ROBOTICS

Product manual

IRB 390

Trace back information:
Workspace 24B version a10
Checked in 2024-06-12
Skribenta version 5.5.019

Product manual

IRB 390 - 15/1300
IRB 390 - 10/1300

IRC5, OmniCore

Document ID: 3HAC066566-001

Revision: M

The information in this manual is subject to change without notice and should not be construed as a commitment by ABB. ABB assumes no responsibility for any errors that may appear in this manual.

Except as may be expressly stated anywhere in this manual, nothing herein shall be construed as any kind of guarantee or warranty by ABB for losses, damage to persons or property, fitness for a specific purpose or the like.

In no event shall ABB be liable for incidental or consequential damages arising from use of this manual and products described herein.

This manual and parts thereof must not be reproduced or copied without ABB's written permission.

Keep for future reference.

Additional copies of this manual may be obtained from ABB.

Original instructions.

Table of contents

This page is intentionally left blank

Overview of this manual

About this manual

This manual contains instructions for:

- mechanical and electrical installation of the IRB 390
- maintenance of the IRB 390
- mechanical and electrical repair of the IRB 390

The robot described in this manual has the following protection types:

- *Standard*

This manual describes the manipulator using either the IRC5 or the OmniCore controller.

Product manual scope

The manual covers all variants and designs of the IRB 390. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

Usage

This manual should be used during:

- installation and commissioning, from lifting the product to its work site and securing it to the foundation, to making it ready for operation
- maintenance work
- repair work
- decommissioning work

Note

It is the responsibility of the integrator to conduct a risk assessment of the final application.

It is the responsibility of the integrator to provide safety and user guides for the robot system.

Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

Prerequisites

A maintenance/repair/installation craftsman working with an ABB robot must:

- be trained by ABB and have the required knowledge of mechanical and electrical installation/repair/maintenance work.
- be trained to respond to emergencies or abnormal situations.

Continues on next page

Continued

Product manual scope

The manual covers all variants and designs of the IRB 390. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

References

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

General

Document name	Document ID
Product manual, spare parts - IRB 390	*3HAC066567-001*
Circuit diagram - IRB 390	*3HAC060545-009*
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*
Product specification - Robot stopping distances according to ISO 10218-1	*3HAC048645-001*
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*
Material/product safety data sheet - Battery pack	*3HAC043118-001*

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

For OmniCore robots

Document name	Document ID
Product specification - IRB 390	*3HAC087211-001*
Product manual - OmniCore V250XT Type B	*3HAC087112-001*
Product manual - OmniCore V400XT	*3HAC081697-001*
Operating manual - OmniCore	*3HAC065036-001*
Technical reference manual - System parameters	*3HAC065041-001*

For IRC5 robots

Document name	Document ID
Product specification - IRB 390	*3HAC066568-001*
Product manual - IRC5 For IRC5 robots, with main computer DSQC10xx.	*3HAC047136-001*
Operating manual - IRC5 with FlexPendant	*3HAC050941-001*
Technical reference manual - System parameters	*3HAC050948-001*

Revisions

Revision	Description
A	First edition.

Continues on next page

Revision	Description
B	Published in release 21A. The following updates are made in this revision: • Updated article number on press tool, cassette sealing. • Updated article number for brake release push button and Molykote P1900. • Added nipple dimension on telescopic shaft. • Updated images of refitting axis-4 gear unit pre-stage. • Updated images that show axis-5 delta unit screw side due to changed amount of attachment screws.
C	Published in release 21C. The following updates are made in this revision: • Text regarding fastener quality is updated, see *Fastener quality on page 85*. • Added inspecting the cup on axis-4 and axis-5 • Added visually inspecting the cup on axis-4 and axis-5 • Added replacing the axis-4 and axis-5 cup o-ring • Dimension changed in tool flange, see *Mechanical interface of the tool flange*.
D	Published in release 22A. The following updates are made in this revision: • Clarified information about telescopic shaft orientation during installation/replacement. • Added information about an external brake release box (option). • Added replacement of universal joint in the maintenance schedule. • Updated expected life for telescopic shaft and universal joint.
E	Published in release 22B. The following updates are made in this revision: • Minor text adjustment in installation procedure (cable connection) for the external brake release box. • Added replacement of telescopic shaft to the maintenance schedule. • Added information about protection screws and washers in lifting eye attachment holes on the base. • Added section about inspecting the oil level of the axis-4 and axis-5 gear unit pre-stage.
F	Published in release 22C. The following updates are made in this revision: • Updated dimension of attachment holes on delta unit mechanical interface for IRB 390-10/1300.
G	Published in release 22D. The following updates are made in this revision: • Added expected life and maintenance activity for inspecting the axis-1, axis-2 and axis-3 motors. • Completed information about protection screws and washers in lifting eye attachment holes on the base with article numbers and anti-seize paste recommendation. • Changed screw dimension for motor covers on axes 1, 2 and 3.
H	Published in release 23A. The following updates are made in this revision: • Corrected the section about cleaning.
J	Published in release 23B. The following updates are made in this revision: • Added general information about cassette sealings in repair chapter.
K	Published in release 23C. The following updates are made in this revision: • Corrected the information about lubricating the thread of the screw that is attached to the delta unit and the upper arm.
L	Published in release 24A. The following updates are made in this revision: • Updated the article number for Calibration toolbox, Axis calibration.
M	Published in release 24B. The following updates are made in this revision: • Added information for the OmniCore robot controller.

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

1.2.1 Safety signals in the manual
Continued

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*.

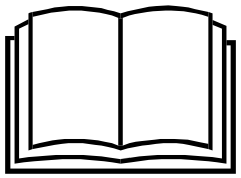
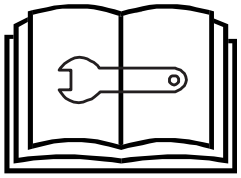
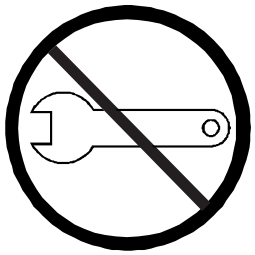
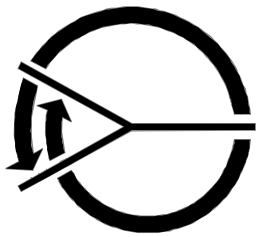
The information labels can contain information in text.

Symbols on safety labels

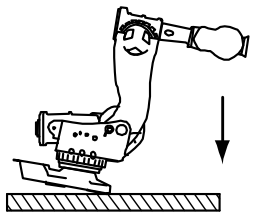
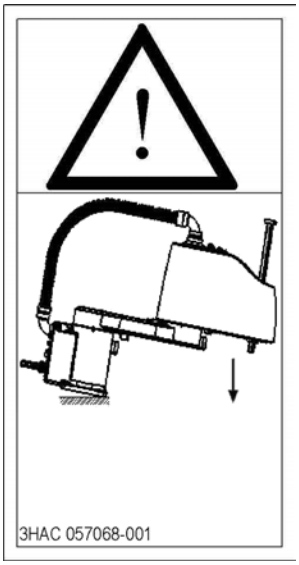
Symbol	Description
 xx0900000812	**Warning!** Warns that an accident *may* occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical 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.

Continues on next page

1.2.2 Safety symbols on manipulator labels
Continued

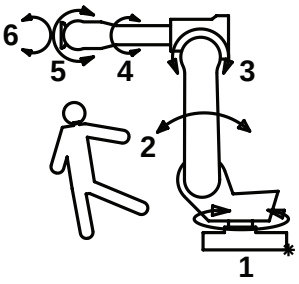
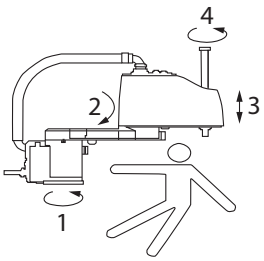
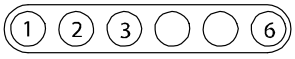
Symbol	Description
 xx0900000813	**See user documentation** Read user documentation for details. Which manual to read is defined by the symbol: • No text: *Product manual*. • EPS: *Application manual - Electronic Position Switches*.
 xx0900000816	**Before disassembly, see product manual**
 xx0900000815	**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

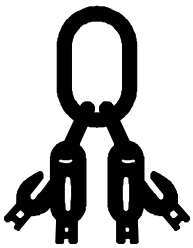
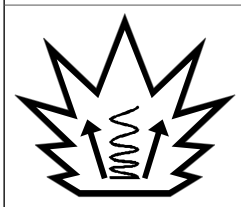
Symbol	Description
 xx0900000810  xx1500002402	**Tip risk when loosening bolts** The robot can tip over if the bolts are not securely fastened.
  xx0900000817	**Crush** Risk of crush injuries.

Continues on next page

1.2.2 Safety symbols on manipulator labels
Continued

Symbol	Description
 xx0900000818  xx1300001087	**Heat** Risk of heat that can cause burns. (Both signs are used)
 xx2400000736  xx1500002616	**Moving robot** The robot can move unexpectedly.
 xx0900000820  xx1000001140	**Brake release buttons**

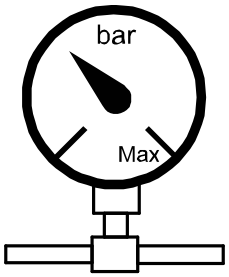
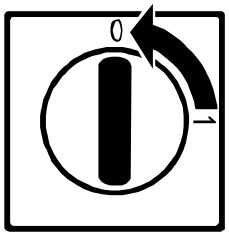
Continues on next page

Symbol	Description
 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**
 xx1000001144	**No mechanical stop**
 xx0900000825	**Stored energy** Warns that this part contains stored energy. Used in combination with *Do not disassemble* symbol.

Continues on next page

1.2.2 Safety symbols on manipulator labels

Continued

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

1.3 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 V250XT Type B*
- *Product manual - OmniCore V400XT*
- *Product manual - IRC5*

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.

If the manipulator is delivered with mechanical stops, these can be used for reducing the working space.

A perimeter safeguarding, for example a fence, shall be dimensioned to withstand the following:

- The force of the manipulator.
- The force of the load handled by the robot if dropped or released at maximum speed.
- The maximum possible impact caused by a breaking or malfunctioning rotating tool or other device fitted to the robot.

The maximum TCP speed and the maximum velocity of the robot axes are detailed in the section *Robot motion* in the product specification for the respective manipulator.

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.

Consider hazards from other equipment in the robot system, for example, that guards remain active until identified hazards are reduced to an acceptable level.

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.

Continues on next page

Using lifting accessories and other external equipment

Ensure that all equipment used during installation, service and all handling of the robot are in correct condition for the intended use.

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.

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

A robot may perform unexpected limited movement.

WARNING

Manipulator movements can cause serious injuries on users and may damage equipment.

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.

Continues on next page

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.

Unexpected movement of robot arm

WARNING

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

A robot may perform unexpected limited movement.

WARNING

Manipulator movements can cause serious injuries on users and may damage equipment.

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.

Hazards due to stored mechanical energy in the manipulator for the purpose of counterbalancing axes must be considered before maintenance or repair.

Never use the robot as a ladder, which means, do not climb on the controller, manipulator, including motors, or other parts. There are hazards of slipping and falling. The robot might be damaged.

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.

Continues on next page

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.
 **Possible pressure build-up in gearbox**	When opening the oil or grease plug, there may be pressure present in the gearbox, causing hot lubricant to spray from the opening.	Open the plug carefully and keep away from the opening. Do not overfill the gearbox when filling. Put oil absorbent cloth, bags or paper at appropriate locations to catch any oil residues. Use appropriate protective gear such as heat-resistant gloves, goggles/protective visor, or a body suit if necessary.
 **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 39*.

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

Continues on next page

1.6.1 Safety during maintenance and repair
Continued

Unexpected movement of robot arm

WARNING

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

A robot may perform unexpected limited movement.

WARNING

Manipulator movements can cause serious injuries on users and may damage equipment.

Related information

See also the safety information related to installation and operation.

1.6.2 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.

CAUTION

Risk of hot surfaces that can cause burns.

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

WARNING

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

A robot may perform unexpected limited movement.

WARNING

Manipulator movements can cause serious injuries on users and may damage equipment.

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.

Unexpected movement of robot arm

WARNING

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

A robot may perform unexpected limited movement.

WARNING

Manipulator movements can cause serious injuries on users and may damage equipment.

This page is intentionally left blank

2 Manipulator description

2.1 Technical data

Weight, robot

The table shows the weight of the robot.

Robot model	Nominal weight
IRB 390	IRB 390 - 15/1300: 133 kg IRB 390 - 10/1300: 148 kg

Note

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

Mounting positions

The table shows valid mounting positions and the installation (mounting) angle for the manipulator.

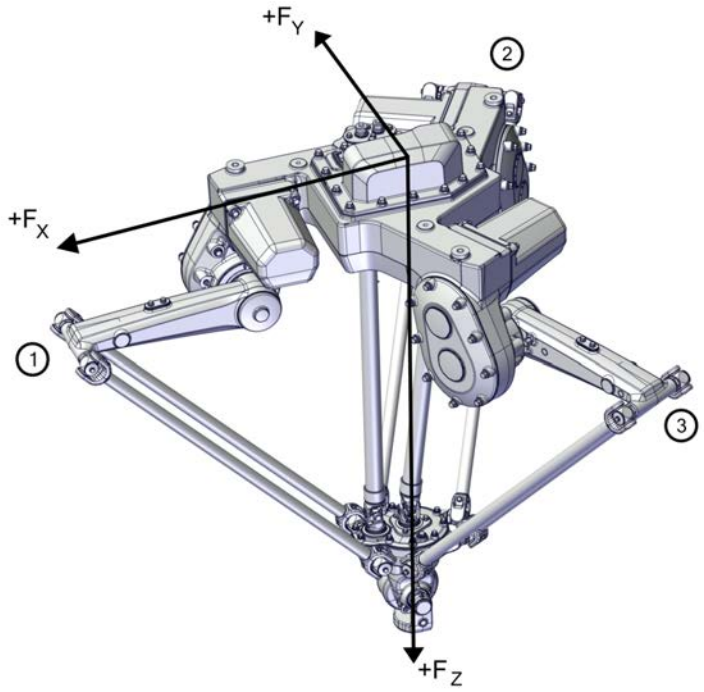
Mounting position	Installation angle
Suspended in robot frame	0°

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



xx2000000862

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!

WARNING

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

Suspended in robot frame

Force	Endurance load (in operation)	Maximum load (emergency stop)
Force xy	±1.8 kN	±4.0 kN
Force z	1.4 ± 0.6 kN	1.4 ± 1.9 kN
Torque xy	2.0 kNm	4.3 kNm
Torque z	0.6 kNm	1.2 kNm

Continues on next page

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	0.3 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.
Minimum resonance frequency	35 Hz **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 description of *Motion Process Mode* in the manual that describes the controller software option, see *References on page 10*.

[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.

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

Parameter	Value
Minimum ambient temperature	-25 °C
Maximum ambient temperature	55 °C
Maximum ambient temperature (less than 24 hrs)	70 °C
Maximum ambient humidity	95%

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	0 °C [i]
Maximum ambient temperature	+50 °C
Maximum ambient humidity	95% 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.

Continues on next page

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	IP67
External brake release box (option)	IP54

[i] According to IEC 60529.

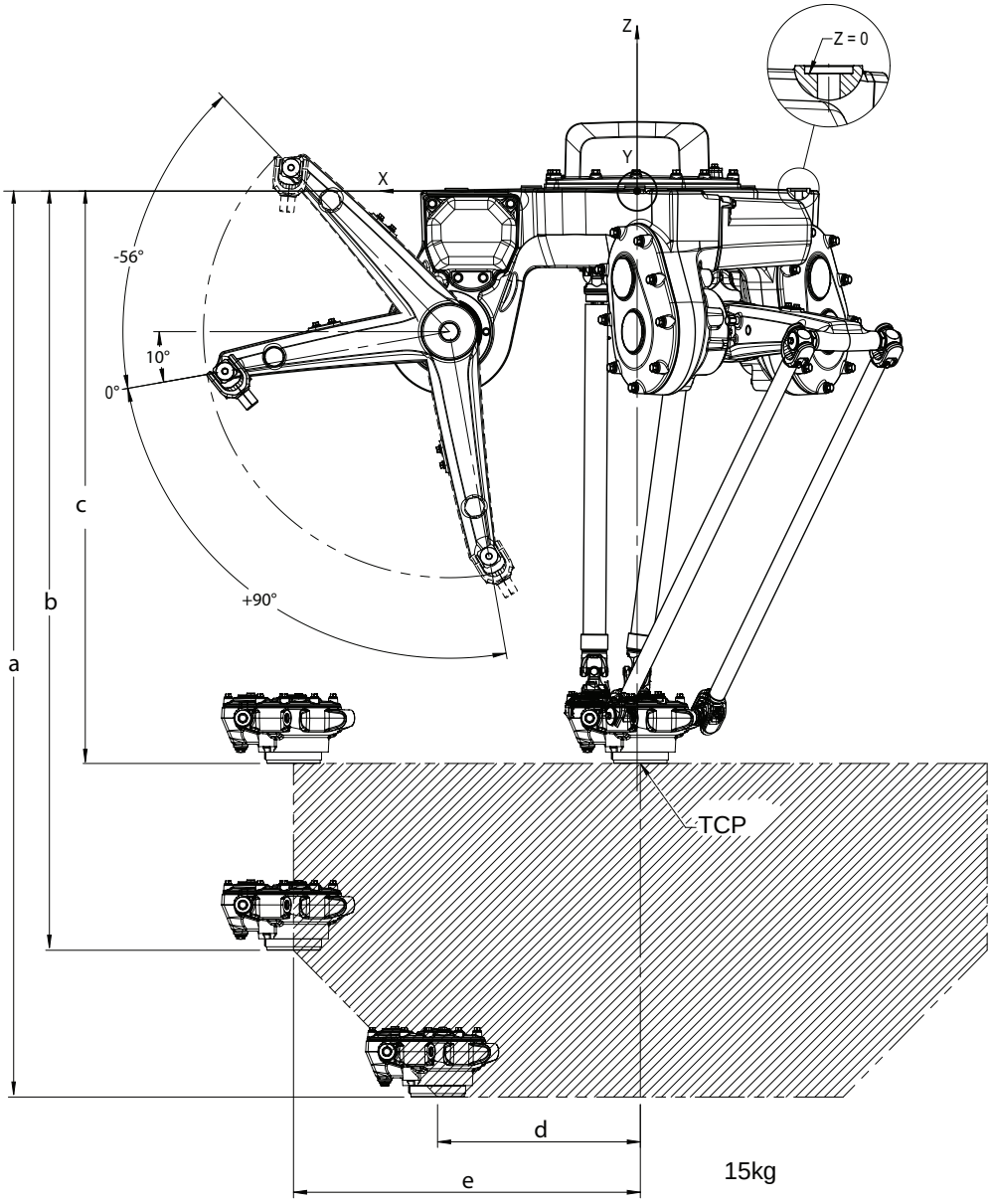
Environmental information

The product complies with IEC 63000. *Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances*.

2.2 Working range

Illustration, working range IRB 390 - 15/1300

This illustration shows the unrestricted working range of the robot.



xx1900001423

Dimensions

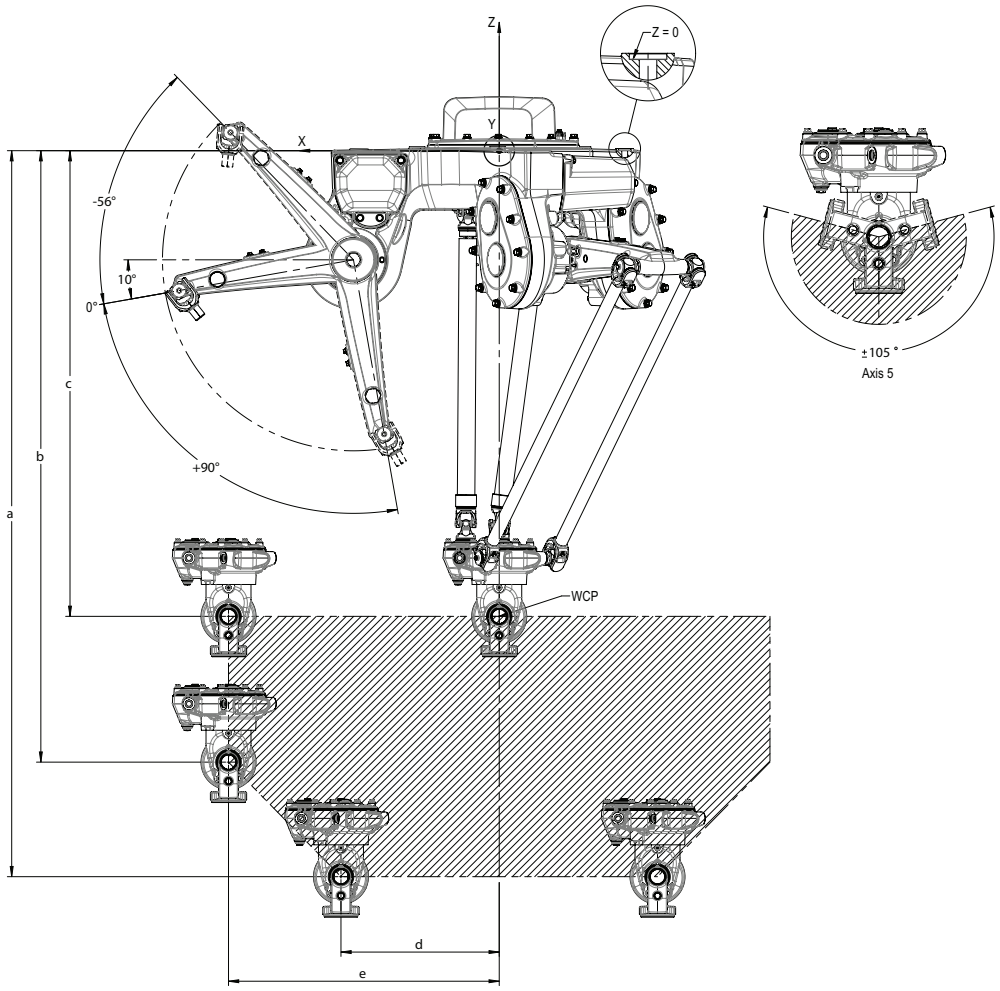
Measurement a	Measurement b	Measurement c	Measurement d	Measurement e
1,463 mm	1,274 mm	1,063 mm	475 mm	650 mm

Continues on next page

2.2 Working range
Continued

Illustration, working range IRB 390 - 10/1300

This illustration shows the unrestricted working range of the robot.



xx1900001422

Dimensions

Measurement a	Measurement b	Measurement c	Measurement d	Measurement e
1,518 mm	1,329 mm	1,118 mm	380 mm	650 mm

2.3 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.

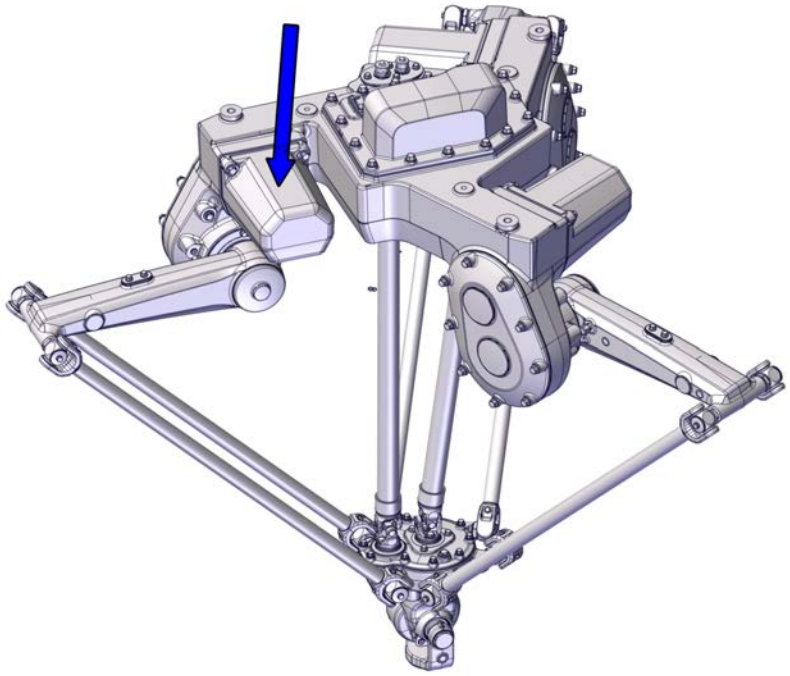
  The mat must be grounded through a current-limiting resistor.
- Use a dissipative table mat.

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

2.4 Robot specific labels (rating label, calibration label and UL label)

Location of robot specific labels

The robot specific labels: rating label, calibration label and UL label (option), are located inside the axis-1 motor cover.



xx2000002198

Label material

The label material is not FDA compliant.

Extra labels enclosed

In addition to the labels attached to the robot according to previous figure, an extra rating label and calibration label are also enclosed in the robot delivery. These labels can be installed on the robot or stored elsewhere.

3 Installation and commissioning

3.1 Introduction to installation and commissioning

General

This chapter contains assembly instructions and information for installing the IRB 390 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 37*.

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 390 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 V250XT Type B*
- *Product manual - OmniCore V400XT*
- *Product manual - IRC5*

3.2 Unpacking

3.2.1 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 37*
6	If the robot is not installed directly, it must be stored as described in: *Storage conditions, robot on page 39*
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: *Operating conditions, robot on page 39*
8	Before taking the robot to its installation site, make sure that the site conforms to: • *Loads on foundation, robot on page 38* • *Protection classes, robot on page 40* • *Requirements, foundation on page 39*
9	When these prerequisites are met, the robot can be taken to its installation site as described in section: *On-site installation on page 47*
10	Install required equipment, if any. • *Safety lamp (option for IRC5) on page 73*

3.3 On-site installation

3.3.1 Transport

General

This section describes how to transport the manipulator.

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

Delivery package

The manipulator is delivered divided in sub-assemblies: base unit, lower arms, delta unit and telescopic shaft. Transport the complete package to the installation site and assemble the robot to the robot frame. See *Orienting, assembling and securing the manipulator on page 52*.

xx2000000860

Transportation after installation

If the manipulator needs to be transported after it has been installed to the robot frame, it should be disassembled prior. Remove the delta unit, the lower arms and telescopic shaft from the base unit.

3.3.2 Brief installation procedure

Introduction

This procedure is a brief guide when installing the robot for the first time. Also see *Pre-installation procedure on page 46*.

First installation

Use these procedures to install the IRB 390.

	Action	Note
1	Transport the manipulator to its intended location.  **Note** Make sure to have required free space above the manipulator to be able to access the parts inside during maintenance or repair. See *Minimum required free space above the robot on page 49*.	
2	Install the valid platform or prepare the foundation for the manipulator.	See *Securing the robot frame on page 50*.
3	Lift and secure the manipulator to the platform/foundation.	See *Orienting, assembling and securing the manipulator on page 52*.
4	Connect the manipulator to the controller.	See • *Product manual - IRC5* • *Product manual - OmniCore V250XT Type B* • *Product manual - OmniCore V400XT*
5	Configure the safety settings.	See • *Product manual - IRC5* • *Product manual - OmniCore V250XT Type B* • *Product manual - OmniCore V400XT*
6	How to start and run the robot is described in the product manual for the controller.	See • *Product manual - IRC5* • *Product manual - OmniCore V250XT Type B* • *Product manual - OmniCore V400XT*
7	Install required equipment, if any. • *Safety lamp (option for IRC5) on page 73*	
8	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

3.3.3 Minimum required free space above the robot

Service activities require free space above the robot

Consider the need of sufficient free space above the robot, before installation.

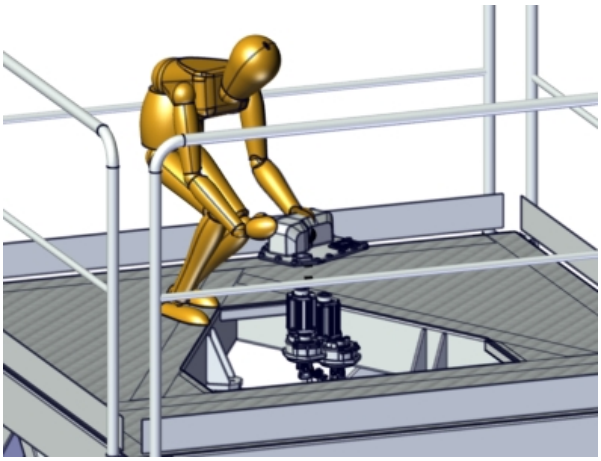
Following service activities require free space:

- Lifting away the base top cover.
- Replacing the base components, such as the SMB battery, axis-4 and axis-5 motor, cable harness.

Examples of access ways to the base components

Service platform

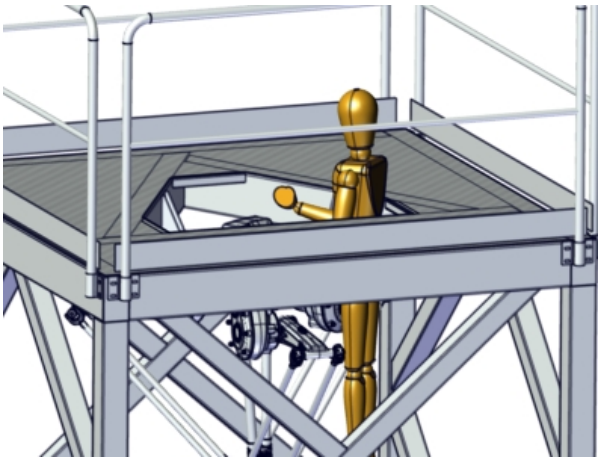
A service platform for access from above is recommended.



xx2000000672

Access way beside the robot

If a platform is not possible the service personnel need to be able to stand beside the robot according to the figure.



xx2000000671

3.3.4 Securing the robot frame

General

This section specifies the requirements for the robot frame installation.

Requirements on robot frame fastening

The fastening of the robot frame to the foundation must withstand the operational loads. See *Loads on foundation, robot on page 38*.

The requirements for the robot foundation, that is the robot anchoring points on the robot frame, must be met. See *Requirements, foundation on page 39*.

WARNING

The robot frame must be secured before mounting the robot.

