M4x8 8.8-A2F
9ADA618-34	Torx pan head screw	M4x12 8.8-A2F
9ADA618-41	Torx pan head screw	M5x6 8.8 Fe/Zn 5c
9ADA618-44	Torx pan head screw	M5x12 A2-70
9ADA618-47	Torx pan head screw	M5x25 8.8-A2F
9ADA624-24	Torx pan head screw	M3x10 8.8-A2F
9ADA624-45	Torx pan head screw	M5x16 8.8-A2F
9ADA267-1	Nut	M2 DIN934 8 ELZN
9ADA267-4	Nut	M4 Steel 8-A2F

Continues on next page

Article number	Screw	Dimension, class and treatment
9ADA267-5	Nut	M5 Steel 8-A2F

9.5 Screw joints

General

This section describes how to tighten the various types of screw joints on ABB robots.

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

UNBRAKO screws

UNBRAKO is a special type of screw recommended by ABB for certain screw joints. It features special surface treatment (Gleitmo as described below) and is extremely resistant to fatigue.

Whenever used, this is specified in the instructions, and in such cases, *no other type of replacement screw* is allowed. Using other types of screws will void any warranty and may potentially cause serious damage or injury.

Gleitmo treated screws

Gleitmo is a special surface treatment to reduce the friction when tightening the screw joint. It is recommended by ABB for M6-M20 screw joints. 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.

Generally, screws are lubricated with *Gleitmo 603* mixed with *Geomet 500* or *Geomet 702* in proportion 1:3. *Geomet* thickness varies according to screw dimensions, refer to the following.

Dimension	Lubricant	Geomet thickness
M6-M20 (any length except M20x60)	*Gleitmo 603* + *Geomet 500*	3-5 μm
M6-M20 (any length except M20x60)	*Gleitmo 603* + *Geomet 720*	3-5 μm
M20x60	*Gleitmo 603* + *Geomet 500*	8-12 μm
M20x60	*Gleitmo 603* + *Geomet 720*	6-10 μm

Screws lubricated in other ways

Screws lubricated with Molykote 1000 or Molykote P1900 should *only* be used when specified in the repair, maintenance or installation procedure descriptions.

In such cases, proceed as follows:

1. Apply lubricant to the screw thread.
2. Apply lubricant between the plain washer and screw head.
3. Screw dimensions of M8 or larger must be tightened with a torque wrench. Screw dimensions of M6 or smaller may be tightened without a torque wrench *if* this is done by trained and qualified personnel.

Continues on next page

Lubricant	Article number
Molykote 1000 (molybdenum disulphide grease)	3HAC042472-001
Molykote P1900 (molybdenum disulphide grease)	3HAC070875-001

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%**!

Tightening torque for oil-lubricated screws with slotted or cross-recess head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws* with *slotted or cross-recess head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Tightening torque for oil-lubricated screws with allen head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws* with *allen head screws.*

Note

A 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

Continues on next page

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
M24	680	960	1150

Tightening torque for lubricated screws (Molykote, Gleitmo or equivalent) with allen head screws

The following table specifies the recommended standard tightening torque for *screws lubricated with Molycote 1000, Gleitmo 603 or equivalent* with *allen head screws.*

Note

A 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]
M5		8
M6		14
M8	28	35
M10	55	70
M12	96	120
M16	235	300
M20	460	550
M24	790	950

i Lubricated with Molycote 1000, Gleitmo 603 or equivalent

9.6 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 arm weighs 25 kg. All lifting accessories used must be sized accordingly.	

9.7 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

Quantity	Tool
1	Torque screwdriver JOFAST 70-ICP range 0.07-0.70 Nm [i]
1	Torque screwdriver JOFAST 170-ICP range 0.17-1.70 Nm *i*
1	Torque screwdriver JOFAST 450-ICP range 0.45-4.50 Nm *i*
1	Torque screwdriver TLS1360 range 2.5-13.6 Nm *i*
1	Screw bit (3 mm--1/4")
1	Screw bit (3 mm--1/4"(ball head))
1	Screw bit (2 mm--1/4")
1	Screw bit (2 mm--1/4"(ball head))
1	Screw bit (TX6--1/4")
1	Screw bit (1.5 mm--1/4")
1	Screw bit (1.5 mm--1/4"(ball head))
1	Screw bit (1.0 mm--1/4")
1	Screw bit (TX10--1/4")
1	Screw bit (TX20--1/4")
1	Screw bit (4 mm--1/4")
1	Screw bit (4 mm--1/4"(ball head))
1	Wrench 7 mm
1	Wrench 8 mm

i The standard torque screwdriver should be calibrated to the torque value specified in the repair procedures, in advance.

9.8 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 367*, and of special tools, listed directly in the instructions and also gathered in this section.

Special tools

Note

If the replacing procedure is not listed in the table below, only standard tools are needed for the procedure.

Tools and equipment with spare part number: (These tools can be ordered from ABB)		Axis-1 motor	Axis-2 motor	Axis-7 motor	Axis-3 motor	Axis-4 motor	Axis-5 motor	Axis-6 motor
Removal tools								
3HAC054868-001	Removal tool	1	1					
3HAC054869-001	Removal tool			1	1			
Lifting accessories								
-	Lifting eye M8 DIN580							
Fixtures								
3HAC054870-001	Fixture tool for wave generator M93	1	1					
3HAC054871-001	Fixture tool for wave generator M92			1	1			
3HAC054904-001	Fixture tool for wave generator M91					1 [i]	1 [i]	1
3HAC074531-001	Fixture tool for wave generator M91 (IRB 14050 Type A)					1 [ii]	1 [ii]	
3HAC074529-001	Machined screw driver					1 [iii]	1 [iii]	

i Required for IRB 14050 (no-type-specified). See *Robot description on page 349* for robot type.
ii Required for IRB 14050 Type A. See *Robot description on page 349* for robot type.
iii Used together with fixture tool for wave generator M91 on axes 4 and 5.

9.9 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.

The instructions delivered with the lifting accessories should be stored for later reference.

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