Required equipment

Equipment	Spare part no.	Note
Standard tools		*Standard toolkit on page 361*

Orienting and securing

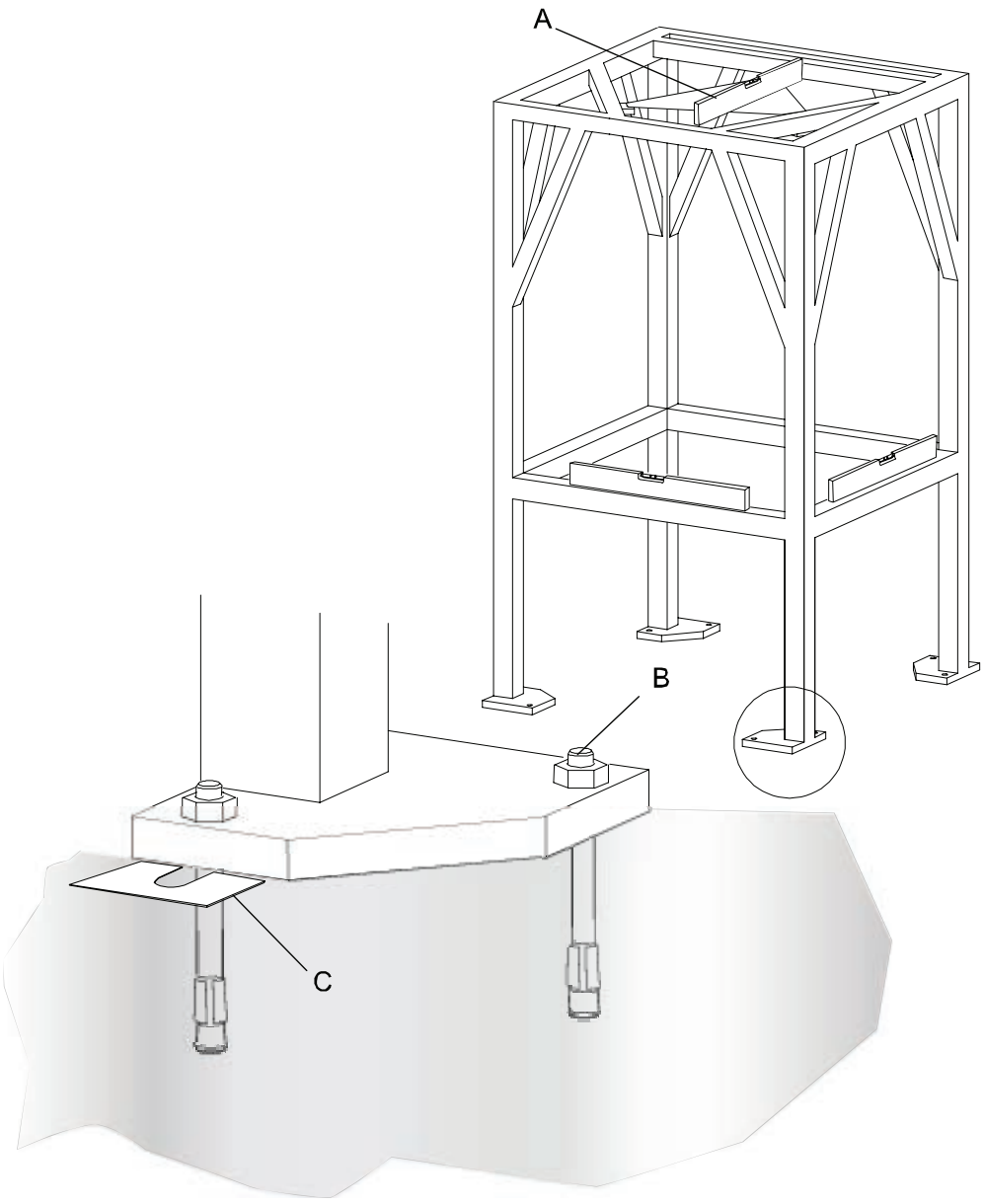
	Action	Note
1	Make sure the installation site for the robot conforms to the specifications in section *Technical data on page 37*.	
2	Make sure that the space above the installation site is sufficient for repair and maintenance.	See *Minimum required free space above the robot on page 49*.
3	Prepare the installation site.	
4	Secure the robot frame to the floor. **Note** Use leveling shims if needed.	Use fastening bolts that withstand the requirements for current foundation.
5	Make sure the robot anchoring points are level after having installed and secured the frame to the floor/foundation.	See *Requirements, foundation on page 39*. See *Illustration of leveling the robot frame on page 51*.

Continues on next page

Illustration of leveling the robot frame

The illustration is an example of how to meet the requirements for robot foundation, when fastening the robot frame.

The robot anchoring points in the frame must achieve required values for the foundation requirements to run the robot safely. See *Requirements, foundation on page 39*.



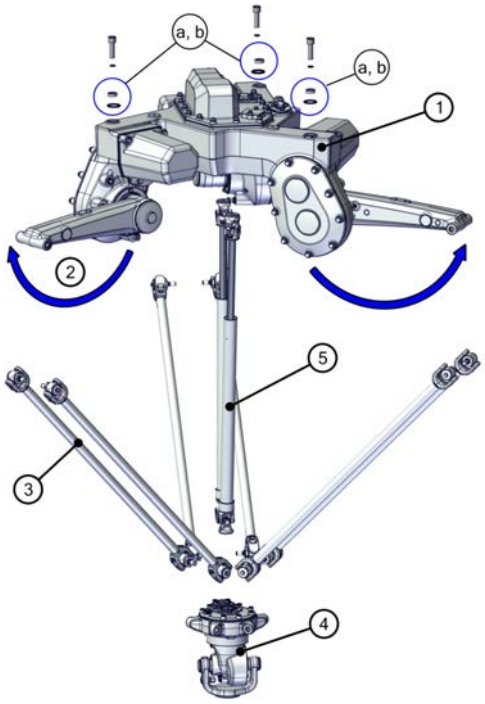
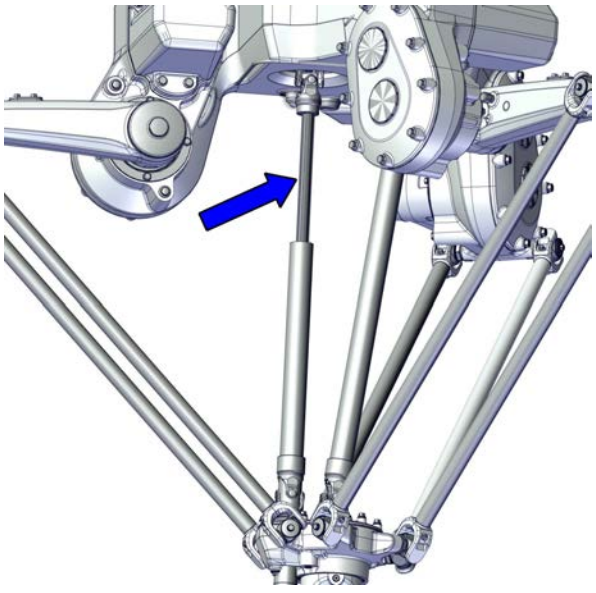
xx2000000601

A	Spirit level
B	Fastening bolts that withstand requirements for current foundation
C	Shim

3.3.5 Orienting, assembling and securing the manipulator

Overview of the assembly order

The IRB 390 is delivered in sub-assemblies which are assembled in the following order:

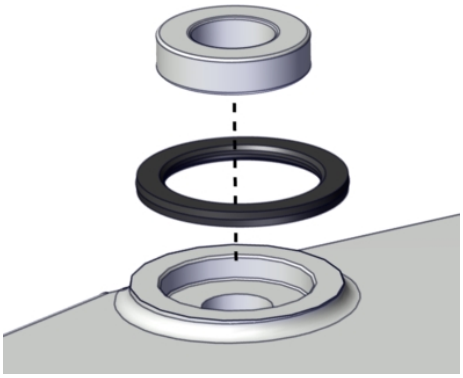
	Assembly order	Illustration
1	Install the base unit. **Note** The distance washer (a) and sealing (b) are packed separately in the delivery.	 xx2000000683
2	Move the upper arms into synchronization position.	
3	Attach the lower arms to the upper arms.	
4	Attach the delta unit to the lower arms.	
5	Attach the telescopic unit.	
6	Calibrate the robot.	
7	**CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	 xx2100002779

Detailed procedures for each step are given further on in this section.

Continues on next page

Attachment screws

The table below specifies the type of securing screws and washers to be used for securing the robot to the base foundation.

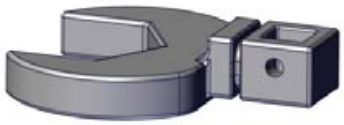
Suitable screws	M16 stainless steel. Minimum length of thread engagement: 24 mm
Quantity	3 pcs
Quality	Minimum quality: A4-80
Suitable washer	12.5x24x6.5 Steel (3HAC082030-001)
Distance washer and sealing	Distance washer: 3HAC070543-001. Sealing ring: 3HAC074660-001.  xx2000000260 Included in the manipulator delivery. Replace if damaged.
Tightening torque	250 Nm
Level surface requirements	0.3 mm

Required tools and equipment

Equipment	Article number	Note
Overhead crane	-	
Lifting eye	3HAC16131-1	M12 3 pcs
Roundsling, 2 m	-	3 pcs **CAUTION** The weight of the IRB 390 robot is IRB 390 - 15/1300: 133 kg IRB 390 - 10/1300: 148 kg All lifting accessories used must be sized accordingly.

Continues on next page

3.3.5 Orienting, assembling and securing the manipulator
Continued

Equipment	Article number	Note
Torque wrench head, open-end insert	3HAC073854-001	Included in robot delivery.  xx1900002148 Used with an interchangeable head torque wrench (not included in delivery). Interface: 14x18 mm.
Interchangeable head torque wrench	-	
Torque wrench head, closed end	3HAC063379-001	Included in robot delivery.  xx2000000282 Used with a torque wrench (not included in delivery) to loosen and tighten the universal joint and telescopic shaft screws. Hole interface: 1/4" square.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Required consumables

Consumable	Article number	Note
Anti-seize paste	3HAC070875-002	Molykote P1900
Cleaning agent	-	Isopropanol

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

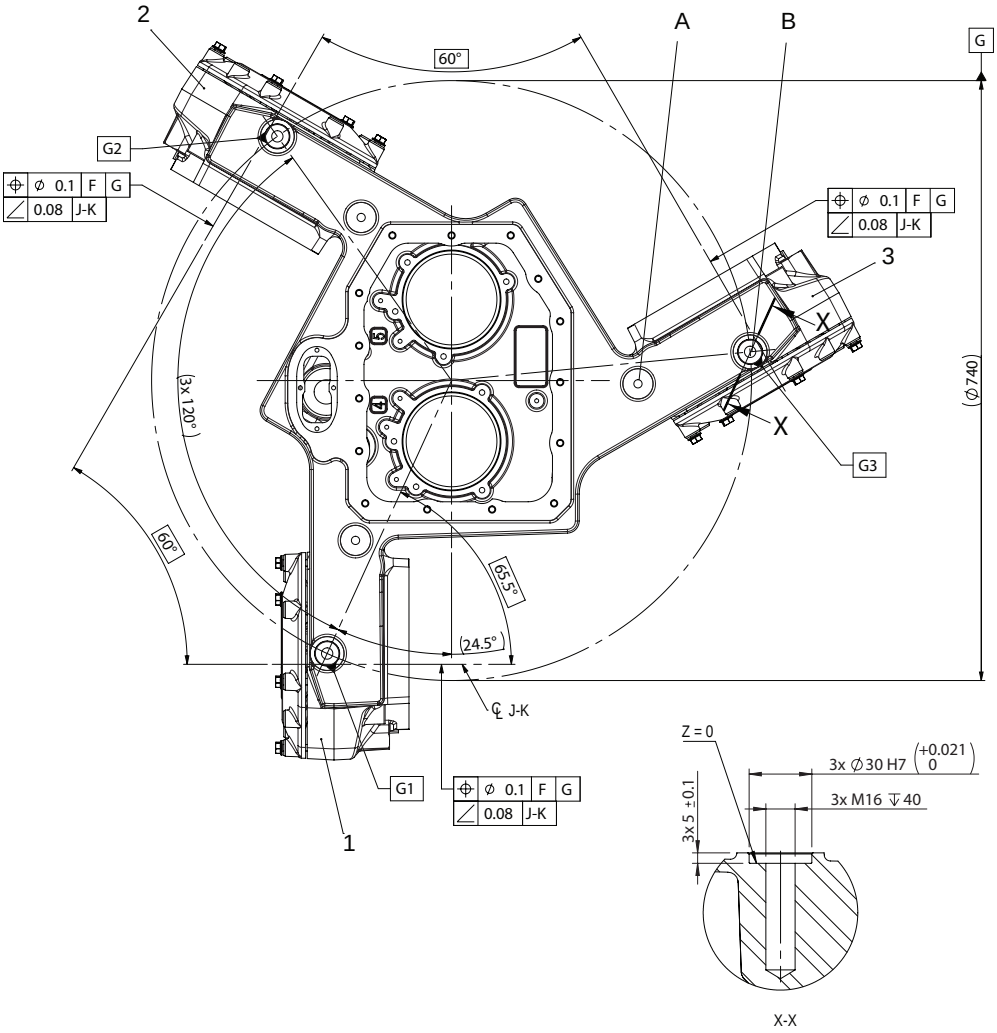
Spare part	Article number	Note
Protection screw	3HAC060233-011	Used in lifting eye attachment holes for robots in hygienic environment. Replace if lost or damaged.

Continues on next page

Spare part	Article number	Note
Sealing washer	3HAC081466-001	Used in lifting eye attachment holes for robots in hygienic environment. Replace if lost or damaged.

Hole configuration, base

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



xx2000000018

1	Axis-1 gearbox
2	Axis-2 gearbox
3	Axis-3 gearbox
A	Attachment holes for lifting eyes
B	Robot mounting holes
G1, G2, G3	Reference plane for each gearbox.

Continues on next page

3.3.5 Orienting, assembling and securing the manipulator
Continued

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

See specification in *Requirements, foundation on page 39*.

Assembling and installing

The IRB 390 is delivered in sub-assemblies.

Assemble the manipulator according to the following order.

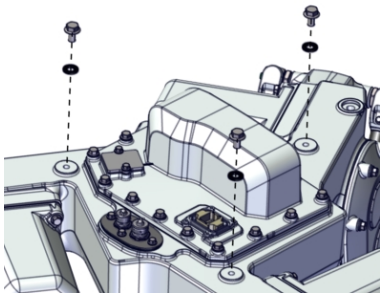
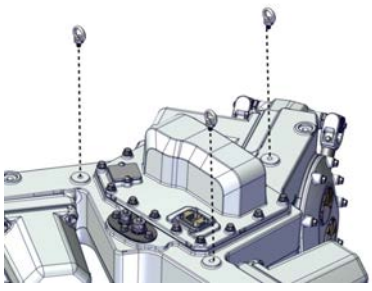
Preparations of the installation site

Use the procedure to prepare the installation site.

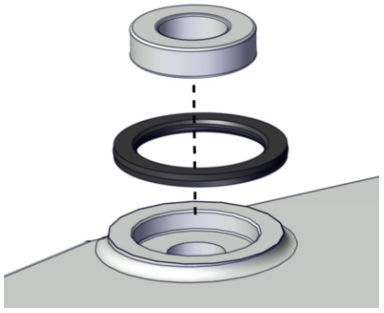
	Action	Note
1	Make sure the installation site for the robot conforms to the specifications in section *Technical data on page 37*.	
2	Make sure that the space above the installation site is sufficient for repair and maintenance.	See *Minimum required free space above the robot on page 49*.
3	Prepare the installation site with attachment holes.	The hole configuration of the base is shown in the figure in *Hole configuration, base on page 55*.

Installing the base unit

Use the procedure to install the base unit.

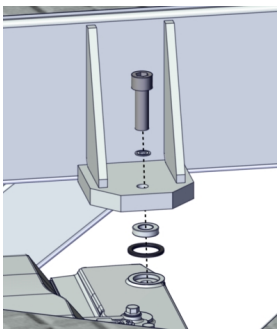
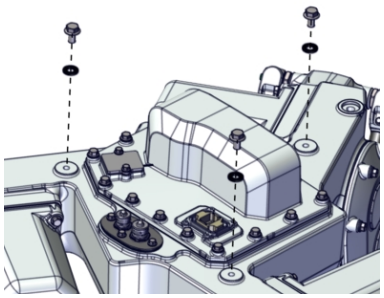
	Action	Note
1	Remove the three protection screws and washers. **Note** Save the protection screws and washers, to refit after the lifting eyes are removed.	 xx2200000718
2	Fasten three lifting eyes.	 xx1900000210

Continues on next page

	Action	Note
3	**CAUTION** The weight of the complete base unit and upper arms is 136 kg. All lifting accessories used must be sized accordingly.	
4	Attach the roundslings to the lifting eyes. **Note** Make sure the roundslings do not rub against any sharp edges.	Make sure the roundsling has free space and does not wear against any part of the robot.
5	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
6	Fit the sealing rings and distance washers to the three mounting points.	Distance washer (3HAC070543-001). Sealing ring (3HAC074660-001)  xx2000000260

Continues on next page

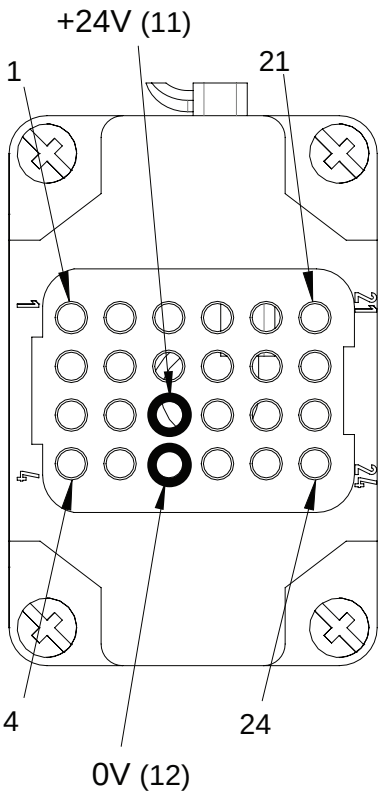
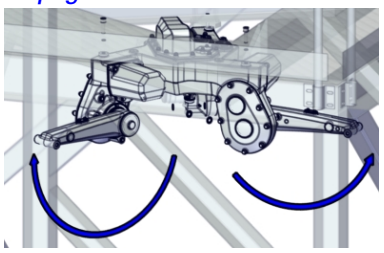
3.3.5 Orienting, assembling and securing the manipulator
Continued

	Action	Note
7	Lift the base unit to its mounting position, mate to the attachment holes and secure with attachment bolts and washers. Attachment bolts: M16 stainless steel. Minimum length of thread engagement: 24 mm, Minimum quality: A4-80 (3 pcs) Washers: 12.5x24x6.5 Steel (3HAC082030-001) Tightening torque: 250 Nm.  xx2000000470	 xx2000000469
8	Remove the lifting eyes and refit the protection screws and washers. Lubricate underneath the screw head to reduce friction against the washer.	Protection screw: 3HAC060233-011 Sealing washer: 3HAC081466-001 Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2200000718

Continues on next page

Moving the upper arms to installation position

Use this procedure to release the brakes and move the upper arms into installation position.

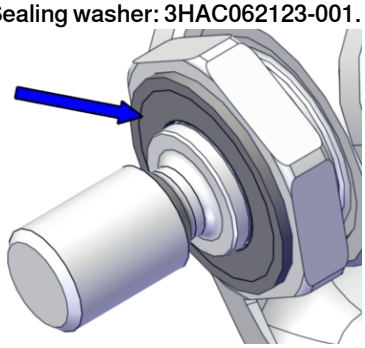
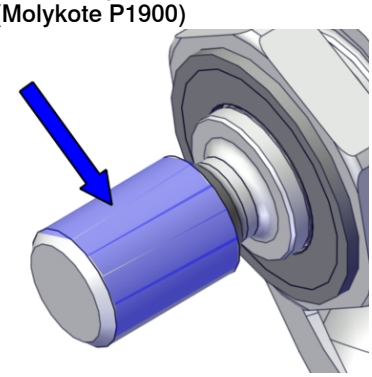
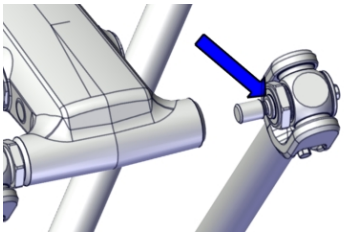
	Action	Note
1	Supply power to connector R1.MP on the robot, to be able to use the brake release button: • 0V on pin 12. • 24V on pin 11. **DANGER** Incorrect connections, such as supplying power to the wrong pin, may cause all brakes to be released simultaneously and instantly! **Note** Do not interchange the 24V and 0V pins. If they are mixed up, damage can be caused to internal electrical components.	 xx2000000686
2	Release the brakes by pressing the brake release button and move the upper arms to synchronization position.	See *Releasing the brakes on page 69*. See *Synchronization marks and synchronization position for axes on page 324*.  xx2000000676
3	Disconnect the 24V supply from the R1.MP connector.	

Continues on next page

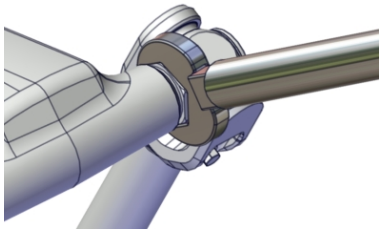
3.3.5 Orienting, assembling and securing the manipulator
Continued

Attaching the lower arms to the upper arms

Use this procedure to fit all lower arms.

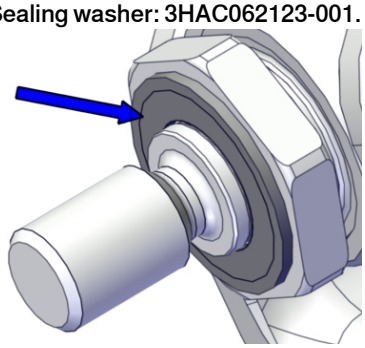
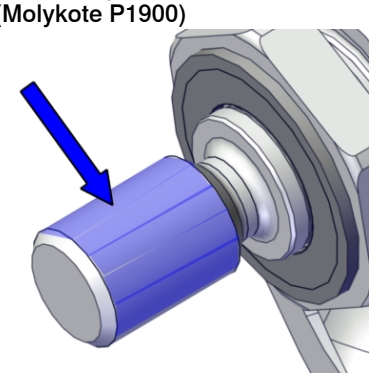
	Action	Note
1	Fit the sealing washer to the lower arm. Replace the sealing washer if damaged.	Sealing washer: 3HAC062123-001.  xx2000000861
2	Lubricate only the thread of the lower arm where the arrow is pointing, see figure. **Note** Do not lubricate the parts marked with the red color.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000684
3	Fit the lower arm. Make sure the sealing washer is in place. **Note** The lower arm can be turned either way, the orientation has no significance.	Lower arm / parallel bar: 3HAC060138-001.  xx1900001796

Continues on next page

	Action	Note
4	Tighten the shaft. Start by hand, then use an interchangeable head torque wrench and the open-end head insert to apply tightening torque.	Tightening torque: 100 Nm. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002152

Attaching the delta unit

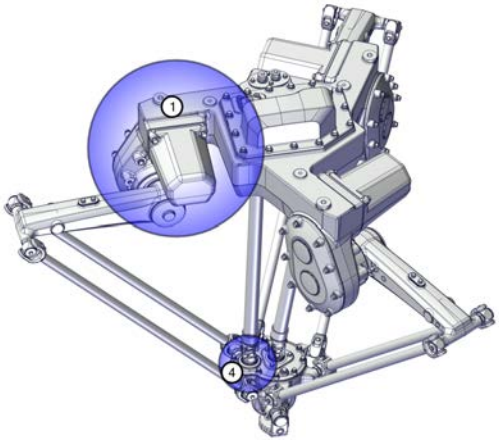
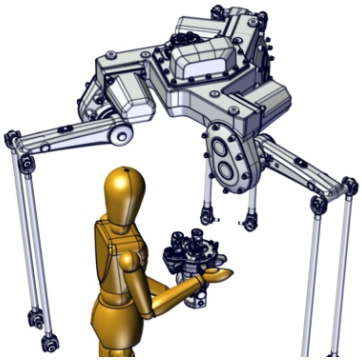
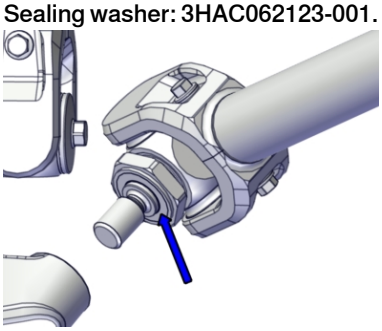
Use this procedure to fit the delta unit.

	Action	Note
1	Fit sealing washers to the lower arms. Replace the sealing washers if damaged.	Sealing washer: 3HAC062123-001.  xx2000000861
2	Lubricate only the thread on the joint of the lower arm. **Note** There must be no grease outside the thread.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000684

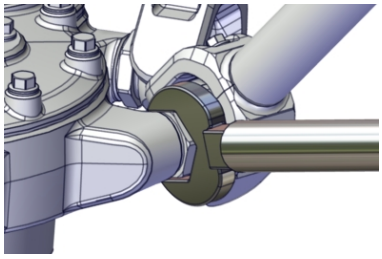
Continues on next page

3.3.5 Orienting, assembling and securing the manipulator

Continued

	Action	Note
3	Lift and hold the delta unit or place the delta unit on a workbench. Orientation of delta unit: axis-4 universal joint side of delta unit directed towards axis-1 side of robot.  xx2000000685 **CAUTION** Axis 5 on the delta unit is not stable. There is a risk of pinching or tipping the unit if holding or putting down the delta unit on its tilt arm. **Tip** This operation is best performed by two persons working together.	Delta unit, axis 4: 3HAC058371-003. Delta unit, axis 4-5: 3HAC058372-002.  xx2000000687
4	Fit all lower arms to the delta unit. Make sure the sealing washers are in place.	Sealing washer: 3HAC062123-001.  xx2000001063

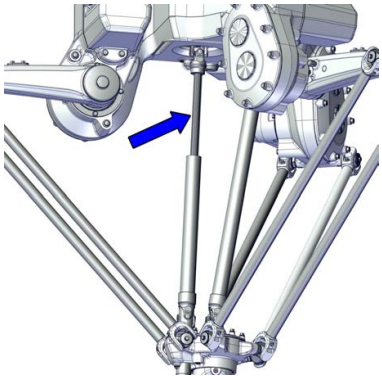
Continues on next page

	Action	Note
5	Tighten the lower arm shafts. Start by hand, then use an interchangeable head torque wrench and the open-end head insert to apply tightening torque.	Tightening torque: 100 Nm. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002150

Attaching the telescopic unit

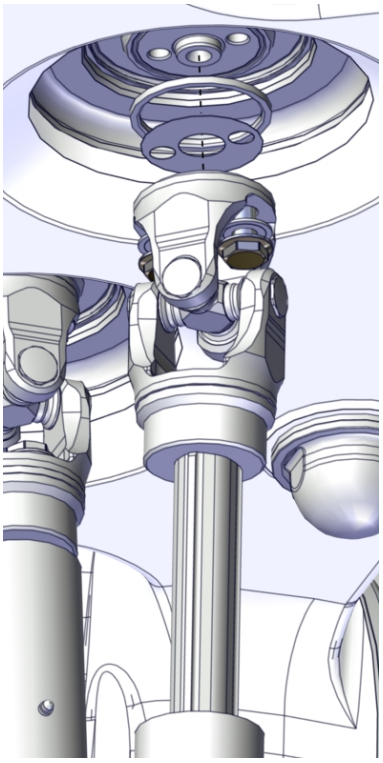
Use these procedures to fit the telescopic unit.

Refitting the upper end of the telescopic shaft

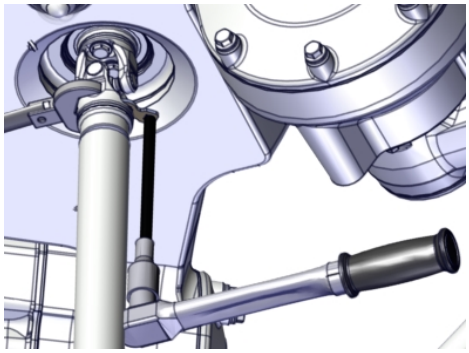
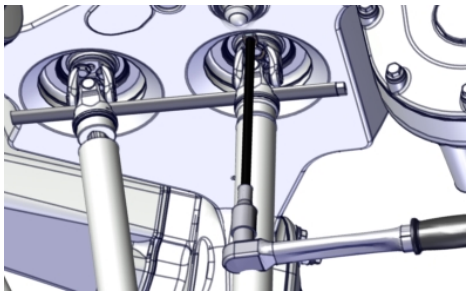
	Action	Note
1	**CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	 xx2100002779
2	Clean the friction shim, the sealing ring and the contact surfaces with isopropanol. Inspect for damage. Replace if damaged.	Cleaning agent: Isopropanol. Friction shim: 3HAC060200-001. Sealing ring: 3HAC060263-001

Continues on next page

3.3.5 Orienting, assembling and securing the manipulator
Continued

	Action	Note
3	Fit the upper end of the telescopic shaft by installing the friction shim, sealing ring and the telescopic shaft at the base unit. **CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	Telescopic shaft unit: 3HAC059382-003  xx2000001109

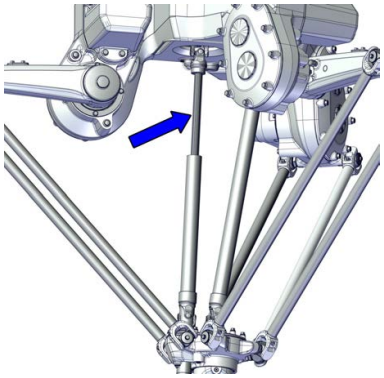
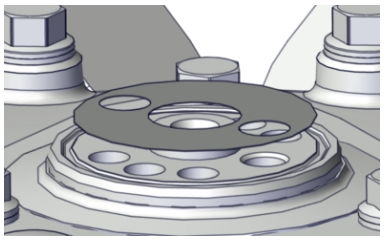
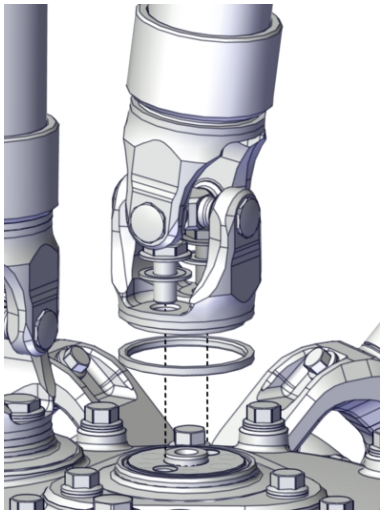
Continues on next page

	Action	Note
4	Lubricate the screw thread and the washer surface underneath the screw head. Secure with the lubricated screws and washers and tighten, using the torque wrench head with a closed end. **Tip** The shaft rotates when loosening/fastening the screws. Use one of two alternatives to hold the shaft still: 1 Hold the motor shaft still with an open-end wrench (47 mm) at the joint while loosening/tightening the screws. Requires two persons.  xx2000000346 2 Hold the motor shaft still by inserting a pin through the joints (5-axis robot) or through the joint and against the casting. Choose an appropriate material for the pin, that does not damage the surface of the joints.  xx2000000688 **CAUTION** There is a risk of damage to the joint if not handled with care.	Anti-seize paste: 3HAC070875-002 (Molykote P1900) Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: 3HAC058626-004 Tightening torque: 35 Nm.

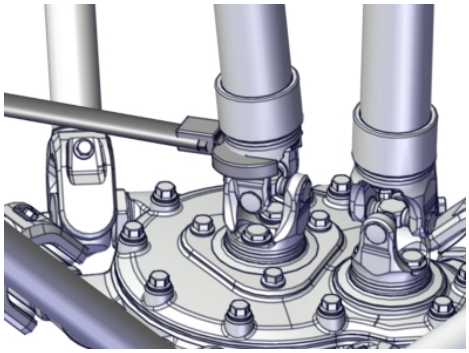
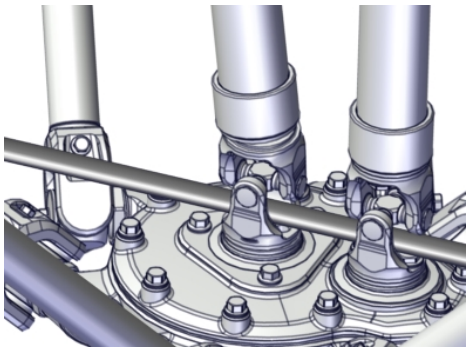
Continues on next page

3.3.5 Orienting, assembling and securing the manipulator
Continued

Refitting the lower end of the telescopic shaft

	Action	Note
1	**CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	 xx2100002779
2	Clean the friction shim and sealing ring with isopropanol. Inspect the friction shim and sealing ring. Replace if damaged.	Cleaning agent: Isopropanol. Friction shim: 3HAC060200-001. Sealing ring: 3HAC060263-001
3	Fit the friction shim.	 xx1900001829
4	Install the sealing ring at the lower joint and guide the telescopic shaft into place. **CAUTION** Hold the telescopic unit carefully, the tube may slide and get damaged.	 xx2000001111

Continues on next page

	Action	Note
5	Lubricate the screw thread and the washer surface underneath the screw head. Secure with the lubricated screws and washers and tighten, using the torque wrench head with a closed end. **Tip** The shaft rotates when loosening/fastening the screws. Use one of two alternatives to hold the shaft still: 1 Hold the motor shaft still with an open-end wrench (47 mm) at the joint while loosening/tightening the screws. Requires two persons.  xx2000001103 2 Hold the motor shaft still by inserting a pin through the joints (5-axis robot) or through the joint and against the casting. Choose an appropriate material for the pin, that does not damage the surface of the joints.  xx2000001104 **CAUTION** There is a risk of damage to the joint if not handled with care.	Anti-seize paste: 3HAC070875-002 (Molykote P1900) Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: 3HAC058626-004 Tightening torque: 35 Nm.

Continues on next page

3.3.5 Orienting, assembling and securing the manipulator
Continued

Calibration

	Action	Note
1	Update the revolution counters.	See *Updating revolution counters on page 326*.

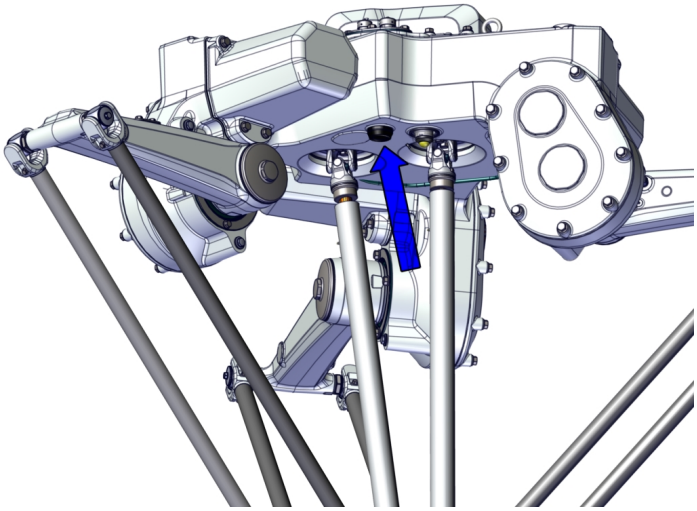
3.3.6 Manually releasing the brakes

Introduction to manually releasing the brakes

This section describes how to release the holding brakes for the axes motors.

Location of the brake release unit

The brake release unit is located as shown in the figure.



xx1900000252

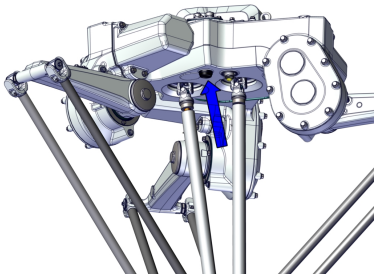
Releasing the brakes

This procedure describes how to release the holding brakes when the robot is equipped with a brake release unit.

	Action	Note
1	The internal brake release unit is equipped with a button for controlling the axes brakes. **Note** If the robot is not connected to the controller, power must be supplied to the connector R1.MP according to the section *Supplying power to connector R1.MP on page 70*.	
2	**DANGER** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways. Make sure no personnel is near or beneath the robot.	

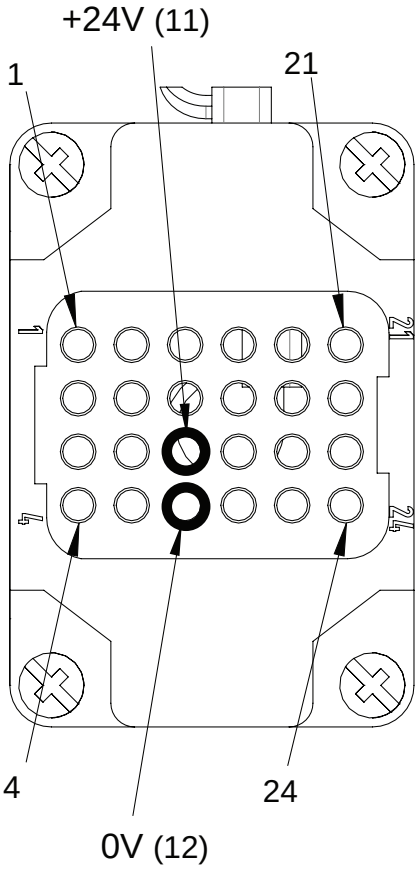
Continues on next page

3.3.6 Manually releasing the brakes
Continued

	Action	Note
3	Release the holding brake of all axes by pressing the brake release button. The brake will be enable as soon as the button is released. **WARNING** Pressing the brake release button will release the holding brakes on all axes simultaneously.	 xx1900000252

Supplying power to connector R1.MP

If the robot is not connected to the controller, power must be supplied to connector R1.MP on the robot, in order to enable the brake release buttons.

	Action	Note
1	**DANGER** Incorrect connections, such as supplying power to the wrong pin, may cause all brakes to be released simultaneously and instantly!	
2	Supply • 0V on pin 12. • 24V on pin 11. **Note** Do not interchange the 24V and 0V pins. If they are mixed up, damage can be caused to internal electrical components.	 xx2000000686

Continues on next page

	Action	Note
3	Use the brake releasing button as described in *Releasing the brakes on page 69*.	

3.3.7 Loads fitted to the robot, stopping time and braking distances

Define loads carefully

Any loads mounted on the robot must be defined correctly and carefully (with regard to the position of center of gravity and mass moments of inertia) in order to avoid jolting movements and overloading motors, gears and structure.

> **CAUTION**
>
> Incorrectly defined loads may result in operational stops or major damage to the robot.

Load diagrams, permitted extra loads (equipment) and their positions are specified in the product specification. The loads must be defined in the software.

Stopping time and braking distances

The performance of the motor brake depends on if there are any loads attached to the robot.

See the product specification for the robot, listed in *References on page 10*.

3.3.8 Safety lamp (option for IRC5)

Description

A signal lamp with a yellow fixed light can be ordered as an option for the robot, as a safety device. If chosen, the signal lamp will be installed by delivery. No extra action is required.

Function

The lamp is active in MOTORS ON mode.

Further information

Further information about the MOTORS ON/MOTORS OFF mode may be found in the product manual for the controller.

3.3.9 Installing a brake release box (option)

General

The robot cable harness is prepared for connecting a brake release box, as an option and as an addition to the standard brake release button.

This option is valuable if access to the standard brake release button is limited.

Brake release box installation

The figure shows a routed cable from the brake release box to the SMB battery compartment located on top of the base unit.

CAUTION

Risk of unintended contact with the push button. Place the brake release box in a way that eliminates the risk of unintended contact with the push button.

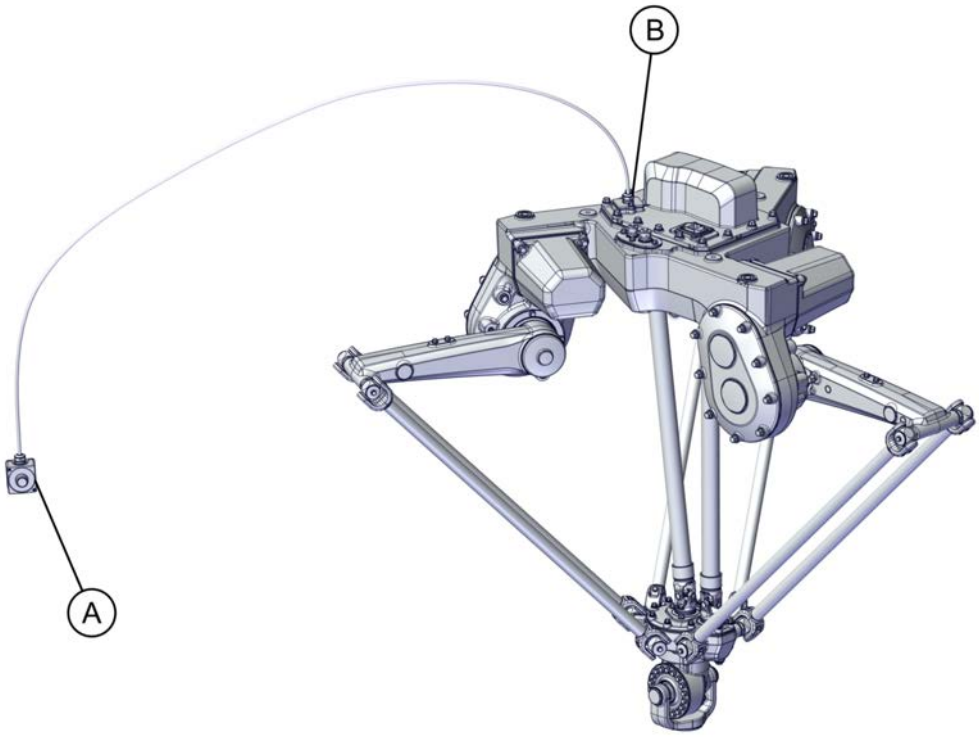
Note

The equipment must be installed in accordance with the specified protection class, see *Protection classes, robot on page 40*.

Note

Place the equipment in a manner that makes it obvious which manipulator it is connected to. There must be no doubt on which manipulator is affected when activating the button.

Continues on next page



xx2200000273

A	Brake release box assembly
B	Connection to robot cable harness connector R3.H1

Technical specification

Function	Data
Signal	24V DC
Current	13A continuously

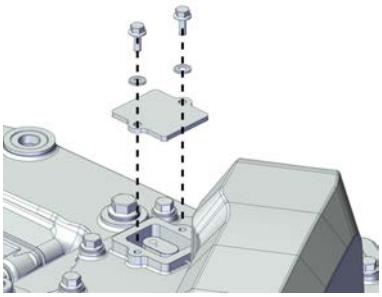
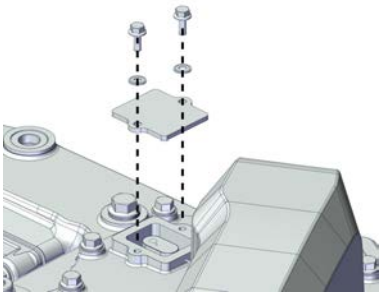
Required equipment

Equipment	Note
2-core cable, shielded	Maximum cable length: 3 m.
Cable connector	
Cable gland	To be installed in the SMB battery cover.
Push button, momentary push to make	Passive actuator with open spring return push button. Must not be susceptible to ESD. Make an installation assembly with the push button, to be fitted to the robot frame or a similar appropriate location. **CAUTION** Risk of unintended contact with the push button. Place the brake release box in a way that eliminates the risk of unintended contact with the push button.

Continues on next page

3.3.9 Installing a brake release box (option)
Continued

Installing brake release box

	Action	Note
1	Remove the SMB battery cover. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	 xx2100002190
2	Connect a 2-wire cable to the external push button and install the push button assembly at an appropriate location, e.g. on the robot frame. **Note** The push button assembly must be secured properly with four screws at a minimum height of 1 m above the floor.	
3	Route the 2-wire cable in a secure way, from the push button to the top of the robot base.	
4	Insert the cable through the cable gland in the battery cover and sealing.	
5	Fit a connector to the 2-wire cable.	
6	Pull out the cabling from the SMB battery compartment and connect the 2-wire cable connector to the connector R3.H1.	
7	Put back the cables inside the SMB battery compartment and refit the SMB battery cover. **CAUTION** The cabling is sensitive to mechanical damage. Handle it with care to avoid damage to the cabling or the connector, avoid any kind of tilt or skew.	 xx2100002190
8	Tighten the cable gland to ensure it is sealed.	

Continues on next page

	Action	Note
9	Install the brake release box assembly on a location easily accessed by the operator. **CAUTION** Risk of unintended contact with the push button. Place the brake release box in a way that eliminates the risk of unintended contact with the push button. **Note** The equipment must be installed in accordance with the specified protection class, see *Protection classes, robot on page 40*. **Note** Place the equipment in a manner that makes it obvious which manipulator it is connected to. There must be no doubt on which manipulator is affected when activating the button.	

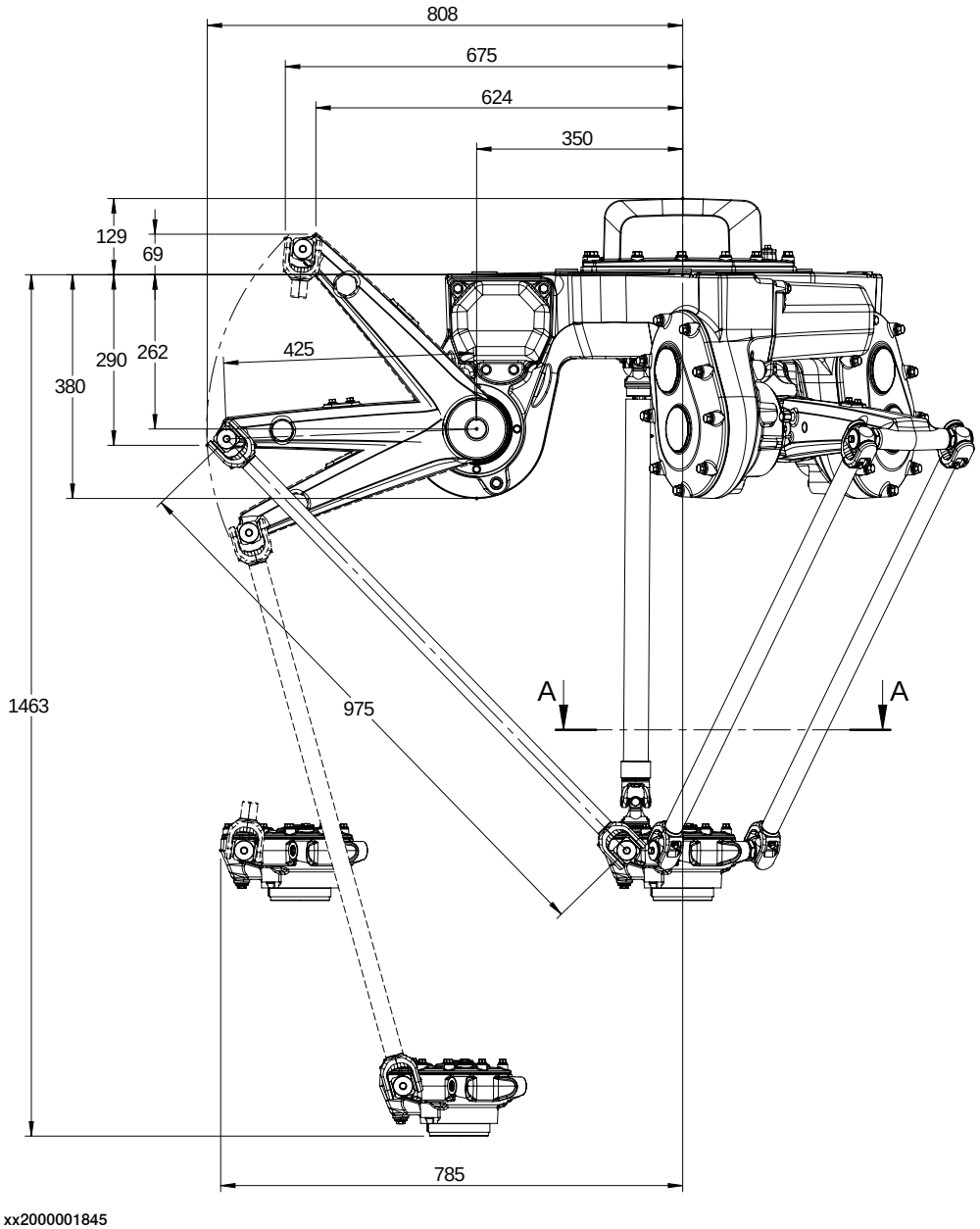
3.3.10 Fitting equipment on the robot (robot dimensions)

Robot dimensions

The figure shows the dimension of the robot.

The view A-A is shown in *Attachment holes for extra loads on the delta unit on page 85*.

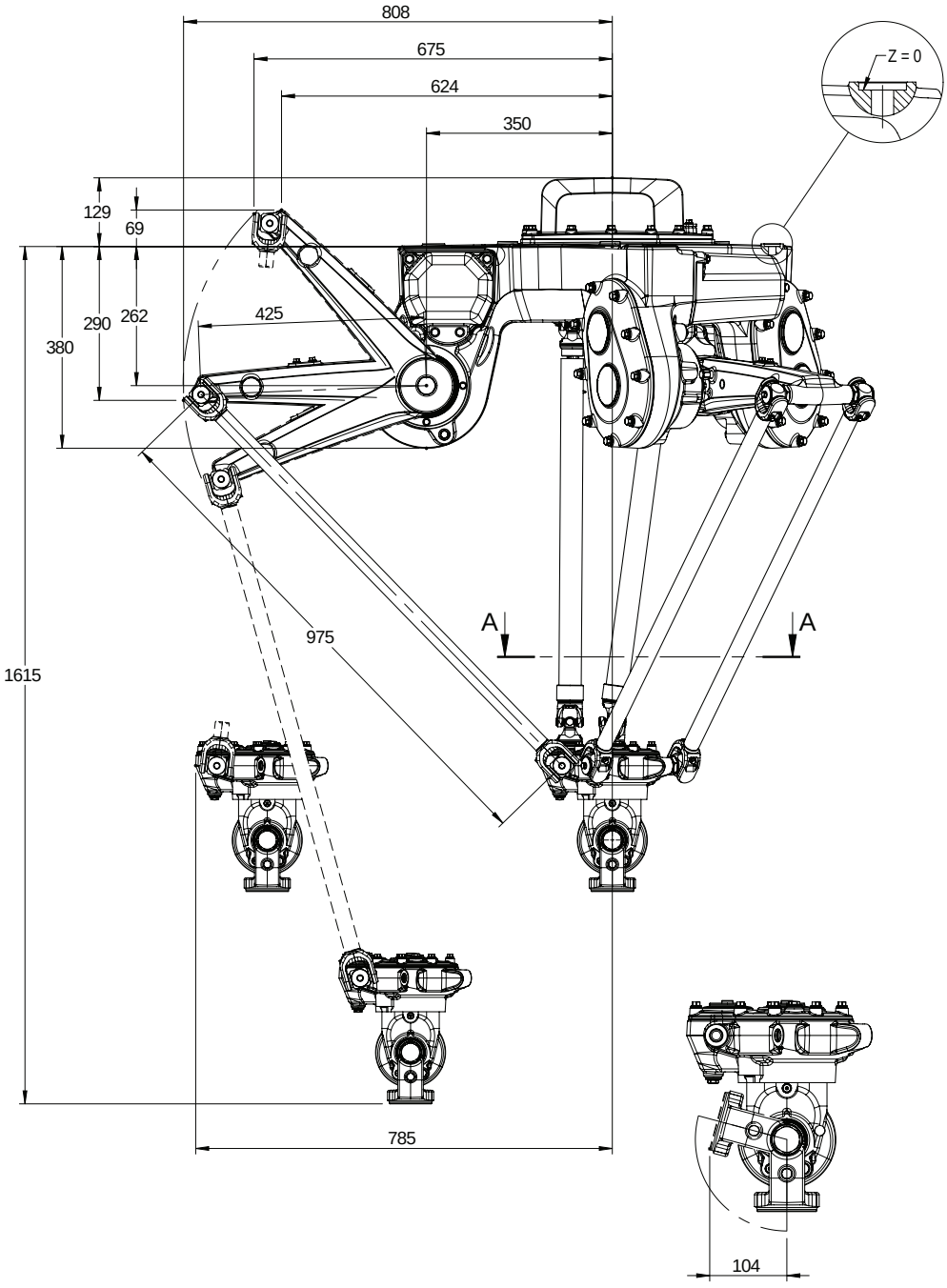
IRB 390 - 15/1300



xx2000001845

Continues on next page

IRB 390 - 10/1300



xx2000001839

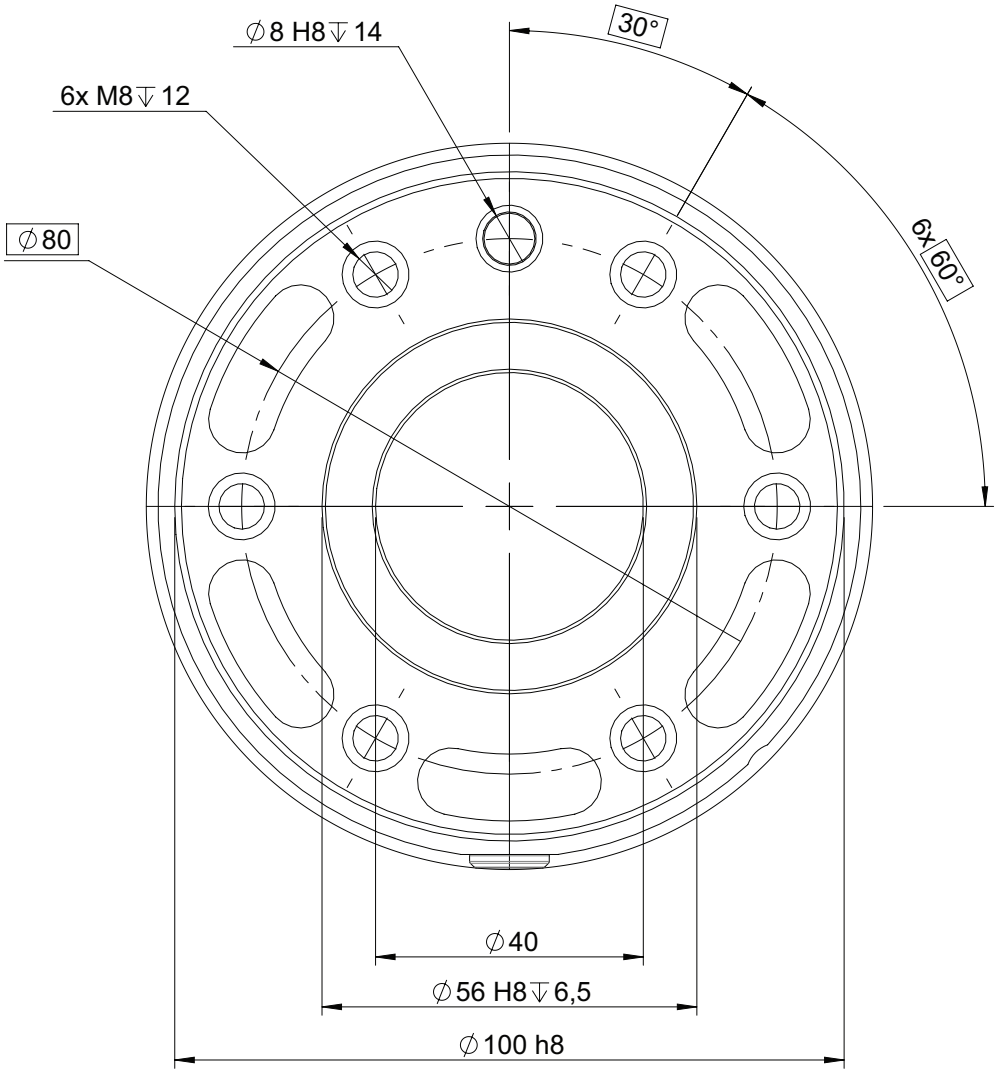
The view A-A is shown in *Attachment holes for extra loads on the delta unit on page 85*.

Continues on next page

3.3.10 Fitting equipment on the robot (robot dimensions)
Continued

Mechanical interface of the tool flange

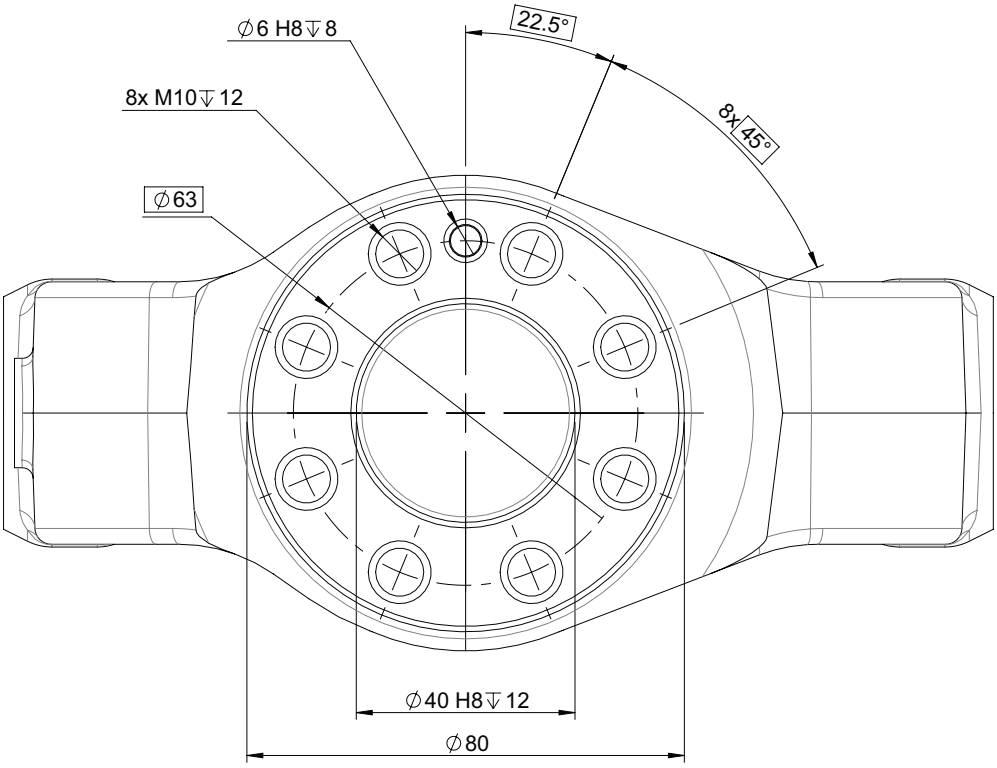
IRB 390 - 15/1300



xx2200001033

Continues on next page

IRB 390 - 10/1300



xx2000002064

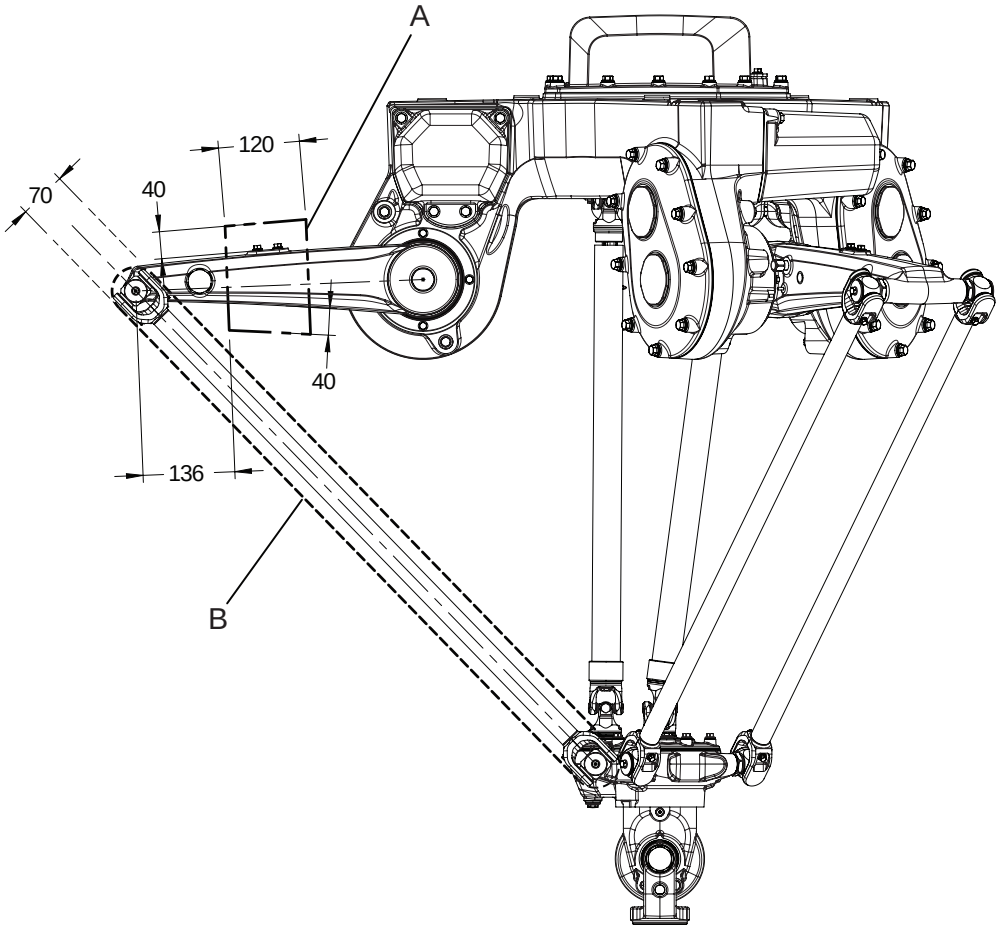
Continues on next page

3.3.10 Fitting equipment on the robot (robot dimensions)
Continued

Attachment holes and dimensions for extra loads

Extra loads can be mounted on robot. Definitions of dimensions and masses are shown in the following figures. The robot is supplied with holes for fitting extra equipment. Maximum allowed arm load depends on center of gravity of arm load and robot payload.

Center of gravity for extra loads on upper and lower arms



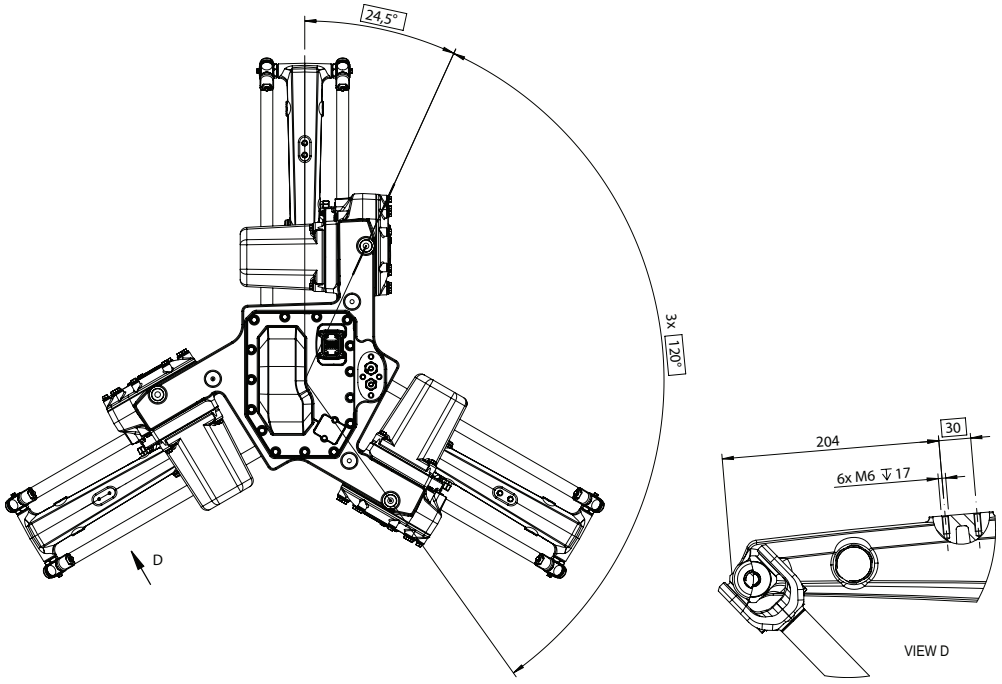
xx2000002341

A	Allowed center of gravity for extra loads on upper arms.
B	Allowed center of gravity for extra loads on lower arms.

Continues on next page

Attachment holes for extra loads on the upper arms

There is a set of two M6 holes on top of each upper arm, that can be used for attaching equipment. Maximum extra load: 0.5 kg/upper arm.



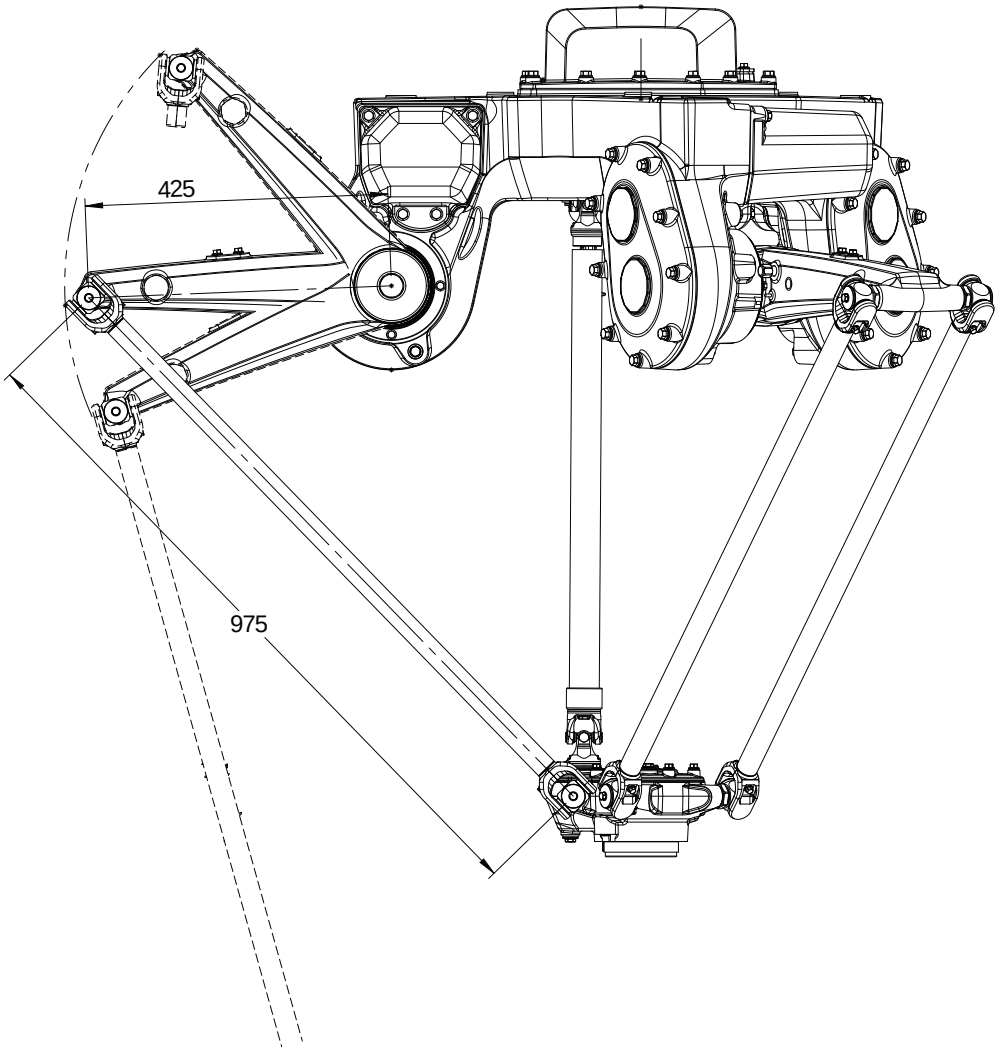
xx2000001847

Continues on next page

3.3.10 Fitting equipment on the robot (robot dimensions)
Continued

Attachment of extra loads on the lower arms

No holes for fitting extra equipment are available on the lower arms. If attaching extra equipment to the lower arms, use shaped clamping blocks. Plastic cable ties can be used but risk damaging of the paint. Do not use metal directly on the lower arms. Maximum extra load: 0.15 kg/lower arm.

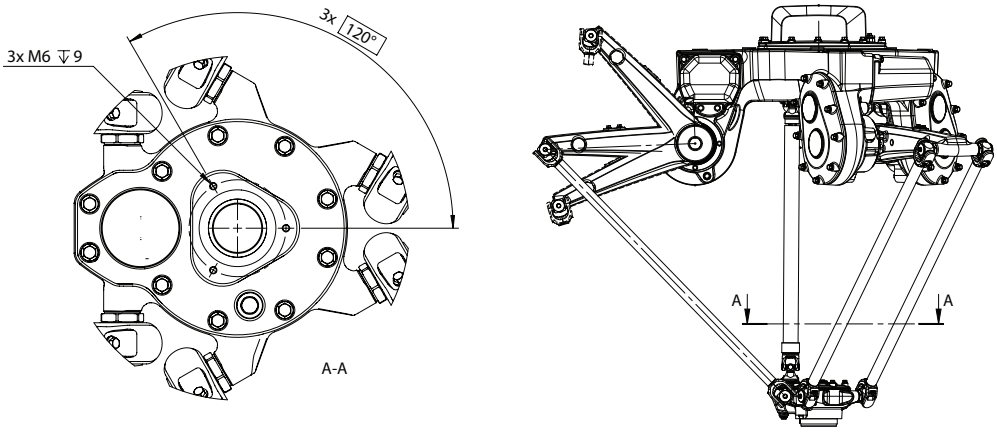


xx2000001849

Continues on next page

Attachment holes for extra loads on the delta unit

There is a set of three M6 holes on top of the delta unit that can be used for attaching equipment. Maximum extra load on the delta unit: 0.5 kg.



xx2000001848

Fastener quality

When fitting tools on the tool flange, only use screws with quality 12.9. For other equipment use suitable screws and tightening torque for your application.

3.4 Electrical connections

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.

> **CAUTION**
>
> Verify that the serial number is according to the number(s) in the *Declaration of Incorporation* (DoI).

Main cable categories

The following table specifies cabling categories between the robot and the controller. Some of the cabling belong to optional applications.

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 86*.
Customer cables	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. See the product manual for the controller, see document number in *References on page 10*.

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

Robot cable, power

Power cable length	Article number
Power cable 3 m	3HAC040503-007
Power cable 7 m	3HAC040503-001

Continues on next page

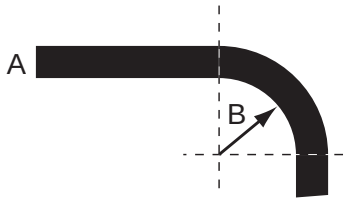
Power cable length	Article number
Power cable 15 m	3HAC040503-002
Power cable 22 m	3HAC040503-003
Power cable 30 m	3HAC040503-004

Robot cable, signals

Signal cable length	Article number
Signal cable, shielded: 3 m	3HAC035320-001
Signal cable, shielded: 7 m	3HAC2493-1
Signal cable, shielded: 15 m	3HAC2530-1
Signal cable, shielded: 22 m	3HAC2540-1
Signal cable, shielded: 30 m	3HAC2566-1

Bending radius for static floor cables

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



xx1600002016

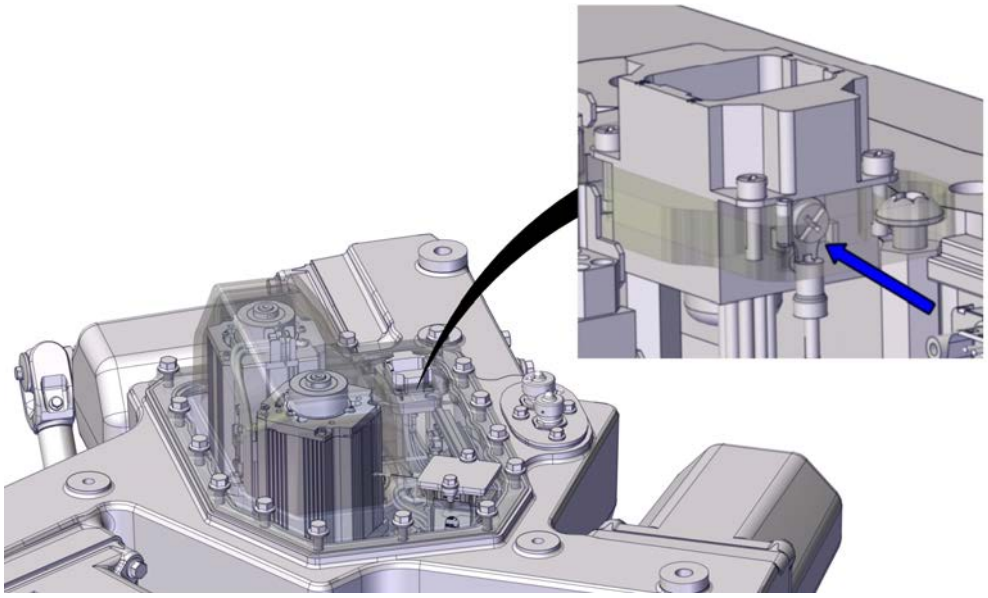
A	Diameter
B	Diameter x10

Continues on next page

3.4.1 Robot cabling and connection points
Continued

Grounding and bonding point on manipulator

There is a grounding/bonding point on the manipulator base. The grounding/bonding point is used for potential equalizing between control cabinet, manipulator and any peripheral devices.



xx2000001106

Installation of extra O-rings

An extra O-ring is delivered together with the robot and must be fitted to the robot during installation.

Equipment	Article number	Note
O-ring	3HAB3772-19	Used to seal between the main power cable and connector.

3.5 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 all safety equipment is installed, as designed for the application.
6	Verify that no personnel are inside the safeguarded space.
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.

Collision risks

CAUTION

When programming the movements of the robot, always identify potential collision risks before initiating motion.

This page is intentionally left blank

4 Maintenance

4.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 390.

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 390 is connected to power, always make sure that the IRB 390 is connected to protective earth and a residual current device (RCD) before starting any maintenance work.

For more information see:

- *Product manual - OmniCore V250XT Type B*
- *Product manual - OmniCore V400XT*
- *Product manual - IRC5*
- *Robot cabling and connection points on page 86*.

4.2 Maintenance schedule and expected component life

4.2.1 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 390:

- 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.

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

4.2.2 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 damage must be attended to immediately.

Life of each component

The inspection intervals *do not* specify the life of each component. Values for these are specified in the section *Expected component life on page 95*

Maintenance schedule

Maintenance activities	Regularly	After first 150 hours	Every 6 months	Every 12 months	Every 36 months	Every 8,000 hours [i]	Every 12,000 hours [i]	Every 20,000 hours [i]	Every 40,000 hours [i]	Reference
Cleaning the seals		x								Minor seepage of grease from the seals can occur, especially during the first running hours. Wipe down affected areas with a dry cloth.
Cleaning the robot	x									*Cleaning the IRB 390 on page 139*
Lubricating the telescopic shafts						x				*Lubricating the telescopic shafts on page 137*
Visually inspecting the cups			x							*Visually inspecting the cup on axis-4 and axis-5 on page 107*
Inspecting and cleaning the cups				x						*Inspecting the cup on axis-4 and axis-5 on page 105*
Inspecting the information labels				x						*Inspecting the information labels on page 98*
Inspecting the lower arms				x						*Inspecting the lower arms on page 100*
Inspecting the axis-1, axis-2 and axis-3 motors			x [ii]							*Inspecting the motors on page 103*
Inspecting the telescopic shafts			x							*Inspecting the telescopic shafts on page 96*

Continues on next page

4.2.2 Maintenance schedule
Continued

Maintenance activities	Regularly	After first 150 hours	Every 6 months	Every 12 months	Every 36 months	Every 8,000 hours [i]	Every 12,000 hours [i]	Every 20,000 hours [i]	Every 40,000 hours [i]	Reference
Inspecting the oil level in gearboxes										Inspect the oil level in the actual gearbox if there is a suspected leakage, after an oil change or a maintenance or repair activity where draining and filling oil is required.
Changing the oil in axis-1, axis-2 and axis-3 gearbox								x		*Changing oil, axis-1, axis-2 and axis-3 gearbox on page 115*
Changing the oil in axis-4 and axis-5 gear prestage								x		*Changing oil, axis-4 and axis-5 gear unit on page 120*
Changing the oil in axis-4 and axis-5 gearbox								x		*Changing oil, axis-4 and axis-5 gear unit on page 120*
Replacing the SMB battery pack					x [iii]					*Changing the SMB battery on page 130*
Replacing the universal joint							x			*Replacing the telescopic shafts and universal joints on page 236*
Replacing the axis-1, axis-2 and axis-3 motors							x			*Replacing the axis-1, axis 2 and axis-3 motor on page 260*
Replacing the telescopic shaft								x		*Replacing the telescopic shafts and universal joints on page 236*
Overhaul of complete robot									x	

[i] Operating hours counted by the DTC = Duty Time Counter
[ii] Perform first inspection after 12 months, then regularly every 6 months.
[iii] The battery is to be replaced at given maintenance interval or at battery low alert.

4.2.3 Expected component life

Expected life depends on usage

The expected life of a specific component of the robot can vary greatly depending on how hard it is run.

Expected component life

Component	Expected life	Note
Gearboxes	40,000 hours	
Motors, axes 1, 2 and 3	12,000 hours	
Universal joints	12,000 hours	
Telescopic shaft	20,000 hours	

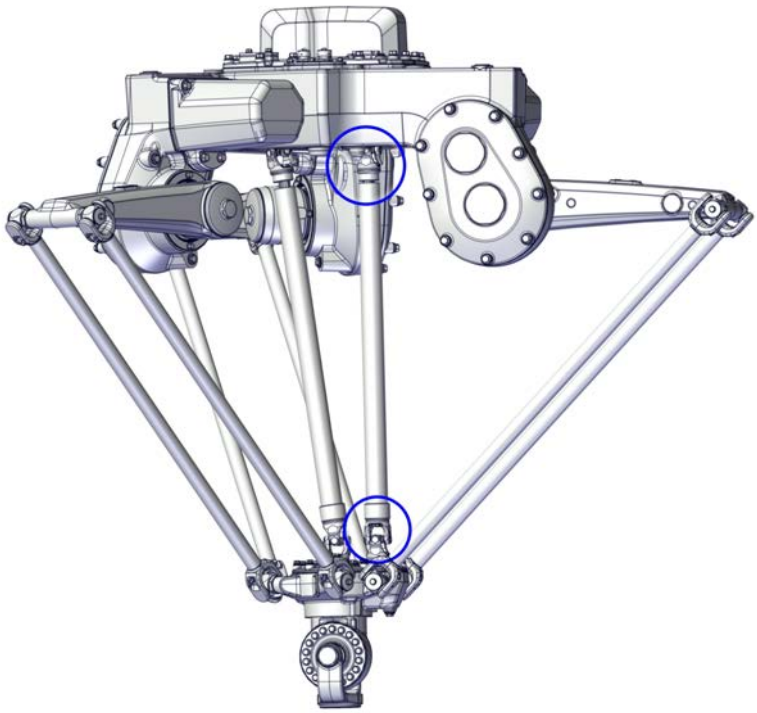
4.3 Inspection activities

4.3.1 Inspecting the telescopic shafts

Location of the telescopic shaft inspection points

The inspection points of the telescopic shafts are shown in the figure.

The figure shows an 5-axis IRB 390.



xx2000000001

Continues on next page

Required tools and equipment

Equipment	Article number	Note
Torque wrench head, closed end	3HAC063379-001	Included in robot delivery.  xx2000000282 Used with a torque wrench (not included in delivery) to loosen and tighten the universal joint and telescopic shaft screws. Hole interface: 1/4" square.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Inspecting the telescopic shafts

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
2	Check the screws and the joints on the telescope bearing housing.	Tightening torque
3	Check the slide bearings, replace if damaged.	
4	Check the universal joints for any damage or cracks. If damage or cracks are detected, replace the complete joint.	See *Replacing the universal joint on page 239*.

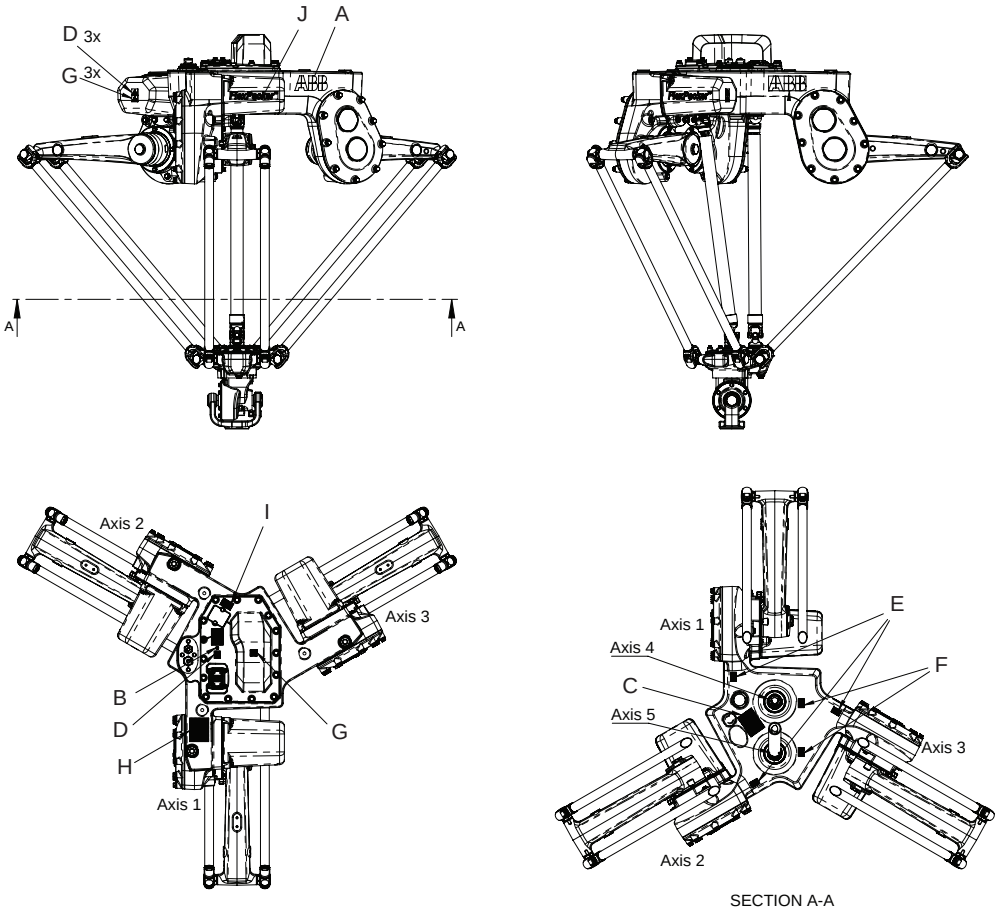
4.3.2 Inspecting the information labels

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 390 via myABB Business Portal, *www.abb.com/myABB*.

The 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*.



xx2000001850

	Spare part number	Description
A	3HAC077213-001	ABB logotype label
B	3HAC067800-001	Waste Electrical & Electronic Equipment (WEEE) label
C	3HAC075336-001	Instruction label Brake release
D	3HAC075337-001	Warning label Electrical (flash)

Continues on next page

	Spare part number	Description
E	3HAC040066-001	Axis mark label, axes 1, 2 and 3
F	3HAC076731-001	Axis mark label, axes 4 and 5
G	3HAC076469-001	Warning label Hot surface
H	3HAC076465-001	Instruction label Lifting of robot
I	3HAC055008-001	Information label Battery
J	3HAC075329-001	FlexPicker label

Required tools and equipment

Visual inspection, no tools are required.

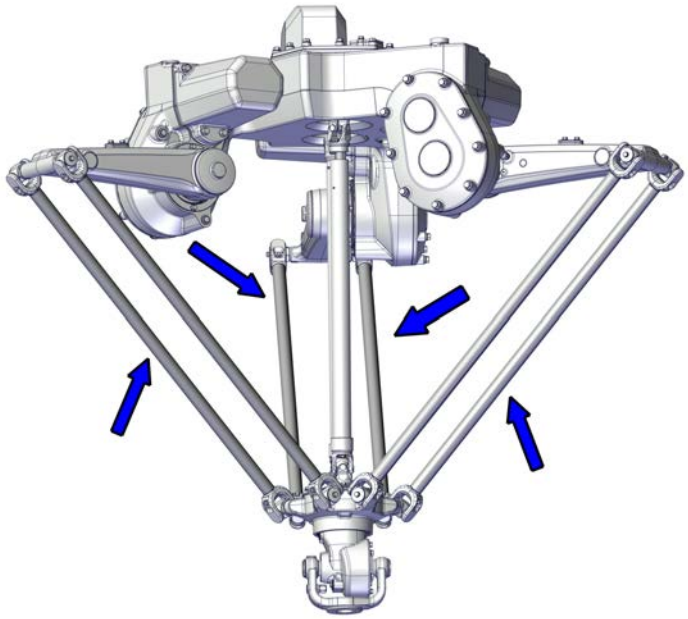
Inspecting, labels

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
2	Inspect the labels, located as shown in the figures.	
3	Replace any missing or damaged labels.	Article numbers for the labels and plate set is specified in *Required spare parts on page 98*.

4.3.3 Inspecting the lower arms

Location of the lower arms

The lower arms are located as shown in the figure.

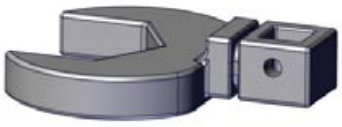


xx1900001427

Required tools and equipment

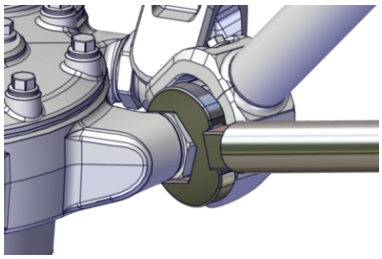
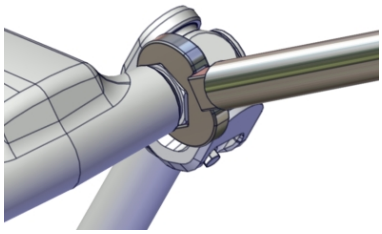
Equipment	Article number	Note
Interchangeable head torque wrench	-	

Continues on next page

Equipment	Article number	Note
Torque wrench head, open-end insert	3HAC073854-001	Included in robot delivery.  xx1900002148 Used with an interchangeable head torque wrench (not included in delivery). Interface: 14x18 mm.

Inspecting the lower arms

Use these procedures to inspect the lower arms.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
2	Check tightening torque of shafts. Use an interchangeable head torque wrench and the open-end head insert.	Tightening torque: 100 Nm. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002150  xx1900002152

Continues on next page

4.3.3 Inspecting the lower arms

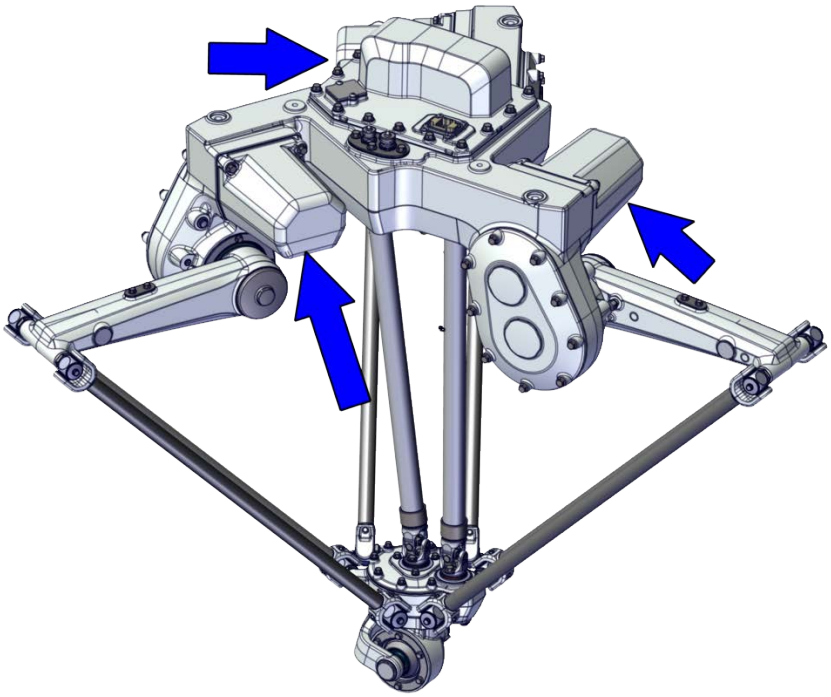
Continued

	Action	Note
3	Check the lower arms for any damage or cracks. If damage or cracks are detected, replace the lower arm.	See *Replacing the lower arm on page 221*.

4.3.4 Inspecting the motors

Location of the motors

The motors are located as shown in the figure.



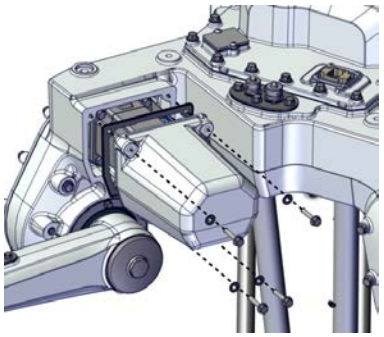
xx1900000758

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Inspecting the motors

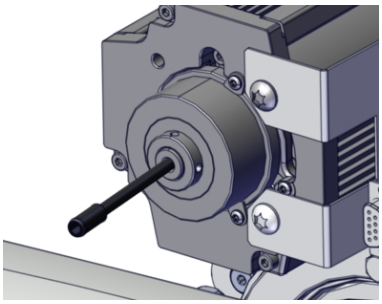
Use these procedures to inspect the motors.

	Action	Note
1	Put the robot in manual mode.	
2	Remove the motor cover and the sealing.	 xx1900000759

Continues on next page

4.3.4 Inspecting the motors

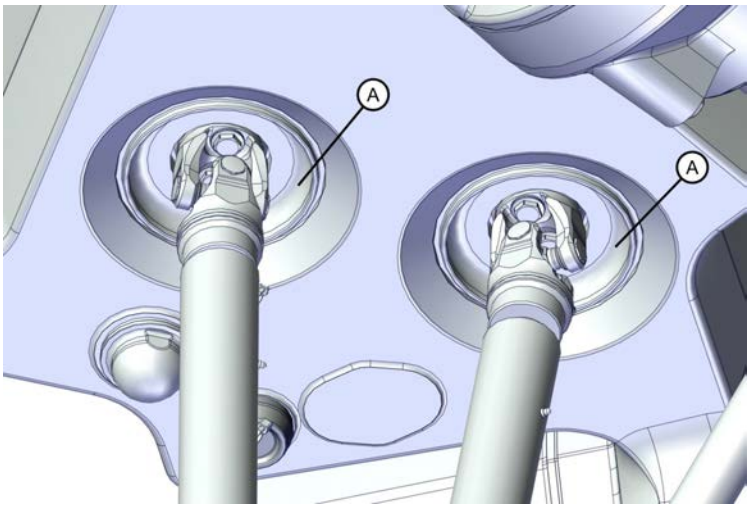
Continued

	Action	Note
3	Thread a screw into the motor pinion.	 xx2200002023
4	Release the brakes with the brake release button.	
5	Check the backlash in the motor by moving the screw/motor pinion from side to side to measure the movement. Replace the motor, if the backlash between the resolver rotor/stator (see encircled areas in the pictures) is so large that the space is 0 mm when rocking the screw from side to side. The motor in the picture is an example of a motor that is due for replacement.	See *Replacing the axis-1, axis 2 and axis-3 motor on page 260*.  xx2200002021  xx2200002022

4.3.5 Inspecting the cup on axis-4 and axis-5

Location of the cup

The cup is located as shown in the figure.



xx2100002193

A	Cup

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Inspecting the cup

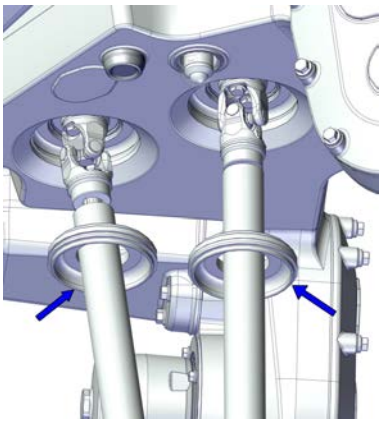
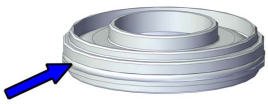
Use this procedure to inspect the cup

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

Continues on next page

4.3.5 Inspecting the cup on axis-4 and axis-5

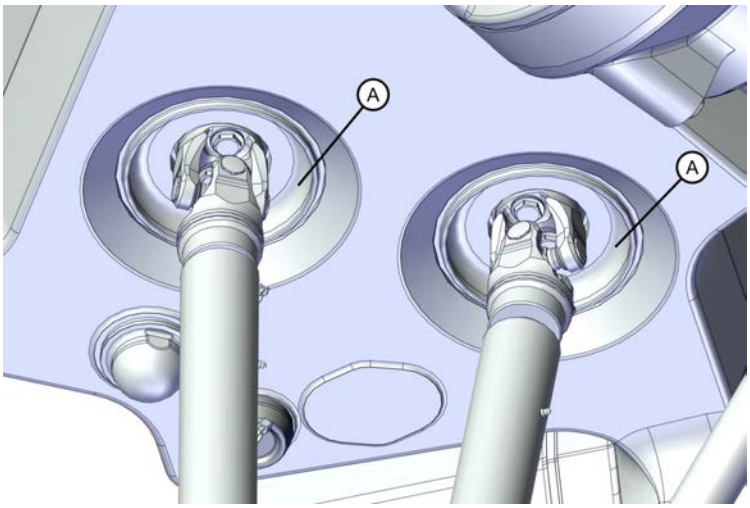
Continued

	Action	Note
2	Remove the cup with pilers by gently pulling on the edge of the cup. Clean the cup with a lint-free cloth	 xx2100002222
3	Check the o-ring. Replace the o-ring if damage.	See *Replacing the axis-4 and axis-5 cup o-ring on page 134*  xx2100002224
4	Firmly place the cup back in the frame by hand.	

4.3.6 Visually inspecting the cup on axis-4 and axis-5

Location of the cup

The cup is located as shown in the figure.



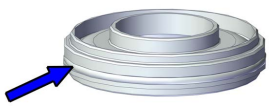
xx2100002193

A	Cup

Required tools and equipment

Visual inspection, no tools are required.

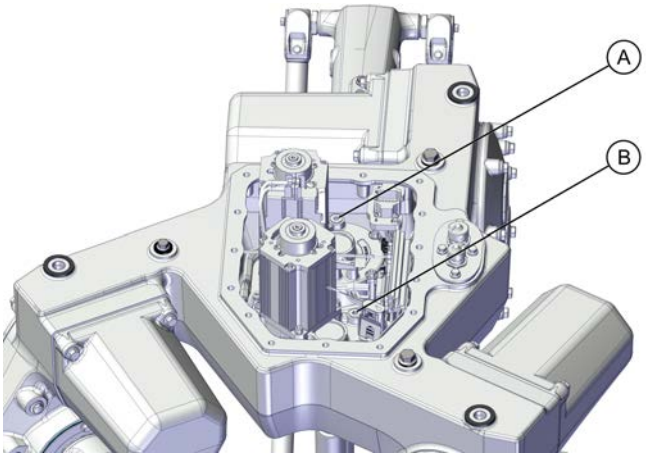
Visually inspecting the cup

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
2	Inspect the cup visually. Inspect and clean the cup if any oil seepage is detected.	See *Inspecting the cup on axis-4 and axis-5 on page 105*  xx2100002224

4.3.7 Inspecting the oil level in axis-4 and axis-5 gear unit pre-stage

Location of the oil plug

The oil plug for inspection is located as shown in the figure.



xx2200000733

A	Inspection hole for oil level, axis-4 gear unit pre-stage
B	Inspection hole for oil level, axis-5 gear unit pre-stage

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Required consumables

Material	Note
Lubricating oil	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*. See *Type and amount of oil in gearboxes on page 113*.
Anti-seize paste	3HAC070875-002 (Molykote P1900)

Required documents

Document	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	Available for registered users on myABB Business Portal, *www.abb.com/myABB*.

Continues on next page

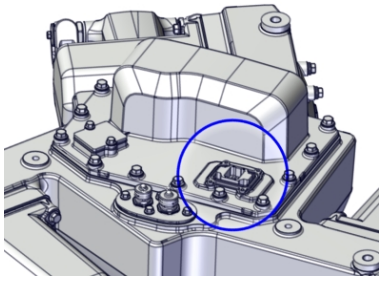
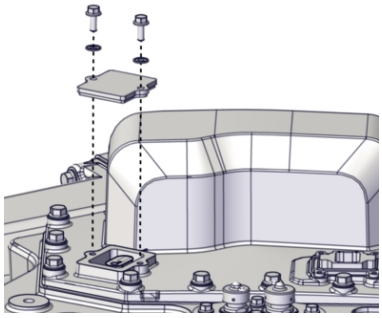
Inspecting the oil level

Use this procedure to inspect the oil level in the gearbox.

Preparations before inspecting the oil level

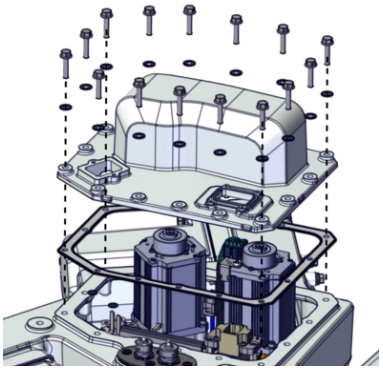
	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the top cover

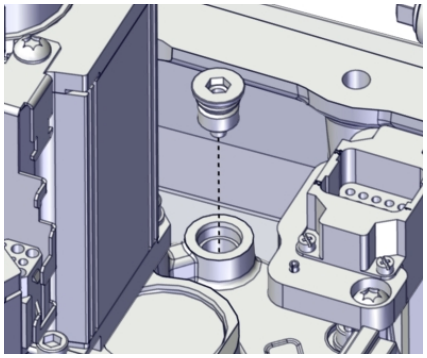
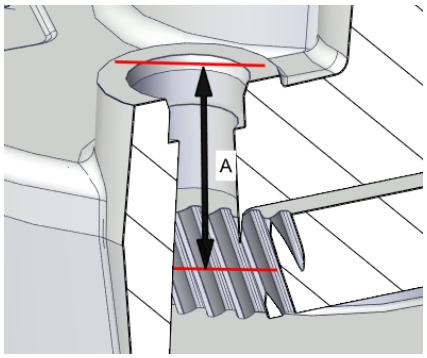
	Action	Note
1	Disconnect connector R1.MP from the base.	 xx2000001006
2	**CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	
3	Remove the SMB battery cover. **Tip** The battery cover is removed to see the battery position during refitting of the top cover.	 xx1900000407

Continues on next page

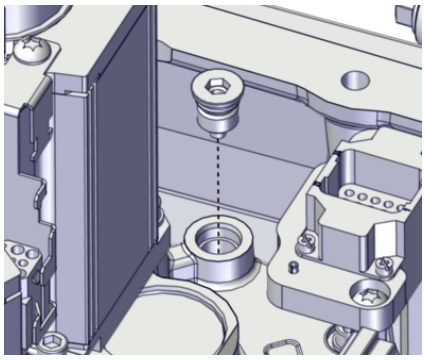
4.3.7 Inspecting the oil level in axis-4 and axis-5 gear unit pre-stage
Continued

	Action	Note
4	Remove the cover by removing the screws and washers. Also remove the sealing.	 xx1900000469

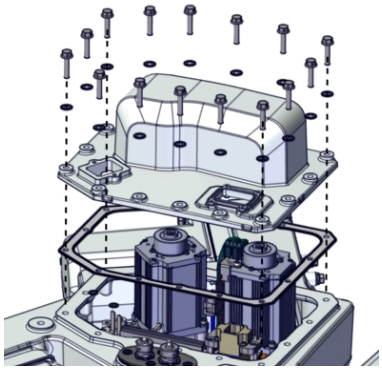
Inspecting the oil level in axis-4 and axis-5 gear unit pre-stage

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	Make sure that the oil temperature is +25 °C ± 10 °C.	
3	Open the oil plug.	 xx2200000734
4	Check the oil level. Required oil level is: 25 mm ± 1 mm.	 xx2200000740 A Oil level from oil plug surface

Continues on next page

	Action	Note
5	Add or drain oil, if required.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*. Further information about how to drain or fill with oil is found in section *Changing oil, axis-4 and axis-5 gear unit pre-stage on page 126*.
6	Clean and lubricate the oil plug and refit it.	Tightening torque: Nm. Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2200000734

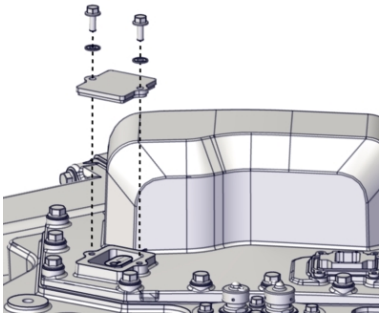
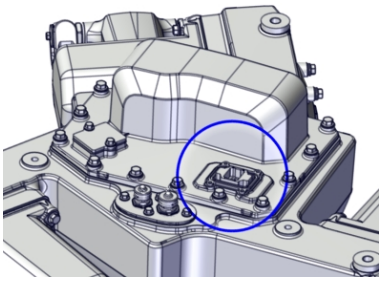
Refitting the top cover

	Action	Note
1	Refit the sealing and tighten the cover with lubricated screws. **CAUTION** Check that the SMB battery does not get squeezed under the cover.	Sealing washer: 3HAC058649-003 Hexagon flange bolt: 3HAC060233-008 (M8x40 stainless steel/A4-80, 15 pcs) Washer: 3HAC058626-004 (M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose., 15 pcs) Anti-seize paste: Molykote P1900 (3HAC070875-002) Tightening torque: 21 Nm.  xx1900000469

Continues on next page

4.3.7 Inspecting the oil level in axis-4 and axis-5 gear unit pre-stage

Continued

	Action	Note
2	Check that the battery is located correctly in the battery compartment and not pinched under the top cover. Then fasten the battery cover and sealing, with lubricated screws and washers. **Note** Do not overtighten to avoid damaging the sealing.	Tightening torque: 4 Nm. Hexagon flange bolt: 3HAC060233-006 (M6x16 stainless steel/A4-80) Washer: 3HAC058626-003 (M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.) Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx1900000407
3	Reconnect connector R1.MP to the base.	 xx2000001006

Concluding procedure

	Action	Note
1	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

4.4 Replacement/changing activities

4.4.1 Type of lubrication in gearboxes

Introduction

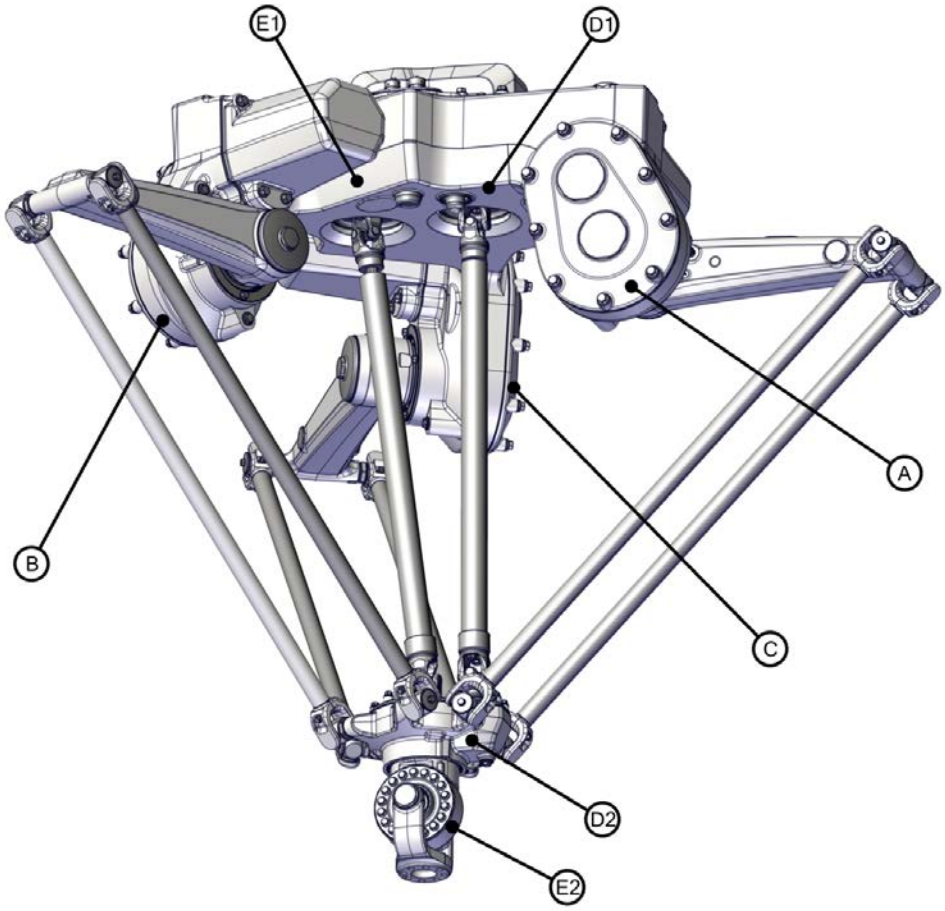
This section describes where to find information about the type of lubrication, article number and the amount of lubrication in the specific gearbox. It also describes the equipment needed when working with lubrication.

Type and amount of oil in gearboxes

Information about the type of lubrication, article number as well as the amount in the specific gearbox can be found in *Technical reference manual - Lubrication in gearboxes* available for registered users on myABB Business Portal, *www.abb.com/myABB*.

Location of gearboxes

The figure shows the location of the gearboxes.



xx1900000303

A	Axis-1 gear
B	Axis-2 gear

Continues on next page

4.4.1 Type of lubrication in gearboxes

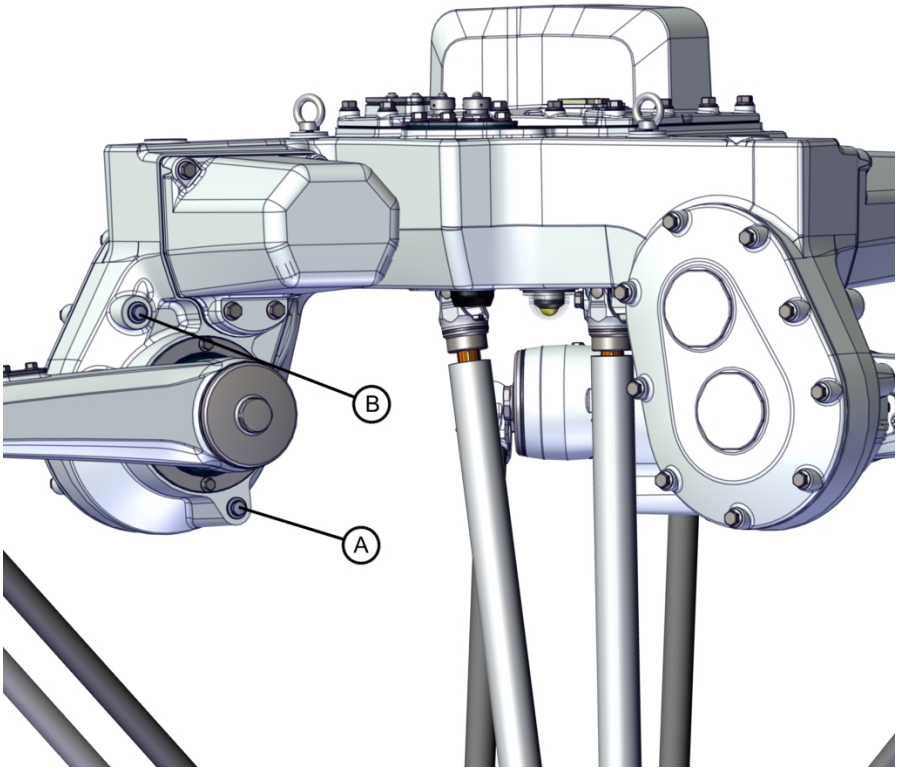
Continued

C	Axis-3 gear
D1	Axis-4 gear prestage
D2	Axis-4 gear
E1	Axis-5 gear prestage
E2	Axis-5 gear

4.4.2 Changing oil, axis-1, axis-2 and axis-3 gearbox

Location of the oil plugs

The oil plugs in gearboxes 1-3 are located as shown in the figure.



xx1900000307

A	Oil plug
B	Ventilation plug

Required tools and equipment

Equipment	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 113*.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Continues on next page

4.4.2 Changing oil, axis-1, axis-2 and axis-3 gearbox
Continued

Required consumables

Material	Note
Lubricating oil	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*. See *Type and amount of oil in gearboxes on page 113*.

Required documents

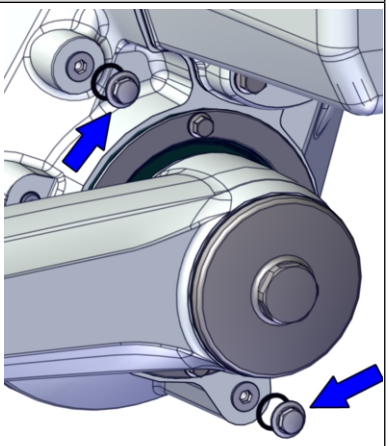
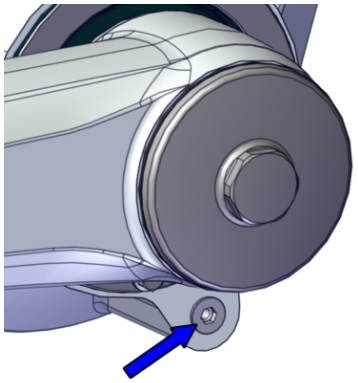
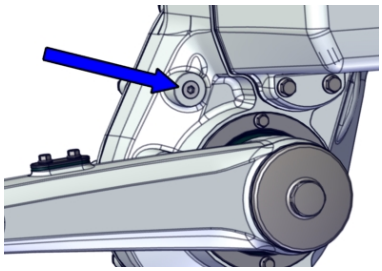
Document	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	Available for registered users on myABB Business Portal, *www.abb.com/myABB*.

Draining the gearbox

Use this procedure to drain the gearbox.

	Action	Note
1	Jog the axis for oil change to 0° (calibration position).	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
4	**CAUTION** The gearbox can contain an excess of pressure that can be hazardous. Open the oil plug carefully in order to let the excess pressure out.	

Continues on next page

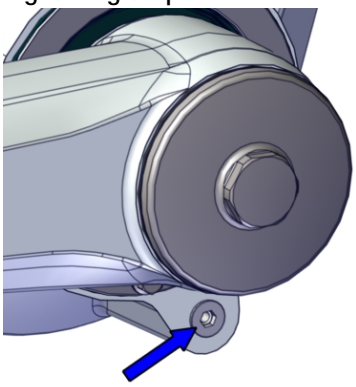
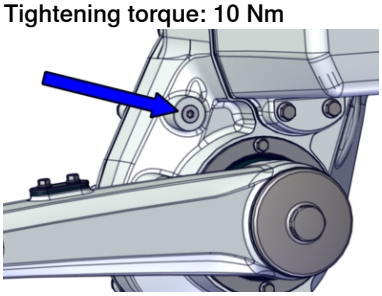
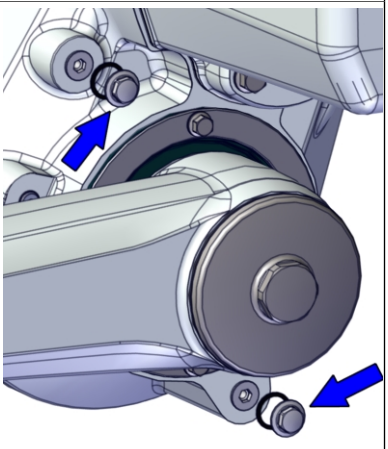
	Action	Note
5	Remove the caps and sealing rings.	 xx2000001591
6	Open the oil plug.	 xx1900000308
7	Open the ventilation plug to speed up the draining.	 xx1900000309
8	Drain the oil.	
9	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 353* for more information.	

Continues on next page

4.4.2 Changing oil, axis-1, axis-2 and axis-3 gearbox
Continued

Refilling the gearbox with oil

Use this procedure to refill the gearbox with oil.

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	Tighten the oil plug.	Tightening torque: 10 Nm  xx1900000308
3	Fill oil until it reaches the lower edge of the upper oil plug hole.	
4	Tighten the ventilation plug.	Tightening torque: 10 Nm  xx1900000309
5	Refit the caps and sealing rings.	 xx2000001591

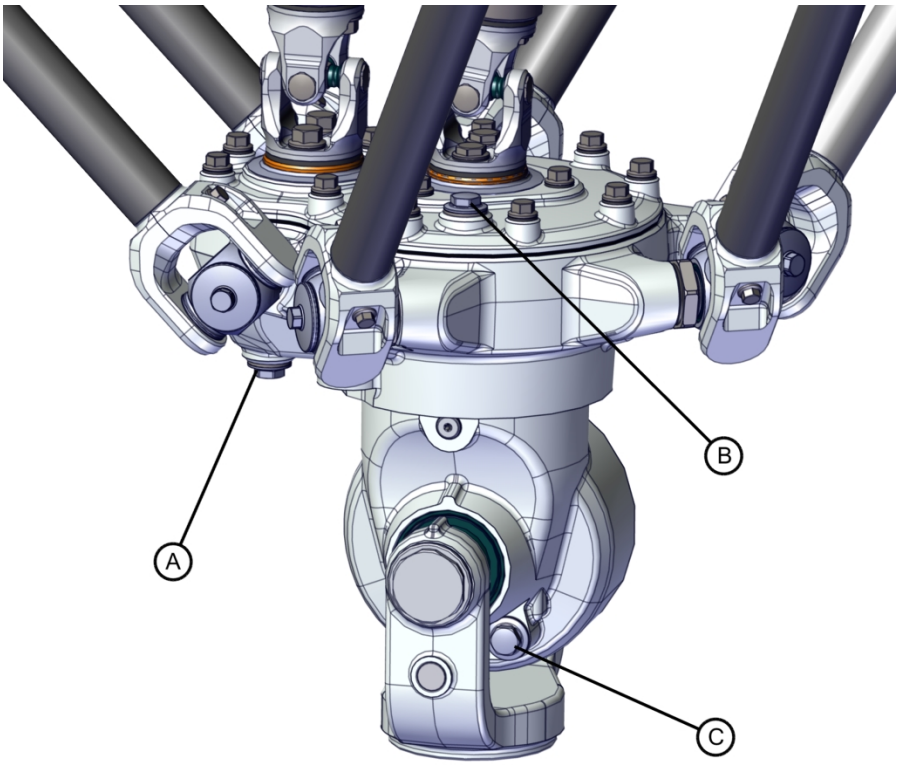
Continues on next page

	Action	Note
6	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

4.4.3 Changing oil, axis-4 and axis-5 gear unit

Location of the oil plugs

The oil plugs in axis-4 and axis-5 gear units are located as shown in the figure.



xx1900000312

A	Oil plug axis 4
B	Ventilation plug
C	Oil plug axis 5

Required tools and equipment

Equipment	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 113*.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Continues on next page

Required consumables

Material	Note
Lubricating oil	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*. See *Type and amount of oil in gearboxes on page 113*.

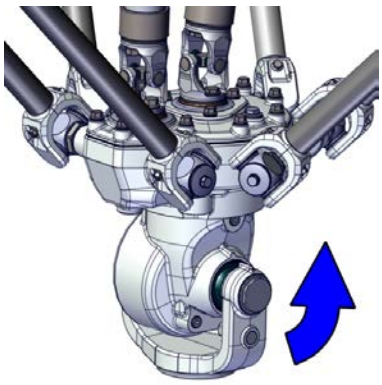
Required documents

Document	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	Available for registered users on myABB Business Portal, *www.abb.com/myABB*.

Draining the gear

Use this procedure to drain the gear.

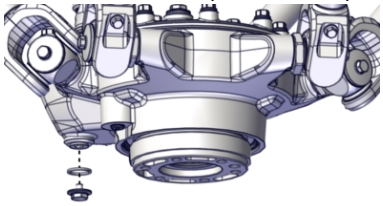
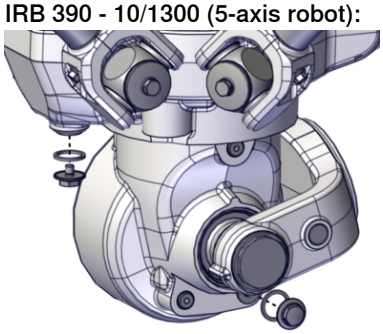
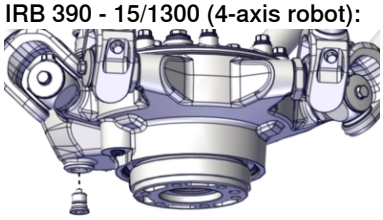
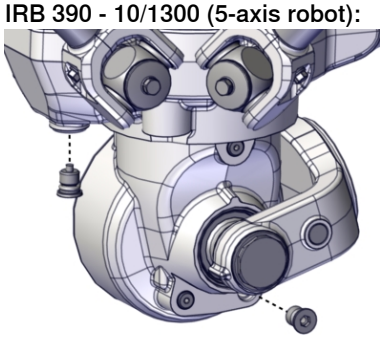
Draining the gear

	Action	Note
1	Robot axis position has no significance. Choose a position convenient for service.	
2	**Valid for IRB 390 - 10/1300 (5-axis robot):** Turn the tilt arm to the opposite side of the oil plug.	 xx1900000315
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
4	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	

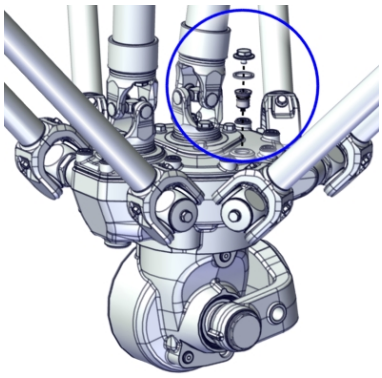
Continues on next page

4.4.3 Changing oil, axis-4 and axis-5 gear unit

Continued

	Action	Note
5	**CAUTION** The gearbox can contain an excess of pressure that can be hazardous. Open the oil plug carefully in order to let the excess pressure out.	
6	Remove the caps and sealing rings.	IRB 390 - 15/1300 (4-axis robot):  xx2000001631 IRB 390 - 10/1300 (5-axis robot):  xx1900000313
7	Open the oil plugs on the gear unit.	IRB 390 - 15/1300 (4-axis robot):  xx2000001632 IRB 390 - 10/1300 (5-axis robot):  xx2000001633

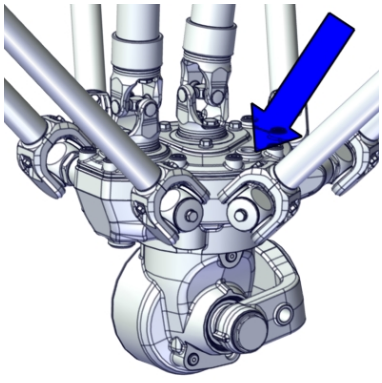
Continues on next page

	Action	Note
8	Open the ventilation plug to speed up the draining.	 xx1900000314
9	Drain the gear.	
10	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 353* for more information.	

Refilling the gearbox with oil

Use this procedure to refill the gearbox with oil.

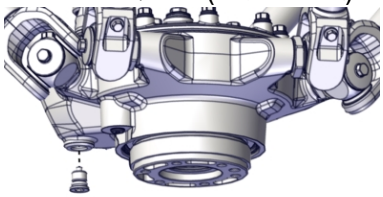
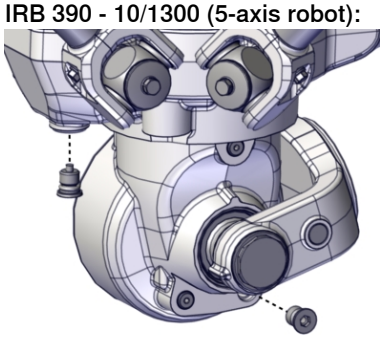
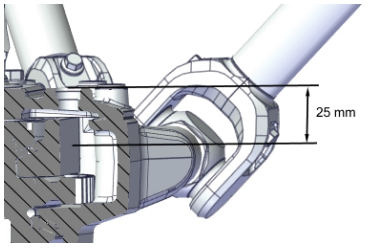
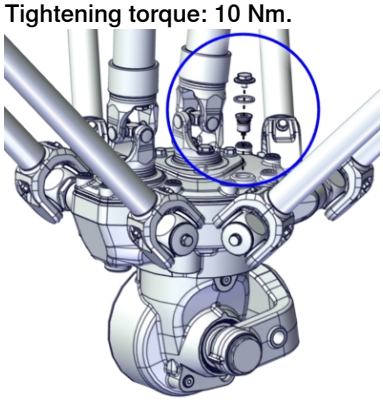
Refilling the gearbox with oil

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**Note** Leave the oil plugs open to achieve a better flow.	
3	Leave the oil plug holes on axis 4 and axis 5 open. Fill with oil at the top oil plug hole until oil starts to drip out through the axis-4 and axis-5 holes.	 xx2000000268

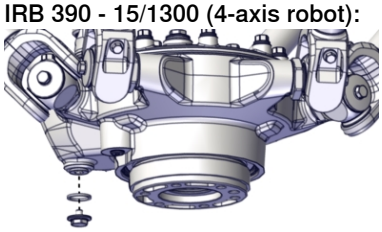
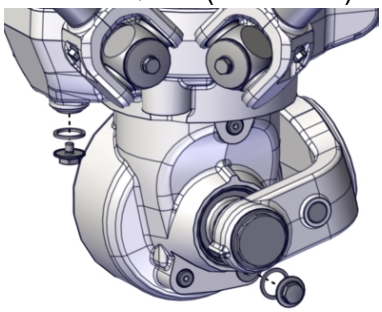
Continues on next page

4.4.3 Changing oil, axis-4 and axis-5 gear unit

Continued

	Action	Note
4	Tighten the oil plug on axis 5 and axis 4. Make sure the o-rings are undamaged.	Tightening torque: 10 Nm. IRB 390 - 15/1300 (4-axis robot):  xx2000001632 IRB 390 - 10/1300 (5-axis robot):  xx2000001633
5	Loosen the brake and turn axis 5 back and forth to release oil bubbles.	
6	Measure 25 mm from the oil surface to the upper oil plug surface to reach correct level.	 xx2000000269
7	Tighten the ventilation plug. Make sure the gasket is undamaged.	Tightening torque: 10 Nm.  xx1900000314

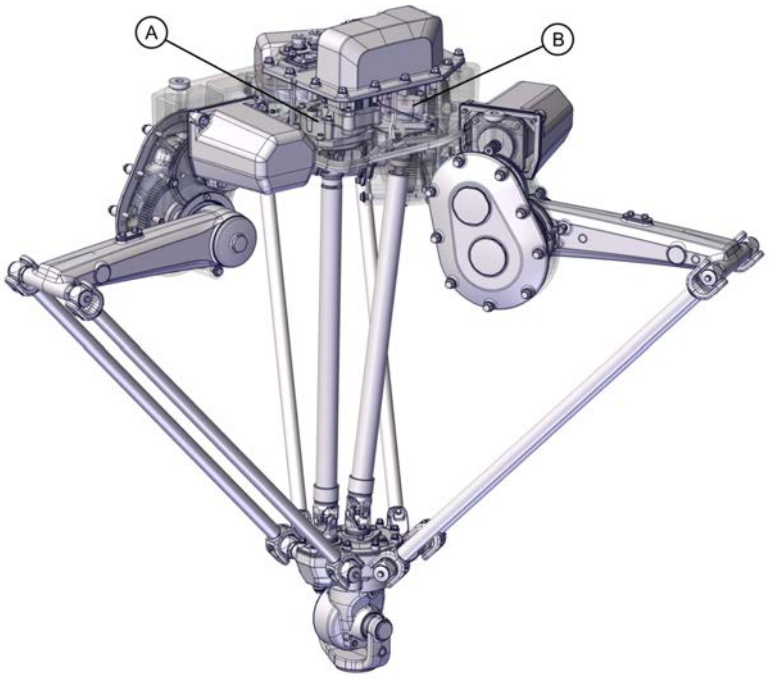
Continues on next page

	Action	Note
8	Refit the caps and sealing rings. Make sure the gasket is undamaged.	IRB 390 - 15/1300 (4-axis robot):  xx2000001631 IRB 390 - 10/1300 (5-axis robot):  xx1900000313
9	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

4.4.4 Changing oil, axis-4 and axis-5 gear unit pre-stage

Location of the gear unit pre-stage

The axis-4 and axis-5 gear unit pre-stages are located as shown in the figure.



xx2000001269

A	Axis 4 gear unit pre-stage
B	Axis 5 gear unit pre-stage

Summary of the change procedure

This is a brief summary of the change procedure, containing the major actions to be performed.

1 Remove the axis-4 and axis-5 motor and gear units from the base unit.
2 Remove the motor.
3 Change the oil.
4 Refit the motor.
5 Refit the axis-4 and axis-5 motor and gear units to the base unit.

Continues on next page

Required tools and equipment

Equipment	Article number	Note
Torque wrench head, closed end	3HAC063379-001	Included in robot delivery.  xx2000000282 Used with a torque wrench (not included in delivery) to loosen and tighten the universal joint and telescopic shaft screws. Hole interface: 1/4" square.
24 VDC power supply	-	Used to release the motor brakes.
Guide pin, M6x150	3HAC080345-001	Always use guide pins in pairs.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 113*.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Required consumables

Material	Note
Lubricating oil	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*. See *Type and amount of oil in gearboxes on page 113*.
Anti-seize paste	3HAC070875-002 (Molykote P1900)

Required documents

Document	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	Available for registered users on myABB Business Portal, *www.abb.com/myABB*.

Continues on next page

4.4.4 Changing oil, axis-4 and axis-5 gear unit pre-stage
Continued

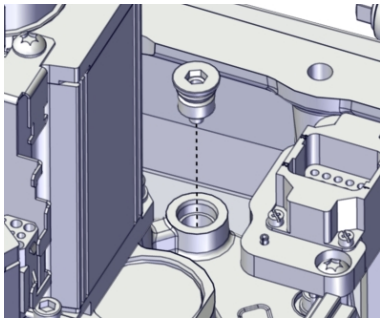
Changing oil in the gear unit pre-stage

Use this procedure to drain the gear unit pre-stage.

Removing the gear unit pre-stage

	Action	Note
1	Remove the gear unit pre-stage from the base unit according to: • *Replacing the axis-4 gear unit pre-stage on page 289* • *Replacing the axis-5 gear unit pre-stage on page 305*	

Changing oil in the gear unit pre-stage

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	Dispose the gear oil in a safe way.	
3	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 353* for more information.	
4	Fill new oil into the gear unit.	Information about the type of lubrication, article number as well as the amount in the specific gearbox can be found in *Technical reference manual - Lubrication in gearboxes* available for registered users on myABB Business Portal, www.abb.com/myABB.
5	Check the oil level.	See *Inspecting the oil level in axis-4 and axis-5 gear unit pre-stage on page 108*.
6	Clean and lubricate the oil plug and refit it.	Tightening torque: Nm. Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2200000734

Continues on next page

Refitting the gear unit pre-stage

	Action	Note
1	Refit the gear unit pre-stage to the base unit according to: • *Replacing the axis-4 gear unit pre-stage on page 289* • *Replacing the axis-5 gear unit pre-stage on page 305*	

4.4.5 Changing the SMB battery

Note

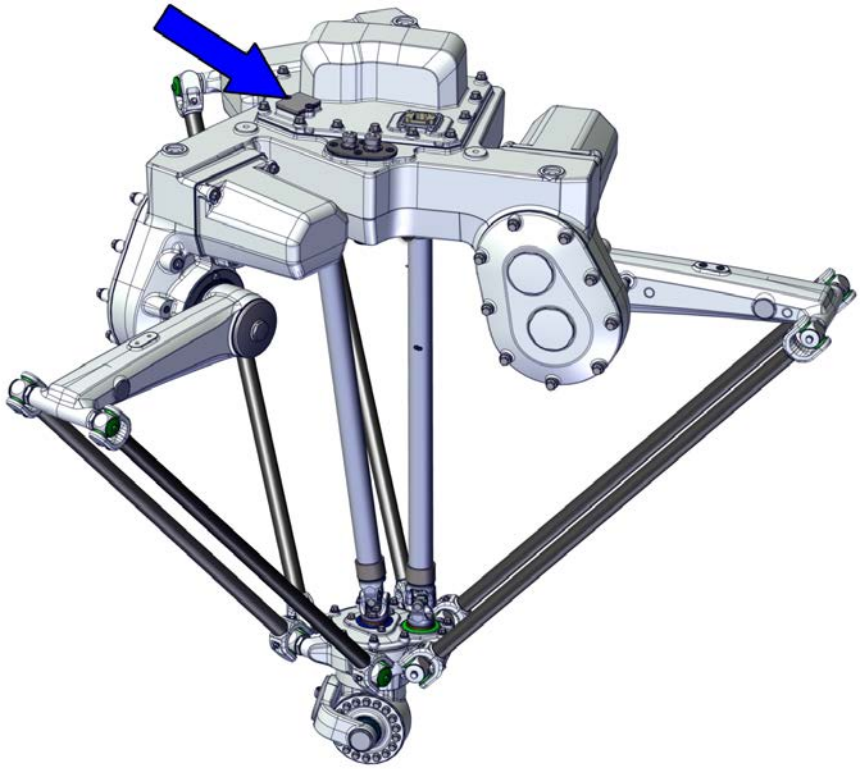
The battery low alert (38213 **Battery charge low**) is displayed when the battery needs to be replaced. The recommendation to avoid an un-synchronized robot is to keep the power to the controller turned on until the battery is to be replaced.

WARNING

See *Hazards related to batteries on page 31*.

Location of the SMB battery

The SMB battery is located as shown in the figure.



xx1900000406

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Continues on next page

Spare part	Article number	Note	Level
Battery unit	3HAC044075-001	Battery includes protection circuits. Only replace with the specified spare part or an ABB-approved equivalent.	L1

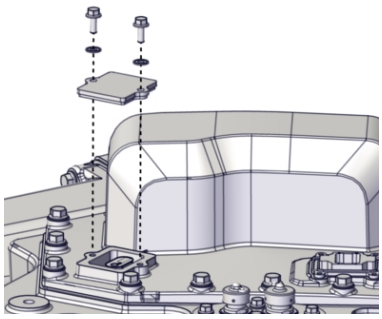
Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the SMB battery

Use this procedure to remove the SMB battery.

Removing the SMB battery

	Action	Note
1	Jog the robot to calibration position.	This is done to facilitate updating of the revolution counter.
2	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
3	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 43*.	
4	Remove the SMB battery cover. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	 xx1900000407

Continues on next page

4.4.5 Changing the SMB battery
Continued

	Action	Note
5	Carefully pull out the battery and disconnect the battery cable. • Battery cable connector R2.G.	 xx1900000408
6	Remove the SMB battery. Battery includes protection circuits. Only replace with a specified spare part or with an ABB-approved equivalent.	

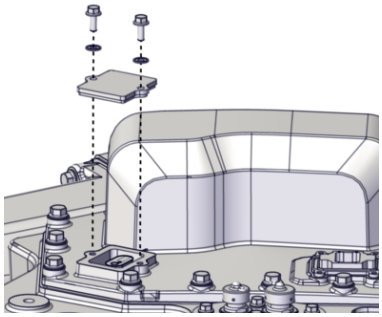
Refitting the battery

Use this procedure to refit the SMB battery.

Refitting the SMB battery

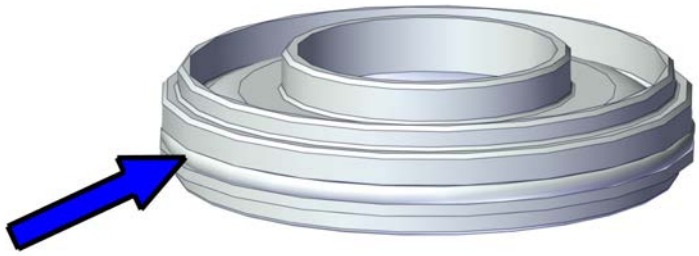
	Action	Note
1	Connect the battery cables. • Battery cable connector R2.G.	
2	Carefully push down the battery into the battery holder.	 xx1900000408

Continues on next page

	Action	Note
3	Fasten the battery cover and sealing, with lubricated screws and washers. **Note** Do not overtighten to avoid damaging the sealing.	Tightening torque: 4 Nm Hexagon flange bolt: 3HAC060233-006 (M6x16 stainless steel/A4-80) Washer: 3HAC058626-003 (M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.) Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx1900000407
4	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

4.4.6 Replacing the axis-4 and axis-5 cup o-ring

Location of the o-ring



xx2100002224

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
O-ring	3HAB3772-107	Replace if damaged.

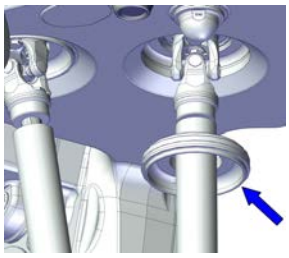
Continues on next page

Required tools and equipment

Equipment	Article number	Note
Torque wrench head, closed end	3HAC063379-001	Included in robot delivery.  xx2000000282 Used with a torque wrench (not included in delivery) to loosen and tighten the universal joint and telescopic shaft screws. Hole interface: 1/4" square.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.
P1900		

Replacing the o-ring

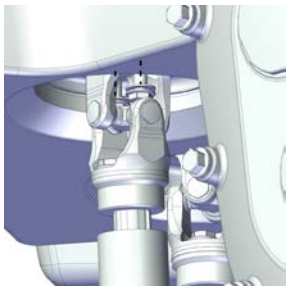
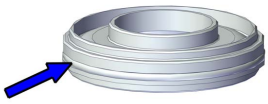
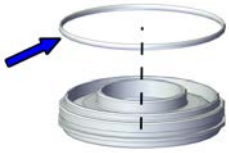
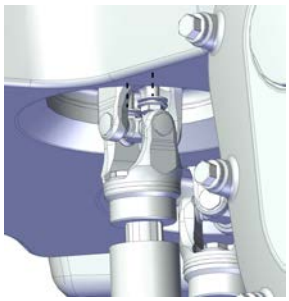
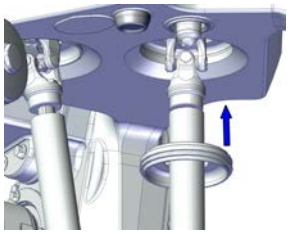
Use these procedures to replace the o-ring on the cup

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
2	Remove the cup with a pilers by gently pulling on the edge of the cup.	 xx2100002210

Continues on next page

4.4.6 Replacing the axis-4 and axis-5 cup o-ring

Continued

	Action	Note
3	Remove the telescopic shaft by removing the upper screws and washers, using a special torque wrench head. **Note** Keep the sealing ring and friction shim for refitting.	 xx2100002194
4	Remove the old o-ring from the cup.	 xx2100002224
5	Add P1900 on the new o-ring.	
6	Install the new o-ring on the cup.	 xx2100002195
7	Refit the cup on the telescopic shaft and let the cup slide down.	
8	Fit the upper end of the telescopic shaft by installing the friction shim, sealing ring and the telescopic shaft at the joint.	 xx2100002482
9	Firmly place the cup in the frame by hand.	 xx2100002481

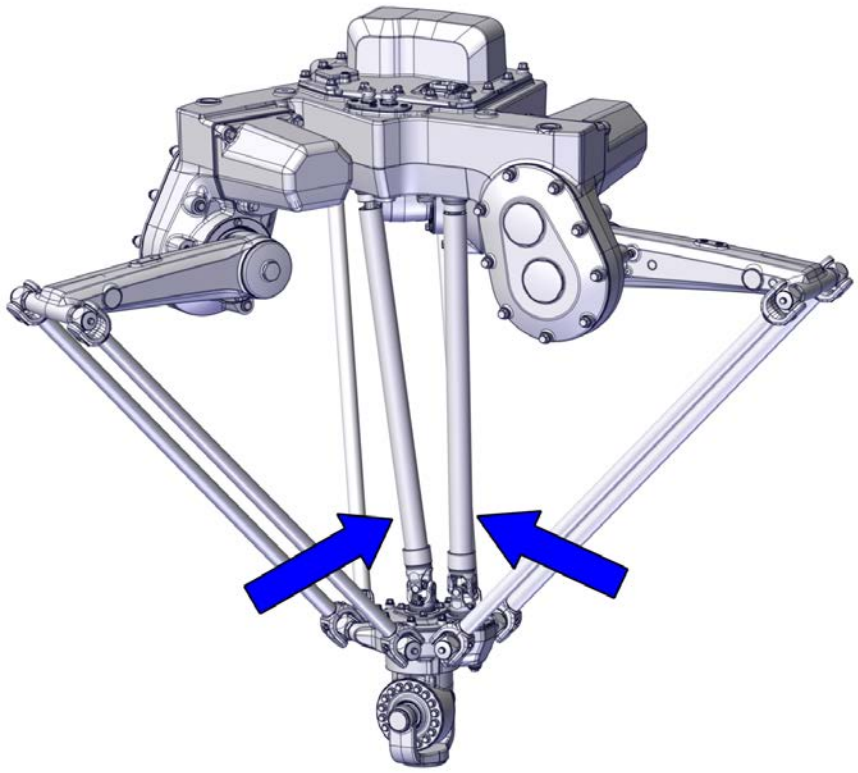
4.5 Lubrication activities

4.5.1 Lubricating the telescopic shafts

Location of the telescopic shaft

The telescopic shafts are located as shown in the figure.

The figure shows an 5-axis IRB 390.



xx1900000253

Required consumables

Consumable	Article number	Note
Grease	3HAC029132-001	FM 222 Amount of re-grease: 2.5 ml

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

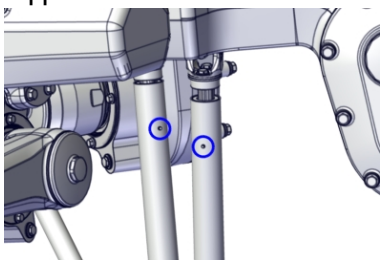
Continues on next page

4.5.1 Lubricating the telescopic shafts
Continued

Lubricating the telescopic shafts

Use this procedure to lubricate the telescopic shafts.

Lubricating the telescopic shafts

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Lubricate the telescopic shaft with grease through the nipple.	Grease: 3HAC029132-001 (FM 222) Amount of re-grease: 2.5 ml Nipple dimension: DIN 3402  xx2000000003
3	Check that the telescope has not been lubricated with excessive amount of grease, by jogging the telescope to fully compressed position. If there is too much grease, there will be an overload error.	

4.6 Cleaning activities

4.6.1 Cleaning the IRB 390

General

To secure high uptime it is important that the IRB 390 is cleaned regularly. The frequency of cleaning depends on the environment in which the manipulator works.

Different cleaning methods are allowed depending on the type of protection of the IRB 390.

Note

Always verify the protection type of the robot before cleaning.

WARNING

Turn off all electrical power supplies to the robot before starting the 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 point the water at connectors, joints, sealings or gaskets.
- Do not use compressed air to clean the robot.
- Do not 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

This following table defines what cleaning methods are allowed for ABB manipulators depending on the protection type.

Protection type	Cleaning method			
	Vacuum cleaner	Wipe with cloth	Rinse with water	High pressure water, steam or spray
Standard	Yes	Yes [i]. Use light cleaning detergent on all surfaces except the telescope. Telescope to be wiped with dry cloth.	Yes, with telescope removed.	No

[i] The robot contains moving mechanical contacts (e.g. seals). Naturally these contacts can release wear particles and minor amounts of grease during their lifetime. Cleaning these areas as part of the normal cleaning routine of the robot is recommended.

Continues on next page

4.6.1 Cleaning the IRB 390
Continued

Usable detergents

This table specifies approved light cleaning detergents according to methods in the table *Cleaning methods on page 139*.

Detergent	Type	Note
Detergent	Topaz LD1	
Disinfectant	P3-Topax 990	

Wiping with cloth

Additional cleaning instructions for robots with food grade lubrication

Make sure that no liquid flows into the robot or stagnates in any gap or surface after cleaning.

Cleaning with low pressure water

The IRB 390 can be cleaned with water if the telescope is removed. Wipe dry with a cloth.

The telescope shall only be wiped with dry cloth.

The following list defines the prerequisites:

- Never point the water directly at the joints
- Maximum water pressure at the nozzle: 700 kN/m^2 (7 bar) I
- Fan jet nozzle should be used, min. 45° spread
- Minimum distance from nozzle to encapsulation: 0.4 meters
- Maximum flow: 20 liters/min I

I Typical tap water pressure and flow

Cables

Movable cables need to be able to move freely:

- Remove waste material, such as sand, dust and chips, if it prevents cable movement.
- Clean the cables if they have a crusty surface, for example from dry release agents.

Cassette sealings

Minor seepage of grease from the seals can occur. Wipe down affected areas with a dry cloth.

5 Repair

5.1 Introduction

Structure of this chapter

This chapter describes repair activities for the IRB 390. 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 390, 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 390 is connected to power, always make sure that the IRB 390 is connected to protective earth and a residual current device (RCD) before starting any repair work.

For more information see:

- *Product manual - OmniCore V250XT Type B*
- *Product manual - OmniCore V400XT*
- *Product manual - IRC5*

5.2 Definition of spare part levels

Spare part level

ABB spare parts are categorized into two levels, L1 and L2. Always check the part level before conducting a service work on a spare part.

- L1 spare parts

  The L1 parts can be replaced in the field. The maintenance and replacement instructions given in the related product manuals must be strictly followed. If there are any problems, contact your local ABB for support.
- L2 spare parts

  To replace the L2 parts require specialized training and might need special tools. Only ABB field service personnel or qualified personnel trained by ABB can replace L2 parts.
- L3 spare parts

  L3 spare parts shall only be replaced or repaired by qualified ABB service technician with knowledge of the application due to reduce risk of injury or damage to equipment. Improper installation may void warranty.

5.3 General procedures

5.3.1 Performing a leak-down test

When to perform a leak-down test

After refitting any motor and gearbox, the integrity of all seals enclosing the gearbox oil must be tested. This is done in a leak-down test.

The gearbox must be drained of oil before performing the leak-down test.

Required equipment

Equipment, etc.	Article number	Note
Leak-down tester	-	
Leak detection spray	-	

Performing a leak-down test

	Action	Note
1	Finish the refitting procedure of the motor or gear in question, but **do not** refill the gearbox with oil before performing the leak-down test.	
2	Remove the upper oil plug on the gear and replace it with the leak-down tester. Regulators, which are included in the leak-down test, may be required.	
3	Use caution, apply compressed air and raise the pressure with the knob until the correct value is shown on the manometer. **CAUTION** The pressure must under no circumstance be higher than 0.25 bar (20-25 kPa). Also during the time when the pressure is raised.	Correct value: 0.2-0.25 bar (20-25 kPa)
4	Disconnect the compressed air supply.	
5	Wait for approximately 8-10 minutes and make sure that no pressure loss occurs.	If the compressed air is significantly colder or warmer than the gearbox to be tested, a slight pressure increase or decrease may occur. This is quite normal.
6	If any pressure drop occurred, then localize the leak as described in step *7*. If no pressure drop occurred, then remove the leak-down tester and refit the oil plug. The test is complete.	
7	Spray any suspected leak areas with the leak detection spray. Bubbles indicate a leak.	
8	When the leak has been localized, take the necessary measures to correct the leak.	

5.3.2 Mounting instructions for sealings

General

This section describes how to mount different types of sealings.

Equipment

Consumable	Article number	Note
Anti-seize paste	3HAC070875-002	Molykote P1900

Rotating sealings

The following procedures describe how to fit rotating sealings.

CAUTION

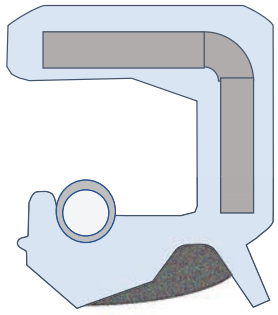
Please observe the following before commencing any assembly of sealings:

- Protect the sealing during transport and mounting, especially the main lip on radial sealings.
- Keep the sealing in its original wrappings or protect it well before actual mounting.
- The fitting of sealings and gears must be carried out on clean workbenches.
- Use a protective sleeve for the main lip during mounting, when sliding over threads, keyways or other sharp edges.
- Do not lubricate a static side of a sealing with grease, since this may result in movement of the sealing during operation.

  The only exception for lubrication of static sides of a sealing, is to use P-80 rubber lubrication gel against certain aluminium surfaces. If usage of P-80 is relevant, it is stated in the repair procedures.

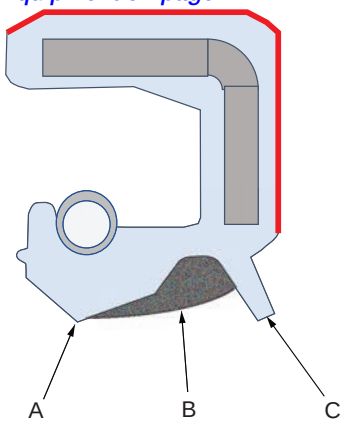
Radial sealings

A radial sealing consists of a flexible rubber lip bonded to a rigid metal case. Only one side of the sealing is static with a metal insert.



xx2300000433

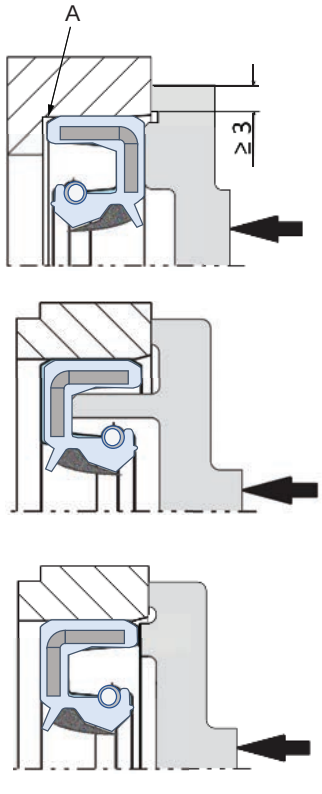
Continues on next page

	Action	Note
1	Check the sealing to ensure that: • The sealing is of the correct type. • There is no damage on the main lip.	
2	Inspect the shaft surface before mounting. If scratches or damage are found, the shaft must be replaced since it may result in future leakage. Do not try to grind or polish the shaft surface to get rid of the defect.	
3	Lubricate the sealing with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the sealing.) Fill 2/3 of the space between the dust lip and the main lip with grease. If the sealing is without dust lip, just lubricate the main lip with a thin layer of grease.	Article number is specified in *Equipment on page 144*.  xx2000000071 A Main lip B Grease C Dust lip **Note** Ensure that no grease is applied to the red marked surface.

Continues on next page

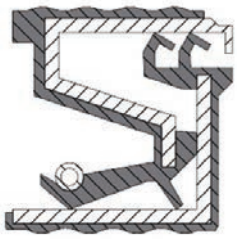
5.3.2 Mounting instructions for sealings

Continued

	Action	Note
4	Mount the sealing correctly with a mounting tool. Never hammer directly on the sealing as this may result in leakage.	 xx2000000072 A Gap
5	Make sure that no grease is left on the robot surface.	

Cassette sealings

A cassette sealing is a fully enclosed seal with an integrated sealing system. Both sides of the cassette sealing are static with metal inserts.



xx2300000432

	Action	Note
1	Check the sealing to ensure that: • The sealing is of the correct type. • There is no damage on the sealing.	
2	Inspect the mating surfaces on the manipulator before mounting. If scratches or damage are found, the part must be replaced since it may result in future leakage. Do not try to grind or polish the surfaces to get rid of the defect.	

Continues on next page

	Action	Note
3	Always install the sealing with a mounting tool specified by ABB. Never hammer directly on the sealing as this may result in leakage.	See the replacement procedure for the cassette sealing, in the repair chapter.
4	Make sure that no grease is left on the robot surface.	

Note

A new sealing has an initial wear that can cause lubricant to seep out and in some cases produce minor residues of rubber particles.

This is normal behavior of the sealing and does not indicate a seal problem. Wipe the surrounding surfaces after initial run time.

Flange sealings and static sealings

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

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

O-rings

The following procedure describes how to fit o-rings.

	Action	Note
1	Ensure that the correct o-ring size is used.	
2	Check the o-ring for surface defects, burrs, shape accuracy, or deformation.	Defective o-rings, including damaged or deformed o-rings, may not be used.
3	Check the o-ring grooves and mating surfaces. They should be free of pores, contamination and obvious scratches/damage.	
4	Lubricate the o-ring with grease.	**CAUTION** Do not lubricate the hollow o-ring for the base cover, it may slip out of its position in the cleaning process.
5	Tighten the screws evenly while assembling.	
6	Check that the o-ring is not squashed outside the o-ring groove.	
7	Make sure that no grease is left on the robot surface.	

5.3.3 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.

Stainless steel screws

Stainless steel screws should be secured by hand at least 2 turns before using an electric screwdriver.

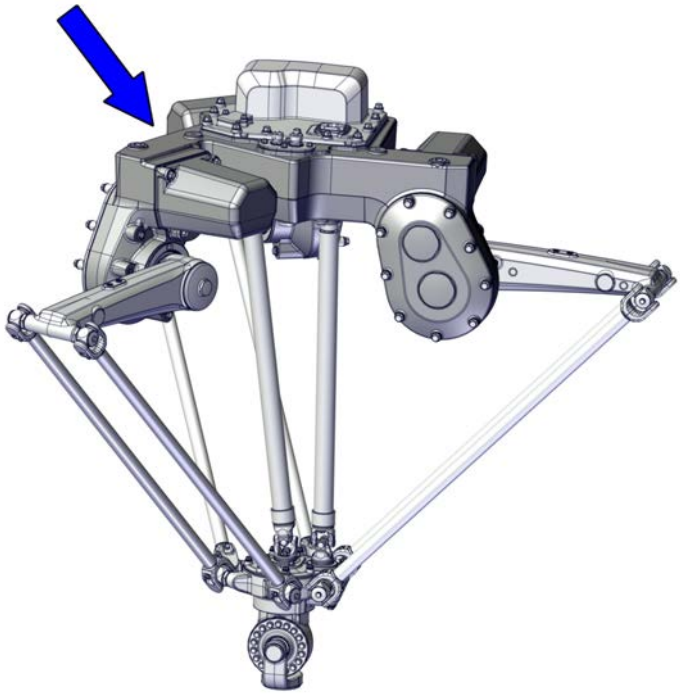
Lubricate the thread of all stainless steel screws with Molykote P1900 (3HAC070875-002). Use the torque specified in the repair, maintenance or installation procedure.

5.4 Base

5.4.1 Replacing the base unit

Location of the base unit

The base unit is located as shown in the figure.



xx2000000306

Summary of the replacement procedure

This is a brief summary of the replacement procedure, containing the major actions to be performed.

1. Remove the telescopic shaft/shafts including the universal joints.
2. Remove the lower arms and delta unit.
3. Remove the upper arms.
4. Lift down the base unit to a workbench.
5. Move the SMB unit, the cable harness, and the axis-4 and axis-5 motor and gear units from the old base to the new.

   Also move the axis-1, axis-2 and axis-3 motors from the old base to the new, if the base spare part is ordered without motors.
6. Refit the new base unit to the robot frame.
7. Refit the upper arms.
8. Refit the lower arms and delta unit.
9. Refit the telescopic shaft/shafts.

Continues on next page

5.4.1 Replacing the base unit
Continued

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Base unit	3HAC060564-003	The spare part includes following parts: • base • axis-1, axis-2 and axis-3 gear • axis-1, axis-2 and axis-3 motor • brake release button	L2
Base unit	3HAC060563-003	The spare part includes following parts: • base • axis-1, axis-2 and axis-3 gear • brake release button	L2

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Anti-seize paste	3HAC070875-002	Molykote P1900

Other spare parts

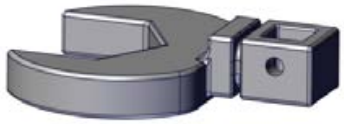
Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Sealing washer	3HAC058649-003	Base unit top cover.
Hexagon flange bolt	3HAC060233-008	M8x40 stainless steel/A4-80
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Sealing ring	3HAC062067-001	Between base unit and upper arm.
Washers, 12 pcs	3HAC043799-001	
Gasket	3HAC058619-001	For the upper arm cover.
Sealing washer	3HAC062123-001	To the lower arm.
Friction shim	3HAC060200-001	Between universal joint and telescopic shaft/base unit/delta unit.
Sealing ring	3HAC060263-001	Between universal joint and telescopic shaft/base unit/delta unit.

Continues on next page

Spare part	Article number	Note
Hexagon flange bolt	3HAC058625-001	M8x16 Bumax 109
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Hexagon flange bolt	3HAC060233-006	M6x16 stainless steel/A4-80
Washer	3HAC058626-003	M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Protection screw	3HAC060233-011	Used in lifting eye attachment holes for robots in hygienic environment. Replace if lost or damaged.
Sealing washer	3HAC081466-001	Used in lifting eye attachment holes for robots in hygienic environment. Replace if lost or damaged.

Required tools and equipment

Equipment	Article number	Note
Torque wrench head, open-end insert	3HAC073854-001	Included in robot delivery.  xx1900002148 Used with an interchangeable head torque wrench (not included in delivery). Interface: 14x18 mm.
Interchangeable head torque wrench	-	
Torque wrench head, closed end	3HAC063379-001	Included in robot delivery.  xx2000000282 Used with a torque wrench (not included in delivery) to loosen and tighten the universal joint and telescopic shaft screws. Hole interface: 1/4" square.
Overhead crane	-	

Continues on next page

5.4.1 Replacing the base unit
Continued

Equipment	Article number	Note
Lifting eye	3HAC16131-1	M12 3 pcs
Roundsling, 2 m	-	3 pcs **CAUTION** The weight of the IRB 390 robot is IRB 390 - 15/1300: 133 kg IRB 390 - 10/1300: 148 kg All lifting accessories used must be sized accordingly.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the base unit

Use these procedures to remove the base unit.

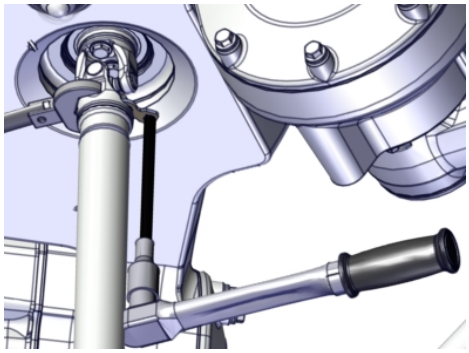
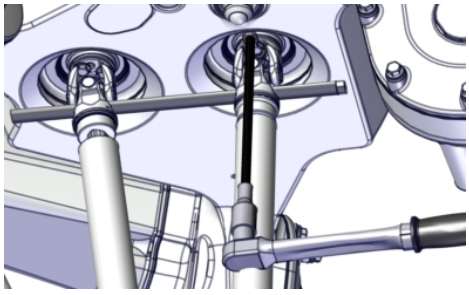
Preparations before removing the base unit

	Action	Note
1	Jog the robot to as close to synchronization position as possible.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
3	Remove any loads or tools attached to the turning disk.	
4	Disconnect all cabling to the robot.	

Removing the telescopic shaft/shafts including the universal joints

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	

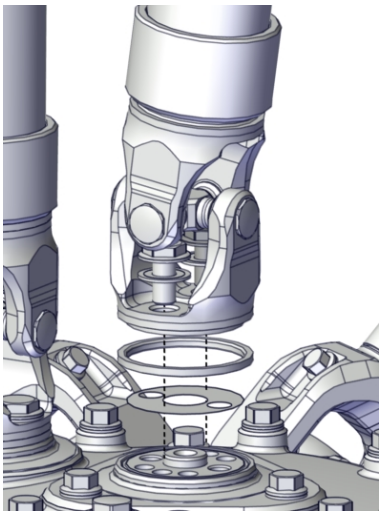
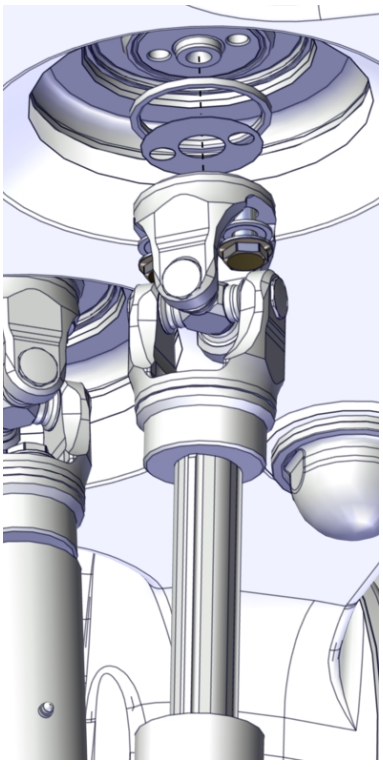
Continues on next page

	Action	Note
2	Loosen all the universal joint screws from the base unit and delta unit before unscrewing them completely. **Tip** The shaft rotates when loosening/fastening the screws. Use one of two alternatives to hold the shaft still: 1 Hold the motor shaft still with an open-end wrench (47 mm) at the joint while loosening/tightening the screws. Requires two persons.  xx2000000346 2 Hold the motor shaft still by inserting a pin through the joints (5-axis robot) or through the joint and against the casting. Choose an appropriate material for the pin, that does not damage the surface of the joints.  xx2000000688	Torque wrench head, closed end: 3HAC063379-001.

Continues on next page

5.4.1 Replacing the base unit

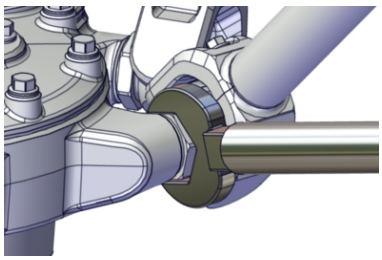
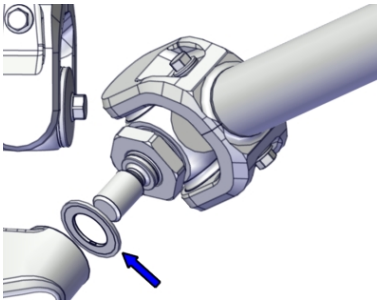
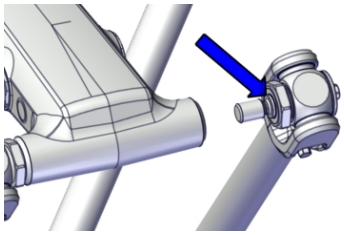
Continued

	Action	Note
3	Remove the telescopic shaft/shafts including the universal joints by removing the screws and washers. **Note** Keep the sealing ring and friction shim for refitting.	Torque wrench head, closed end: 3HAC063379-001.  xx2000001108  xx2000001109

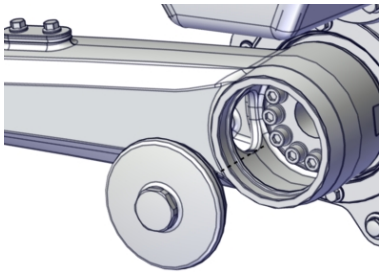
Removing the lower arms and the delta unit

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	

Continues on next page

	Action	Note
2	**CAUTION** The weight of the delta unit is IRB 390 - 15/1300: 7 kg IRB 390 - 10/1300: 12 kg Support the weight of the delta unit from below.	
3	Loosen the lower arms from the delta unit by loosening the bolts. Use an interchangeable head torque wrench and the open-end head insert.	Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002150
4	Remove the lower arms and the delta unit. **Note** Save the sealing washer for refitting, or replace it if damaged.  xx1900001801	 xx1900001796

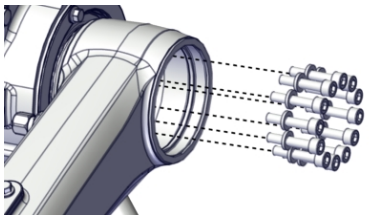
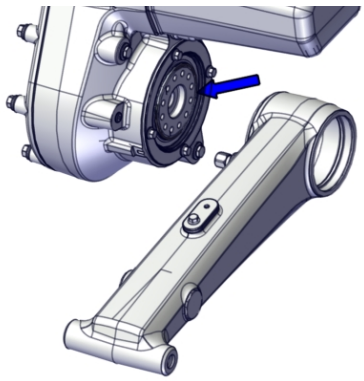
Removing the upper arms

	Action	Note
1	Remove the upper arm cover. **Note** Keep the sealing for refitting.	 xx1900001799

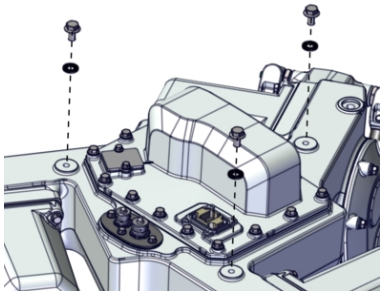
Continues on next page

5.4.1 Replacing the base unit

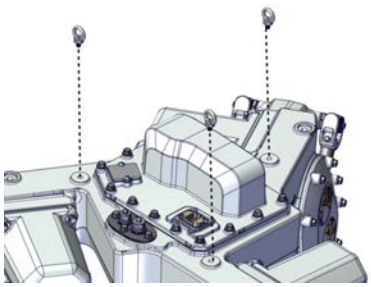
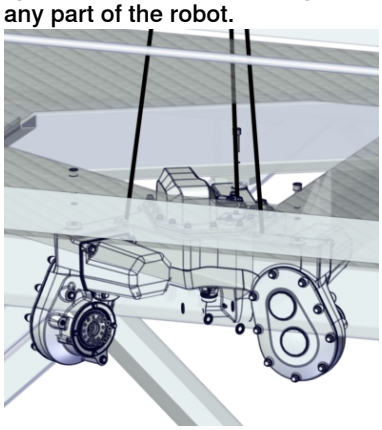
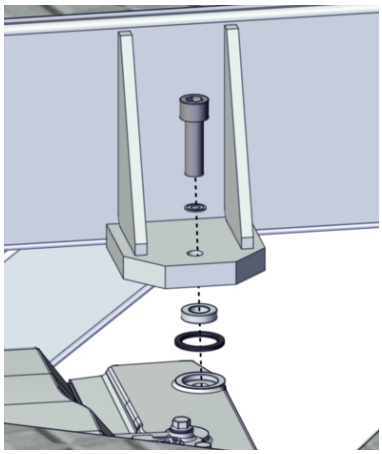
Continued

	Action	Note
2	Remove the screws and washers.	 xx1900001800
3	Remove the upper arm from the base unit. **Note** Keep the sealing ring for refitting.	 xx1900001820

Removing the base unit

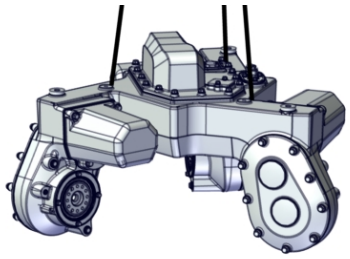
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	**CAUTION** The weight of the base unit is 125 kg All lifting accessories used must be sized accordingly.	
3	Remove the three protection screws and washers.	 xx2200000718

Continues on next page

	Action	Note
4	Fasten three lifting eyes.	 xx1900000210
5	Attach the roundslings to the lifting eyes and attach to an overhead crane. **Note** Make sure the roundslings do not rub against any sharp edges.	Make sure the roundsling has free space and does not wear against any part of the robot.  xx2000000920
6	Raise the overhead crane to take the weight of the robot.	
7	Remove the attachment screws and washers.	 xx2000000469

Continues on next page

5.4.1 Replacing the base unit
Continued

	Action	Note
8	Lift away the robot and place it on a suitable working space for continuing the removal work.	 xx2000001110

Moving equipment from the old base to the new spare part

The base spare part has several possible configurations with included equipment.

Move equipment from the old base to the new spare part accordingly, before refitting the base to the robot frame.

See detailed replacement procedures:

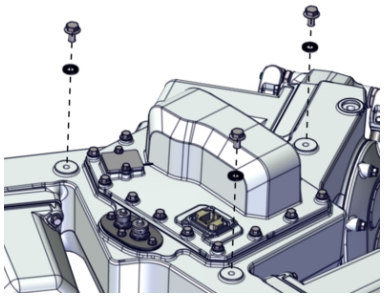
- *Replacing the SMB unit on page 185*.
- *Replacing the axis-4 gear unit pre-stage on page 289*.
- *Replacing the axis-5 gear unit pre-stage on page 305*.
- *Replacing the cable harness on page 192*.
- *Replacing the axis-1, axis 2 and axis-3 motor on page 260*.

Refitting the base unit

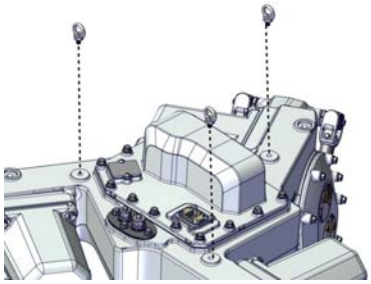
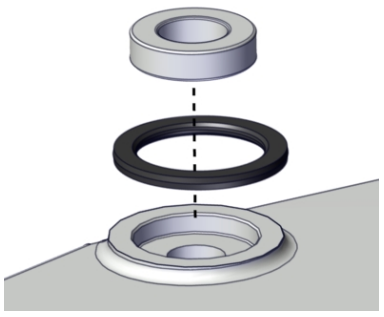
Use these procedures to refit the base unit.

Installing the base unit

Use the procedure to install the base unit.

	Action	Note
1	Remove the three protection screws and washers. **Note** Save the protection screws and washers, to refit after the lifting eyes are removed.	 xx2200000718

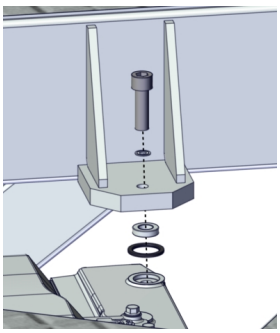
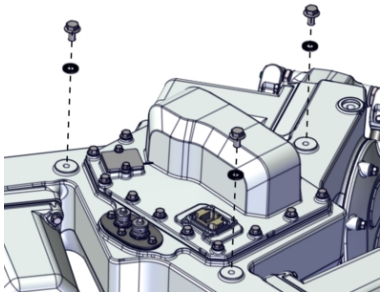
Continues on next page

	Action	Note
2	Fasten three lifting eyes.	 xx1900000210
3	**CAUTION** The weight of the complete base unit and upper arms is 136 kg. All lifting accessories used must be sized accordingly.	
4	Attach the roundslings to the lifting eyes. **Note** Make sure the roundslings do not rub against any sharp edges.	Make sure the roundsling has free space and does not wear against any part of the robot.
5	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
6	Fit the sealing rings and distance washers to the three mounting points.	Distance washer (3HAC070543-001). Sealing ring (3HAC074660-001)  xx2000000260

Continues on next page

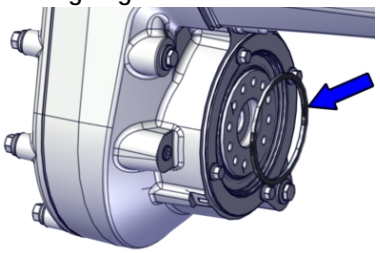
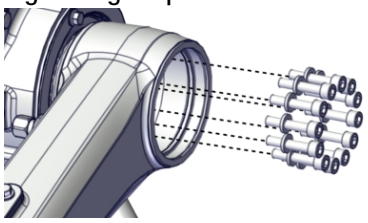
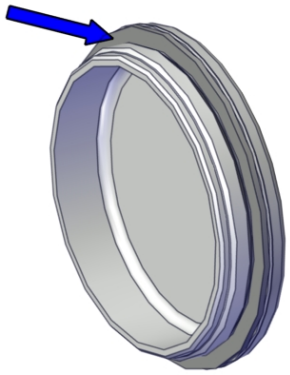
5.4.1 Replacing the base unit

Continued

	Action	Note
7	Lift the base unit to its mounting position, mate to the attachment holes and secure with attachment bolts and washers. Attachment bolts: M16 stainless steel. Minimum length of thread engagement: 24 mm, Minimum quality: A4-80 (3 pcs) Washers: 12.5x24x6.5 Steel (3HAC082030-001) Tightening torque: 250 Nm.  xx2000000470  xx2000000469	
8	Remove the lifting eyes and refit the protection screws and washers. Lubricate underneath the screw head to reduce friction against the washer.	Protection screw: 3HAC060233-011 Sealing washer: 3HAC081466-001 Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2200000718

Continues on next page

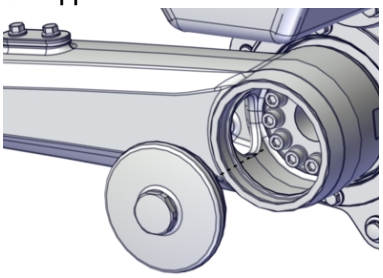
Refitting the upper arms

	Action	Note
1	Clean and fit the sealing ring. Replace if damaged.	Sealing ring: 3HAC062067-001.  xx1900001821
2	Fit the upper arm to the base unit and secure with 12 attachment screws and washers.	Upper arm: 3HAC060604-003. Hex socket head cap screw: M8x40 12.9 Gleitmo 603+Geomet 500 (12 pcs) Washers, 12 pcs: 3HAC043799-001 (12 pcs) Tightening torque: 35 Nm.  xx1900001800
3	Check the upper arm cover gasket. Replace if damaged.	Gasket: 3HAC058619-001.  xx1900001822
4	Lubricate the thread of the upper arm cover and the gasket with grease.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)

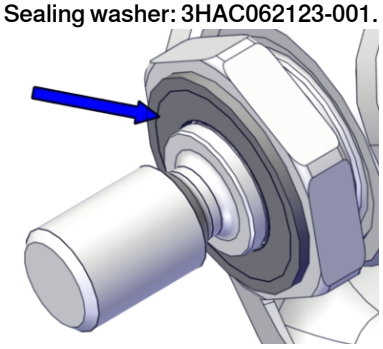
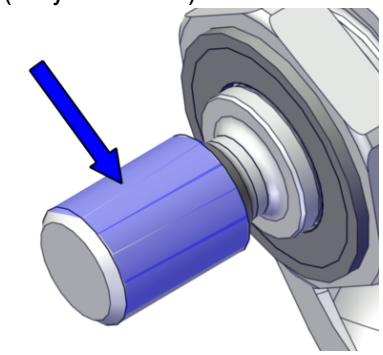
Continues on next page

5.4.1 Replacing the base unit

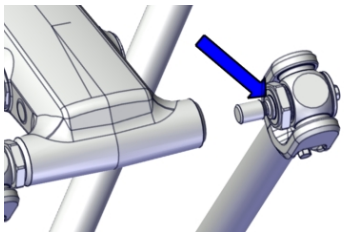
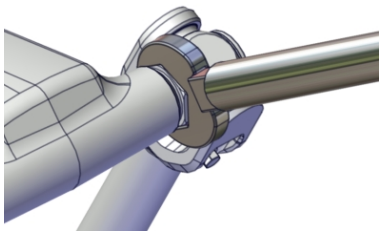
Continued

	Action	Note
5	Refit the upper arm cover including the gasket.	Tightening torque: approximately 45 Nm. Tighten until the cover bottoms on the upper arm.  xx1900001799

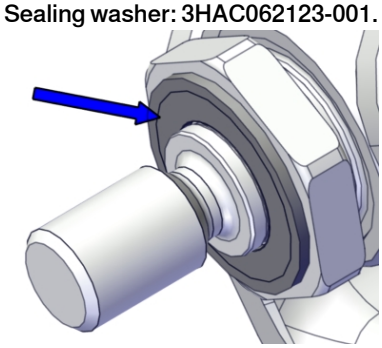
Refitting the lower arm to the upper arm

	Action	Note
1	Fit the sealing washer to the lower arm. Replace the sealing washer if damaged.	Sealing washer: 3HAC062123-001.  xx2000000861
2	Lubricate only the thread of the lower arm where the arrow is pointing, see figure. **Note** Do not lubricate the parts marked with the red color.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000684

Continues on next page

	Action	Note
3	Fit the lower arm. Make sure the sealing washer is in place. **Note** The lower arm can be turned either way, the orientation has no significance.	Lower arm / parallel bar: 3HAC060138-001.  xx1900001796
4	Tighten the shaft. Start by hand, then use an interchangeable head torque wrench and the open-end head insert to apply tightening torque.	Tightening torque: 100 Nm. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002152

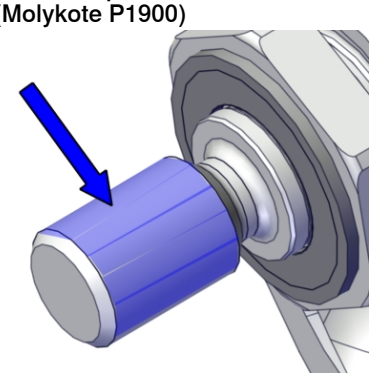
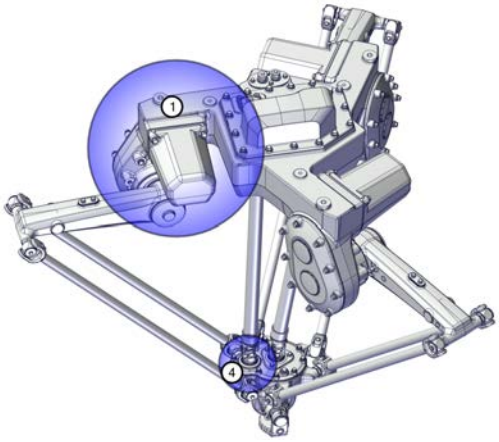
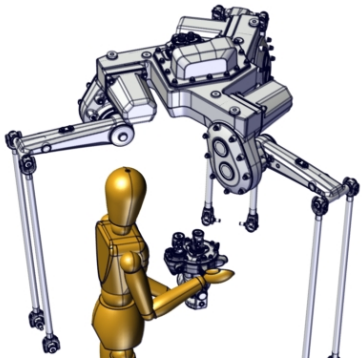
Refitting the delta unit

	Action	Note
1	Fit sealing washers to the lower arms. Replace the sealing washers if damaged.	Sealing washer: 3HAC062123-001.  xx2000000861

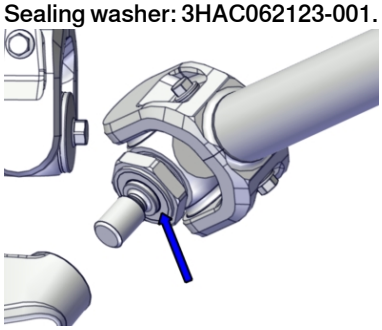
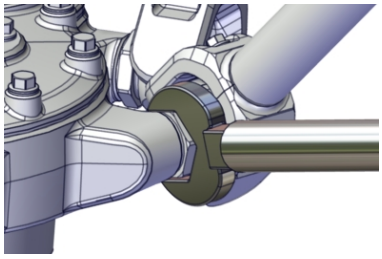
Continues on next page

5.4.1 Replacing the base unit

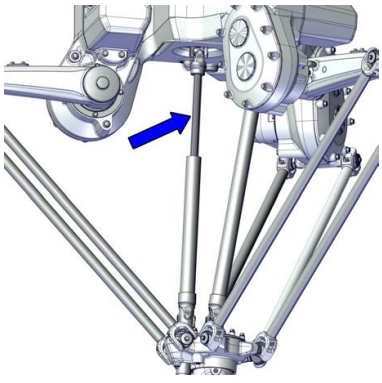
Continued

	Action	Note
2	Lubricate only the thread on the joint of the lower arm. **Note** There must be no grease outside the thread.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000684
3	Lift and hold the delta unit or place the delta unit on a workbench. Orientation of delta unit: axis-4 universal joint side of delta unit directed towards axis-1 side of robot.  xx2000000685 **CAUTION** Axis 5 on the delta unit is not stable. There is a risk of pinching or tipping the unit if holding or putting down the delta unit on its tilt arm. **Tip** This operation is best performed by two persons working together.	Delta unit, axis 4: 3HAC058371-003. Delta unit, axis 4-5: 3HAC058372-002.  xx2000000687

Continues on next page

	Action	Note
4	Fit all lower arms to the delta unit. Make sure the sealing washers are in place.	Sealing washer: 3HAC062123-001.  xx2000001063
5	Tighten the lower arm shafts. Start by hand, then use an interchangeable head torque wrench and the open-end head insert to apply tightening torque.	Tightening torque: 100 Nm. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002150

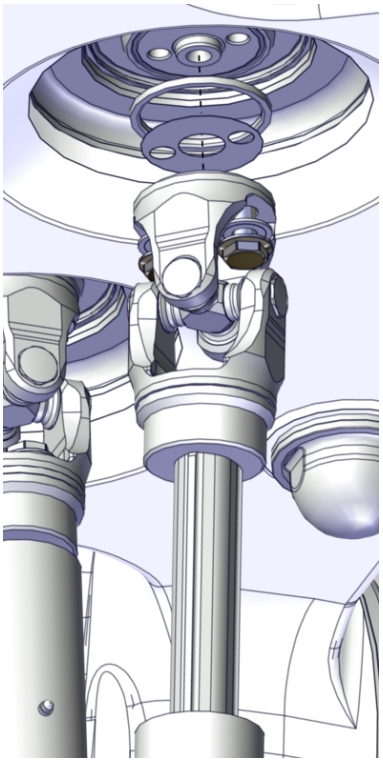
Refitting the upper end of the telescopic shaft

	Action	Note
1	**CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	 xx2100002779
2	Clean the friction shim, the sealing ring and the contact surfaces with isopropanol. Inspect for damage. Replace if damaged.	Cleaning agent: Isopropanol. Friction shim: 3HAC060200-001. Sealing ring: 3HAC060263-001

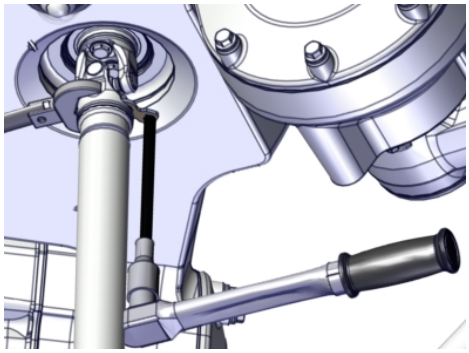
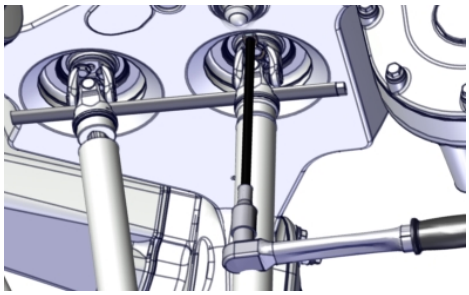
Continues on next page

5.4.1 Replacing the base unit

Continued

	Action	Note
3	Fit the upper end of the telescopic shaft by installing the friction shim, sealing ring and the telescopic shaft at the base unit. **CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	Telescopic shaft unit: 3HAC059382-003  xx2000001109

Continues on next page

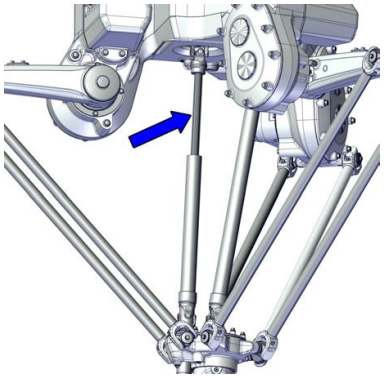
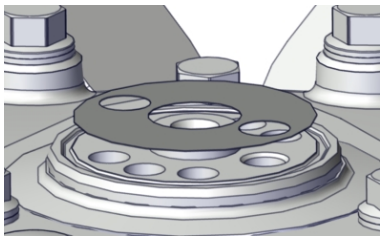
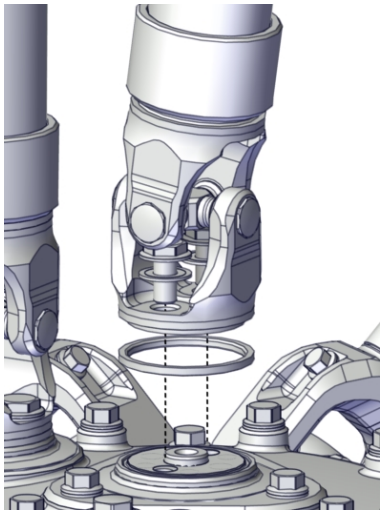
	Action	Note
4	Lubricate the screw thread and the washer surface underneath the screw head. Secure with the lubricated screws and washers and tighten, using the torque wrench head with a closed end. **Tip** The shaft rotates when loosening/fastening the screws. Use one of two alternatives to hold the shaft still: 1 Hold the motor shaft still with an open-end wrench (47 mm) at the joint while loosening/tightening the screws. Requires two persons.  xx2000000346 2 Hold the motor shaft still by inserting a pin through the joints (5-axis robot) or through the joint and against the casting. Choose an appropriate material for the pin, that does not damage the surface of the joints.  xx2000000688 **CAUTION** There is a risk of damage to the joint if not handled with care.	Anti-seize paste: 3HAC070875-002 (Molykote P1900) Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: 3HAC058626-004 Tightening torque: 35 Nm.

Continues on next page

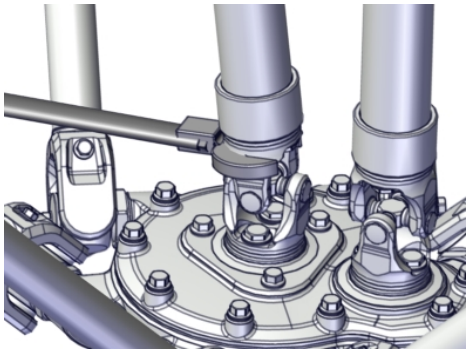
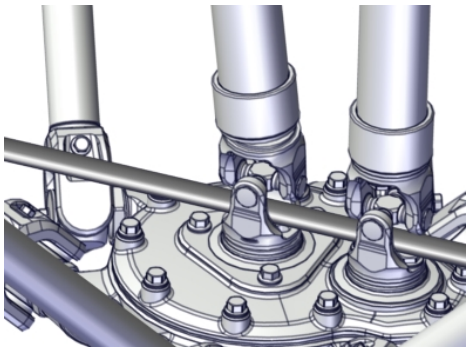
5.4.1 Replacing the base unit

Continued

Refitting the lower end of the telescopic shaft

	Action	Note
1	**CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	 xx2100002779
2	Clean the friction shim and sealing ring with isopropanol. Inspect the friction shim and sealing ring. Replace if damaged.	Cleaning agent: Isopropanol. Friction shim: 3HAC060200-001. Sealing ring: 3HAC060263-001
3	Fit the friction shim.	 xx1900001829
4	Install the sealing ring at the lower joint and guide the telescopic shaft into place. **CAUTION** Hold the telescopic unit carefully, the tube may slide and get damaged.	 xx2000001111

Continues on next page

	Action	Note
5	Lubricate the screw thread and the washer surface underneath the screw head. Secure with the lubricated screws and washers and tighten, using the torque wrench head with a closed end. **Tip** The shaft rotates when loosening/fastening the screws. Use one of two alternatives to hold the shaft still: 1 Hold the motor shaft still with an open-end wrench (47 mm) at the joint while loosening/tightening the screws. Requires two persons.  xx2000001103 2 Hold the motor shaft still by inserting a pin through the joints (5-axis robot) or through the joint and against the casting. Choose an appropriate material for the pin, that does not damage the surface of the joints.  xx2000001104 **CAUTION** There is a risk of damage to the joint if not handled with care.	Anti-seize paste: 3HAC070875-002 (Molykote P1900) Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: 3HAC058626-004 Tightening torque: 35 Nm.

Continues on next page

5.4.1 Replacing the base unit

Continued

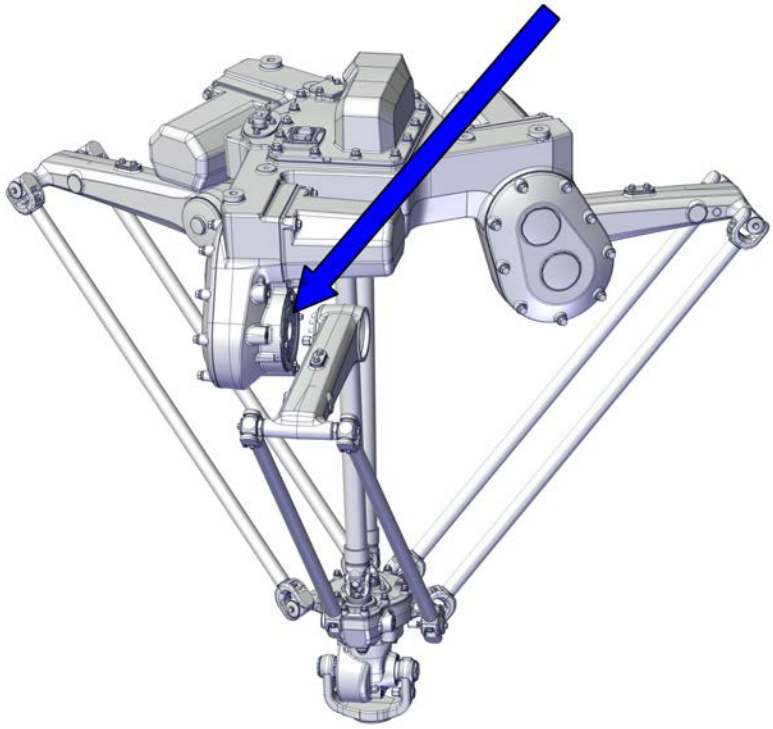
Concluding procedure

	Action	Note
1	Reconnect all cabling to the robot.	
2	Calibrate the robot.	See *Calibration on page 321*.
3	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.4.2 Replacing the cassette sealing

Location of the cassette sealing

The cassette sealing is located as shown in the figure.



xx2000000110

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Cassette sealing	3HAC043926-003		L2

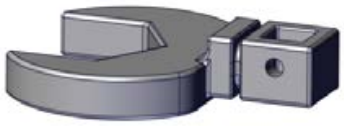
Required consumables

Consumable	Article number	Note
P-80 rubber lubrication gel	3HAC074427-001	P-80 Emulsion IFC
Anti-seize paste	3HAC070875-002	Molykote P1900
Cable ties	-	

Continues on next page

5.4.2 Replacing the cassette sealing
Continued

Required tools and equipment

Equipment	Article number	Note
Lashing strap	-	Width 25 mm Length 2.5 m
Torque wrench head, open-end insert	3HAC073854-001	Included in robot delivery.  xx1900002148 Used with an interchangeable head torque wrench (not included in delivery). Interface: 14x18 mm.
Interchangeable head torque wrench	-	
Screw M8 x minimum 25 mm	-	Used to press out the cassette sealing holder. 4 pcs.
Press tool, cassette sealing	3HAC069723-010	Used to fit the cassette sealing.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

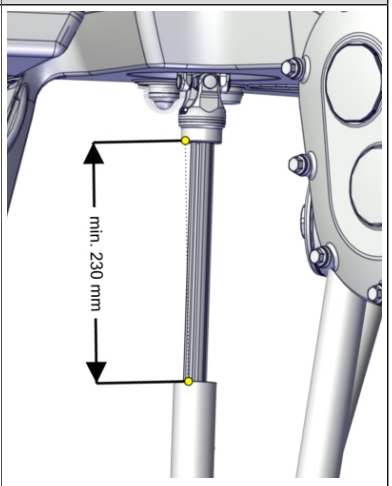
Spare part	Article number	Note
O-ring	3HAB3772-110	Replace if damaged.
Cassette sealing holder	3HAC067484-001	
Sealing ring	3HAC067485-001	Replace if damaged.
Hexagon flange bolt	3HAC060233-009	M6x20 stainless steel/A4-80
Washer	3HAC058626-003	M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Sealing ring	3HAC062067-001	Between base unit and upper arm.
Washers, 12 pcs	3HAC043799-001	
Gasket	3HAC058619-001	For the upper arm cover.
Sealing washer	3HAC062123-001	To the lower arm.

Continues on next page

Removing the cassette sealing

Use these procedures to remove the cassette sealing.

Preparations before removing the cassette sealing

	Action	Note
1	Jog the upper arms to an appropriate working position. Move the robot so that the telescopic shaft is extended 230 mm as minimum, to be able to secure the lower arms against the shaft further on in the procedure.	 xx2000000927
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

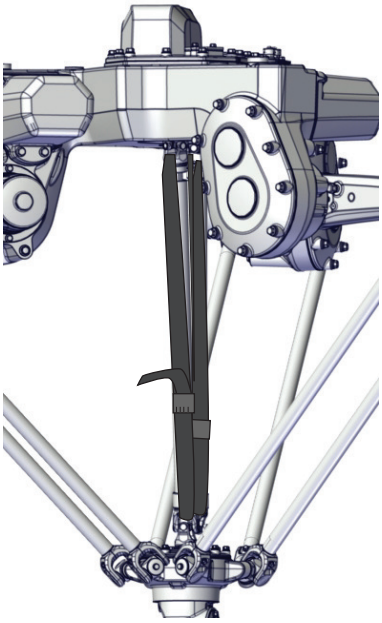
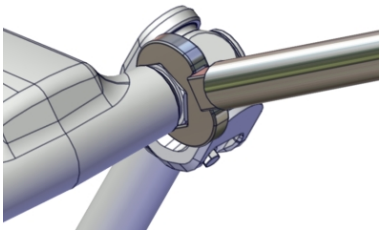
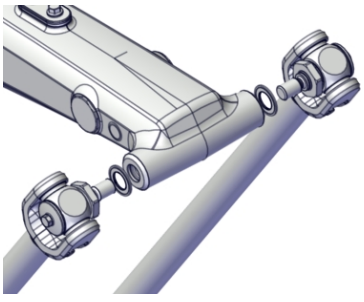
Loosening the lower arm shafts

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	

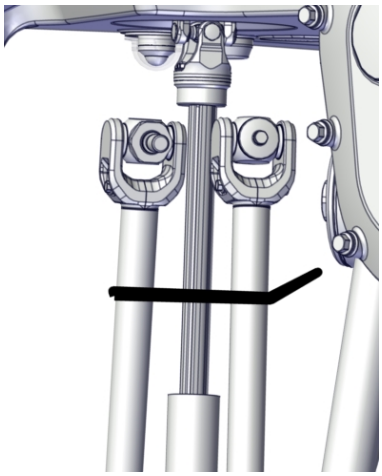
Continues on next page

5.4.2 Replacing the cassette sealing

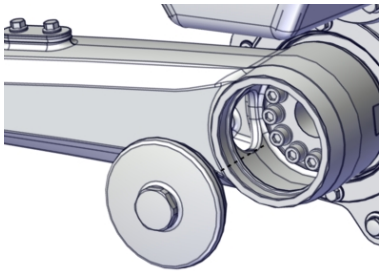
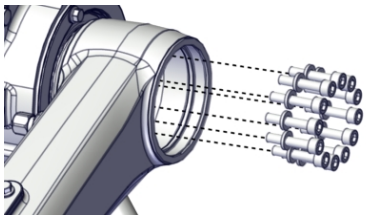
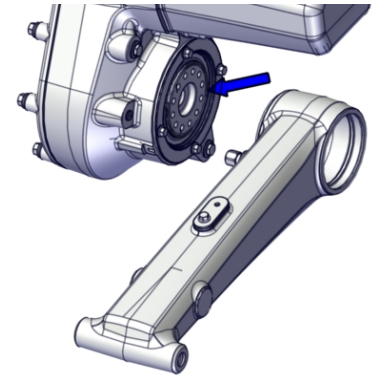
Continued

	Action	Note
2	**CAUTION** The delta unit will become unstable when a lower arm is removed. Support the weight of the delta unit before removing the arm to minimize the movement. Either support the weight from underneath or secure the weight with a lashing strap through the universal joints closest to the telescopic shaft.	Lashing strap  xx2000000334
3	Loosen the both lower arm shafts from the upper arm by loosening the bolts. Use an interchangeable head torque wrench and the open-end head insert.	Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002152
4	Disconnect the lower arms from the upper arm.	 xx1900001802

Continues on next page

	Action	Note
5	Secure the lower arms against the telescope shaft with a cable tie. **CAUTION** Put some soft material between the surfaces, to protect them from scratches etc.	Cable ties  xx2000000921

Removing the upper arm

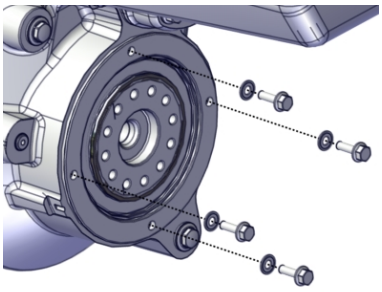
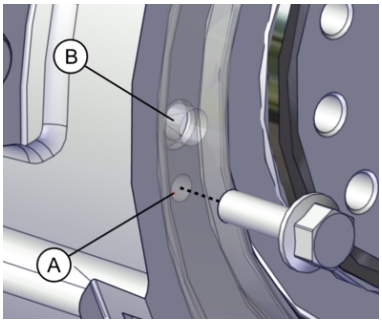
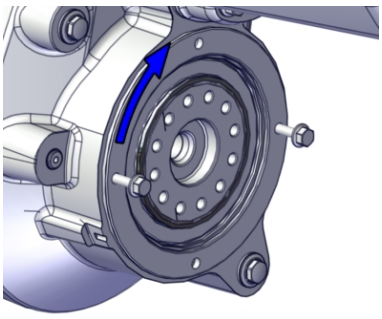
	Action	Note
1	Remove the upper arm cover. **Note** Keep the sealing for refitting.	 xx1900001799
2	Remove the screws and washers.	 xx1900001800
3	Remove the upper arm from the base unit. **Note** Keep the sealing ring for refitting.	 xx1900001820

Continues on next page

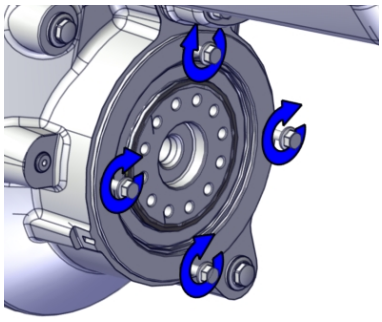
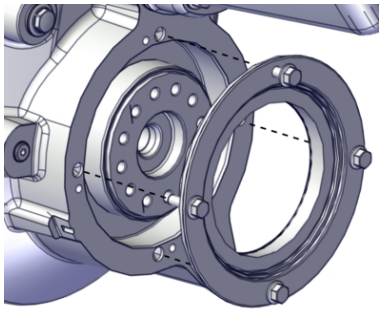
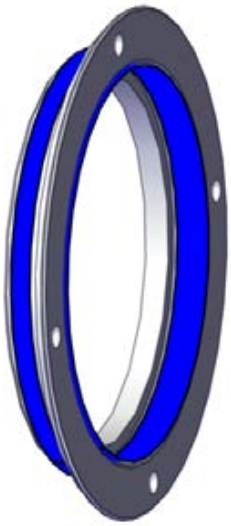
5.4.2 Replacing the cassette sealing

Continued

Removing the cassette sealing

	Action	Note
1	Remove the attachment screws and washers.	 xx2000000112
2	The base casting has four press out holes (B) to be used for pressing out the cassette sealing holder. Do not mix them with the attachment screw holes (A). Insert two M8 screws with minimum length of 25 mm into opposite attachment screw holes (A) in the sealing holder, just enough to get a grip of the holder. Then rotate the sealing holder approximately 10° clockwise, to the position where the press out holes (B) are accessible (visible when looking through the attachment screw holes).	Screw M8 x minimum 25 mm  xx2000000290 A Attachment screw holes B Press out holes  xx2000000113

Continues on next page

	Action	Note
3	Insert two more M8 screws minimum length of 25 mm to the holder and press out the cassette sealing holder by screwing in the four screws alternatively until the holder is loose. **CAUTION** Use only the press out holes (B in previous figure) for pressing out the holder.	 xx2000000114  xx2000000289
4	Remove the cassette sealing from the holder by first pulling out the inner ring, and then knocking out the outer ring with a striker. **CAUTION** Be careful not to damage the outer and inner surface of the sealing holder, highlighted in the figure.  xx2000000291	 xx2000001112

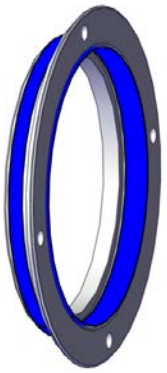
Continues on next page

5.4.2 Replacing the cassette sealing
Continued

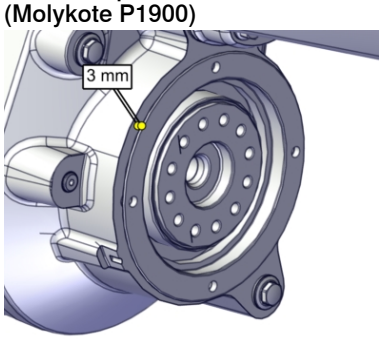
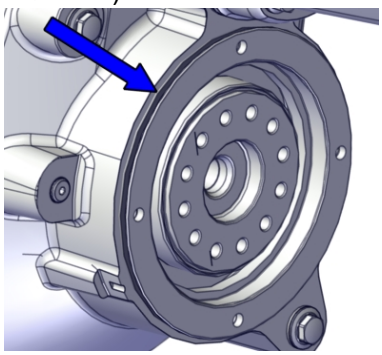
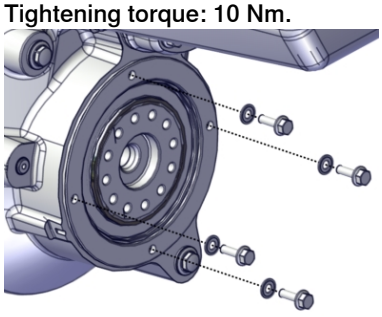
Refitting the cassette sealing

Use these procedures to refit the cassette sealing.

Refitting the cassette sealing

	Action	Note
1	Inspect the outer and inner surface of the cassette sealing holder for scratches. Replace the holder if there are damages on the surfaces highlighted in the figure.	Cassette sealing holder: 3HAC067484-001.  xx2000000291
2	Lubricate and fit the o-ring to the cassette sealing holder. Replace if damaged.	O-ring: 3HAB3772-110. Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000928

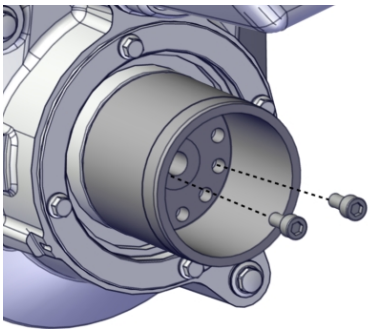
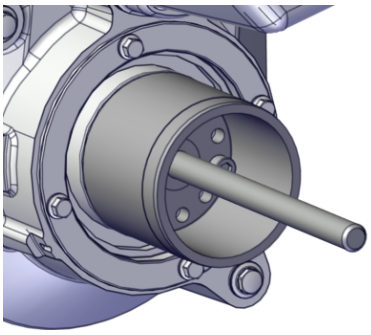
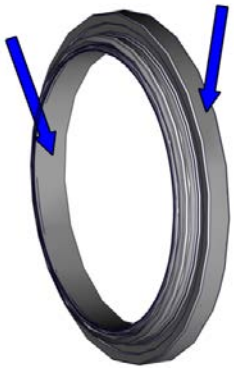
Continues on next page

	Action	Note
3	Refit the sealing holder with lubricated screws and washers but leave a distance for the sealing ring, approximately 3 mm.	Hexagon flange bolt: 3HAC060233-009 (4 pcs, M6x20 stainless steel/A4-80). Washer: 3HAC058626-003 (M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.). Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000929
4	Lubricate and refit the sealing ring. Replace if damaged.	Sealing ring: 3HAC067485-001. Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000000930
5	Tighten the screws and washers.	Tightening torque: 10 Nm.  xx2000000112

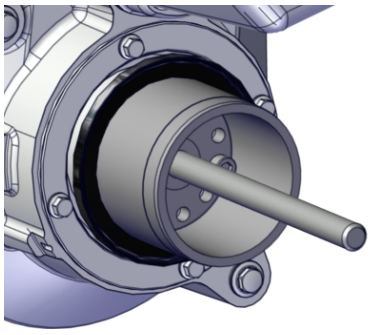
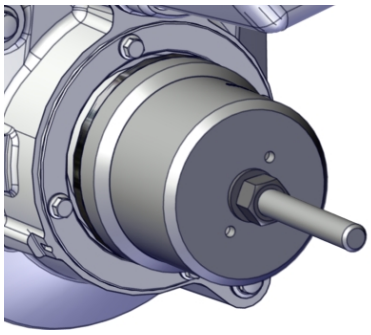
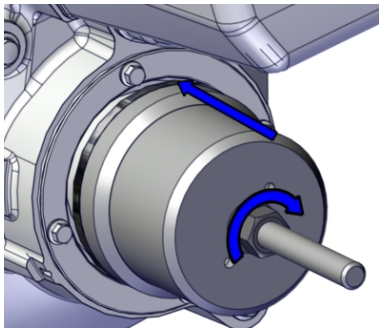
Continues on next page

5.4.2 Replacing the cassette sealing

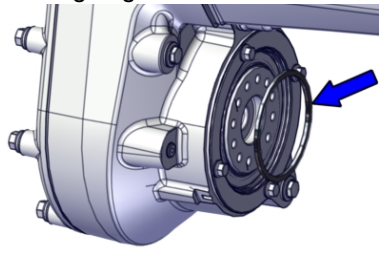
Continued

	Action	Note
6	Fit the press tool sleeve to the upper arm with two of the attachment screws.	Press tool, cassette sealing: 3HAC069723-010  xx2000001824
7	Fit the threaded shaft.	 xx2000001825
8	Lubricate the outer and inner diameter of the cassette sealing sparingly with assembly lubricant.	P-80 rubber lubrication gel: 3HAC074427-001 (P-80 Emulsion IFC)  xx2000001827

Continues on next page

	Action	Note
9	Thread the cassette sealing to the sleeve.	Cassette sealing: 3HAC043926-003.  xx2000001826
10	Fit the press tool and then the washer and the nut to the threaded shaft.	 xx2000001828
11	Press the cassette sealing into the sealing holder by screwing in the nut on the thread shaft until the press tool bottom. Leave in place for at least 30 seconds before removing the tool.	 xx2000001829

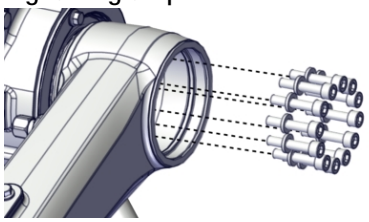
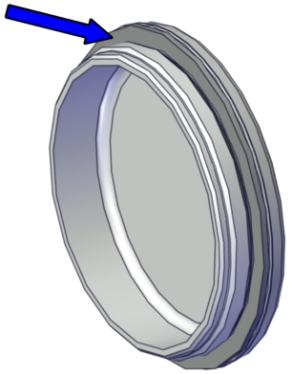
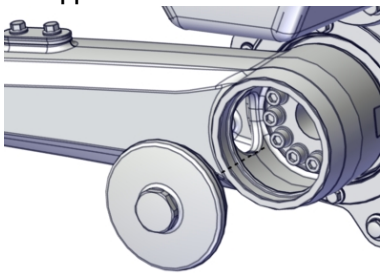
Refitting the upper arm

	Action	Note
1	Clean and fit the sealing ring. Replace if damaged.	Sealing ring: 3HAC062067-001.  xx1900001821

Continues on next page

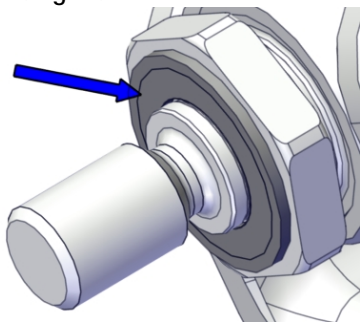
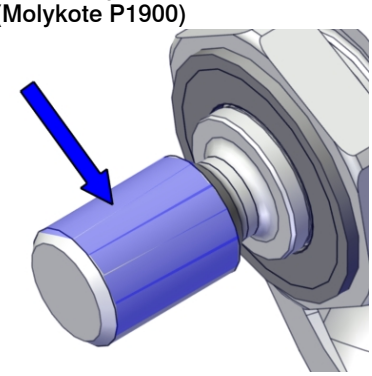
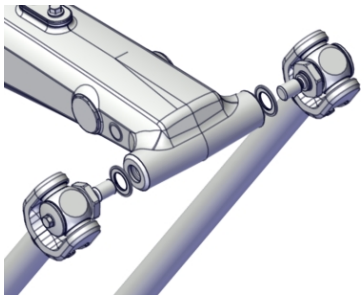
5.4.2 Replacing the cassette sealing

Continued

	Action	Note
2	Fit the upper arm to the base unit and secure with 12 attachment screws and washers.	Upper arm: 3HAC060604-003. Hex socket head cap screw: M8x40 12.9 Gleitmo 603+Geomet 500 (12 pcs) Washers, 12 pcs: 3HAC043799-001 (12 pcs) Tightening torque: 35 Nm.  xx1900001800
3	Check the upper arm cover gasket. Replace if damaged.	Gasket: 3HAC058619-001.  xx1900001822
4	Lubricate the thread of the upper arm cover and the gasket with grease.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)
5	Refit the upper arm cover including the gasket.	Tightening torque: approximately 45 Nm. Tighten until the cover bottoms on the upper arm.  xx1900001799

Continues on next page

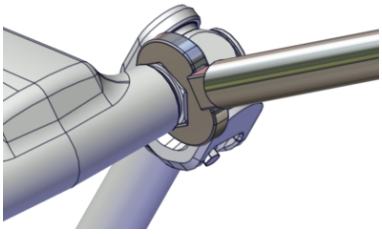
Refitting the lower arm shafts

	Action	Note
1	Fit sealing washers to the lower arm. Replace the sealing washers if damaged.	Sealing washer: 3HAC062123-001.  xx2000000861
2	Lubricate the lower arm thread with grease. **Note** The surface under the thread head must be dry and not contain grease.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000684
3	Secure the lower arms including the sealing washers to the upper arm. Make sure the sealing washers are in place.	Lower arm / parallel bar: 3HAC060138-001.  xx1900001802

Continues on next page

5.4.2 Replacing the cassette sealing

Continued

	Action	Note
4	Tighten the shafts. Start by hand, then use an interchangeable head torque wrench and the open-end head insert to apply tightening torque.	Tightening torque: 100 Nm. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002152

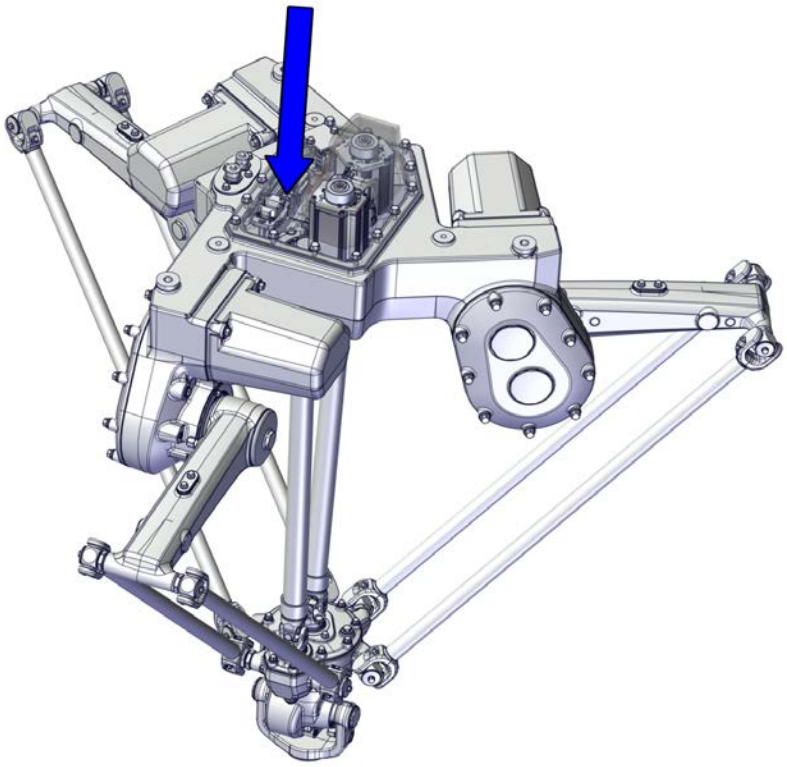
Concluding procedure

	Action	Note
1	Calibrate the robot.	See *Calibration on page 321*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.4.3 Replacing the SMB unit

Location of the serial measurement board (SMB) unit

The SMB unit is located as shown in the figure.



xx2000001003

Note

This repair procedure requires sufficient free space above the robot for removal of the top cover and affected spare parts.

Read more about access ways in *Minimum required free space above the robot on page 49*.

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Serial measurement unit DSQC 633C	3HAC043904-001	Complete unit with serial measurement board and bracket.	L2

Continues on next page

5.4.3 Replacing the SMB unit
Continued

Required consumables

Consumable	Article number	Note
Anti-seize paste	3HAC070875-002	Molykote P1900
Cable ties	-	

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Hexagon flange bolt	3HAC060233-006	M6x16 stainless steel/A4-80
Washer	3HAC058626-003	M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Sealing washer	3HAC058649-003	Base unit top cover.
Hexagon flange bolt	3HAC060233-008	M8x40 stainless steel/A4-80
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the SMB unit

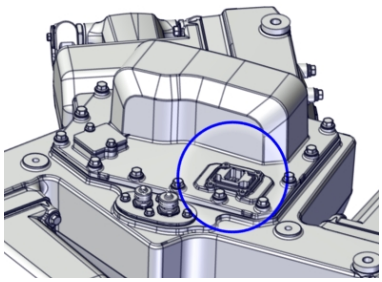
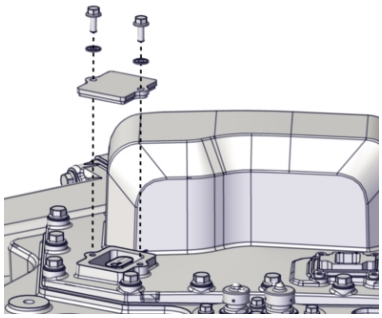
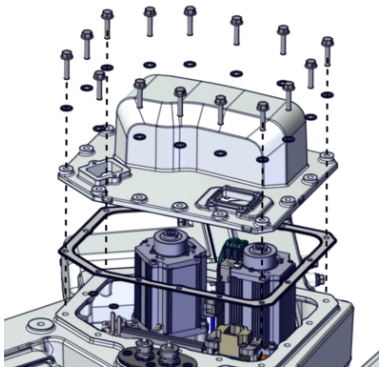
Use these procedures to remove the SMB unit.

Preparations before removing the SMB unit

	Action	Note
1	Jog the robot to calibration position.	This is done to facilitate updating of the revolution counter.
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Continues on next page

Removing the top cover

	Action	Note
1	Disconnect connector R1.MP from the base.	 xx2000001006
2	**CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	
3	Remove the SMB battery cover. **Tip** The battery cover is removed to see the battery position during refitting of the top cover.	 xx1900000407
4	Remove the cover by removing the screws and washers. Also remove the sealing.	 xx1900000469

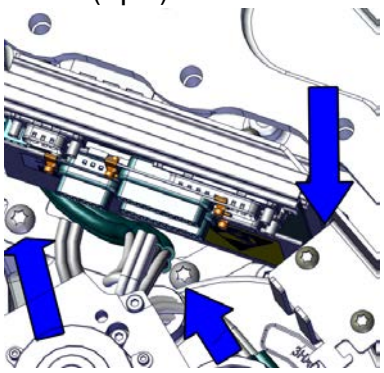
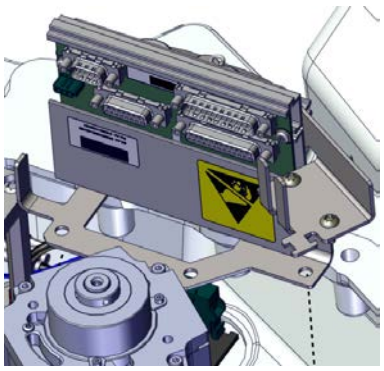
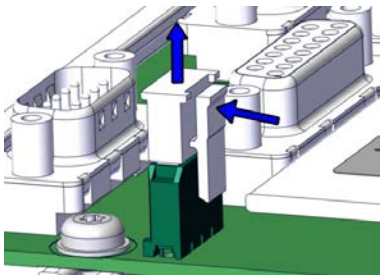
Removing the SMB unit

	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 43*.	

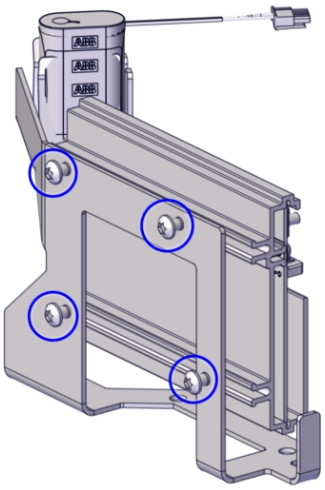
Continues on next page

5.4.3 Replacing the SMB unit

Continued

	Action	Note
2	Cut the cable tie	
3	Remove the screws that secure the SMB unit bracket.	Screws (3 pcs)  xx1900000753
4	Pull out the SMB unit assembly a little and disconnect the connectors from the SMB board: • R2.FB1-4, R2.FB5 (IRB 390 - 10/1300) • Battery cable connector R2.G. Disconnect the battery cable by pressing down the upper lip of the R2.G connector to release the lock while pulling the connector upwards.	 xx1900000754  xx1700000993

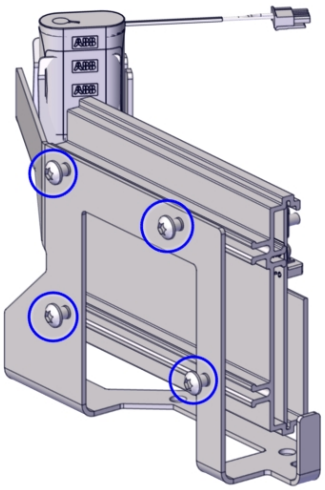
Continues on next page

	Action	Note
5	If replacing the SMB board with a new, loosen the four screws enough for the board to be removed. Otherwise, leave it mounted. Put the SMB board or the complete assembly in an ESD bag.	 xx2000001051

Refitting the SMB unit

Use these procedures to refit the SMB unit.

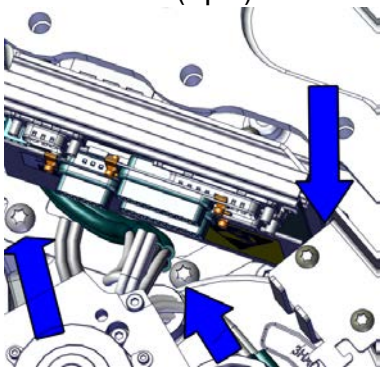
Refitting the SMB unit

	Action	Note
1	Put the SMB unit into the SMB bracket and secure with the four screws.	 xx2000001051
2	Connect the connectors: • R2.FB1-4, R2.FB5 (IRB 390 - 10/1300) • Battery cable connector R2.G.	

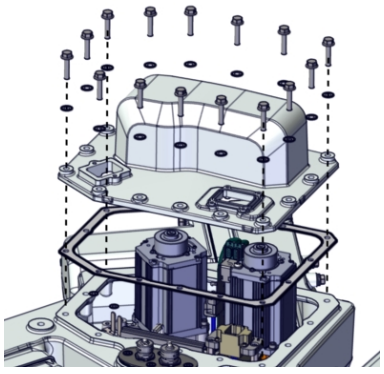
Continues on next page

5.4.3 Replacing the SMB unit

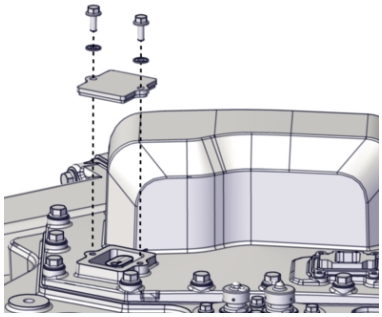
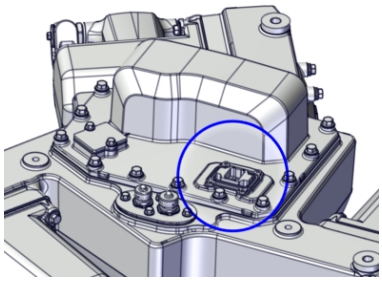
Continued

	Action	Note
3	Secure the SMB bracket with the screws.	M6x16 8.8-A2F (3 pcs)  xx1900000753

Refitting the top cover

	Action	Note
1	Refit the sealing and tighten the cover with lubricated screws. **CAUTION** Check that the SMB battery does not get squeezed under the cover.	Sealing washer: 3HAC058649-003 Hexagon flange bolt: 3HAC060233-008 (M8x40 stainless steel/A4-80, 15 pcs) Washer: 3HAC058626-004 (M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose., 15 pcs) Anti-seize paste: Molykote P1900 (3HAC070875-002) Tightening torque: 21 Nm.  xx1900000469

Continues on next page

	Action	Note
2	Check that the battery is located correctly in the battery compartment and not pinched under the top cover. Then fasten the battery cover and sealing, with lubricated screws and washers. **Note** Do not overtighten to avoid damaging the sealing.	Tightening torque: 4 Nm. Hexagon flange bolt: 3HAC060233-006 (M6x16 stainless steel/A4-80) Washer: 3HAC058626-003 (M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.) Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx1900000407
3	Reconnect connector R1.MP to the base.	 xx2000001006

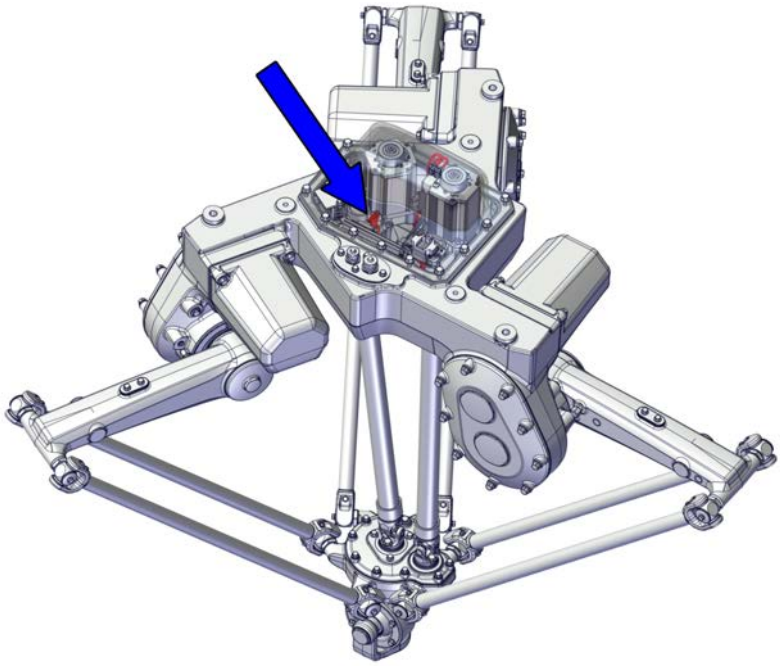
Concluding procedure

	Action	Note
1	Update the revolution counters.	See *Updating revolution counters on page 326*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.4.4 Replacing the cable harness

Location of the cable harness

The cable harness is located inside the base unit, as shown in the figure.



xx2000001004

> **Note**
>
> This repair procedure requires sufficient free space above the robot for removal of the top cover and affected spare parts.
>
> Read more about access ways in *Minimum required free space above the robot on page 49*.

Summary of the replacement procedure

This is a brief summary of the replacement procedure, containing the major actions to be performed.

1. Loosen upper ends of the telescopic shaft/shafts.
2. Disconnect the motor connectors at axis-1, axis-2 and axis-3 motors.
3. Remove the SMB unit assembly.
4. Remove the axis-4 and axis-5 motor and gear units.
5. Replace the cable harness.
6. Refit the removed parts in reversed order.

Continues on next page

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Cable harness	3HAC060469-001		L2

Required consumables

Consumable	Article number	Note
Cable ties	-	
Cleaning agent	-	Isopropanol
Anti-seize paste	3HAC070875-002	Molykote P1900

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Sealing ring	3HAC059017-002	For the gear unit.
Friction shim	3HAC060200-001	Between universal joint and telescopic shaft/base unit/delta unit.
Sealing ring	3HAC060263-001	Between universal joint and telescopic shaft/base unit/delta unit.
Hexagon flange bolt	3HAC058625-001	M8x16 Bumax 109
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Sealing washer	3HAC058649-003	Base unit top cover.
Hexagon flange bolt	3HAC060233-008	M8x40 stainless steel/A4-80
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Hexagon flange bolt	3HAC060233-003	M8x45 stainless steel/A4-80
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Hexagon flange bolt	3HAC060233-006	M6x16 stainless steel/A4-80
Washer	3HAC058626-003	M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.

Continues on next page

5.4.4 Replacing the cable harness
Continued

Required tools and equipment

Equipment	Article number	Note
Torque wrench head, closed end	3HAC063379-001	Included in robot delivery.  xx2000000282 Used with a torque wrench (not included in delivery) to loosen and tighten the universal joint and telescopic shaft screws. Hole interface: 1/4" square.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the cable harness

Use these procedures to remove the cable harness.

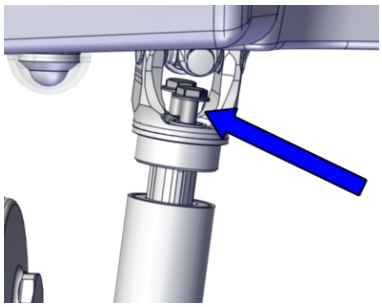
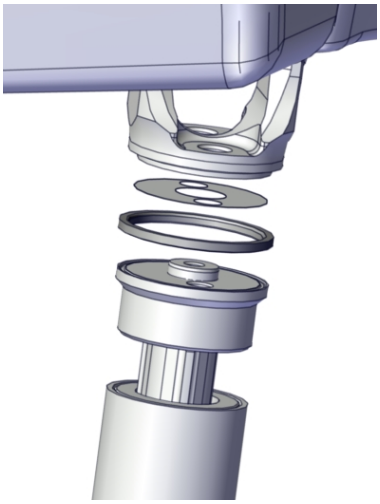
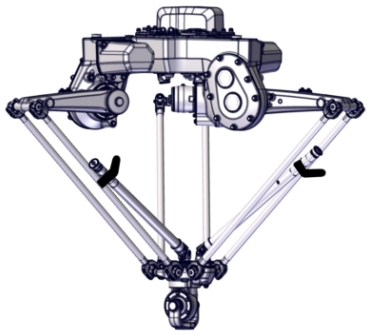
Preparations before removing the cable harness

	Action	Note
1	Jog the robot to calibration position.	This is done to facilitate updating of the revolution counter.
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Continues on next page

Loosening the telescopic shaft/shafts

For IRB 390 - 10/1300 (5-axis robot): loosen both shafts.

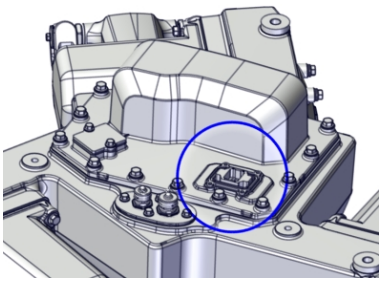
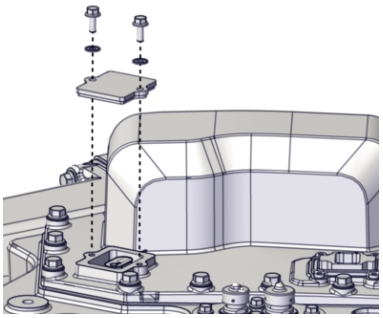
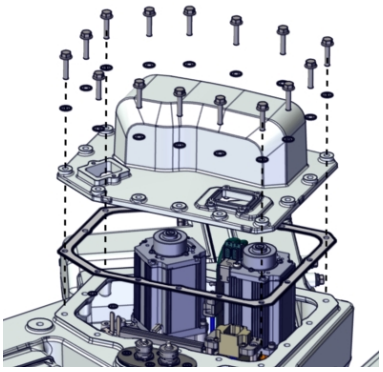
	Action	Note
1	Remove the upper screws and washers of the telescopic shaft, using a special torque wrench head.	Torque wrench head, closed end: 3HAC063379-001.  xx1900001823
2	Loosen the upper end of the telescopic shaft and secure the shaft against a part of the robot with a cable tie. **CAUTION** Put some soft material between the surfaces, to protect them from scratches etc. **Note** Keep the sealing ring and friction shim for refitting.  xx1900001825	 xx2000001022

Continues on next page

5.4.4 Replacing the cable harness

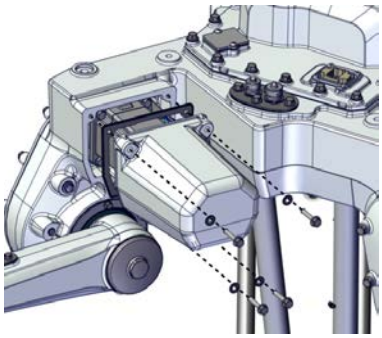
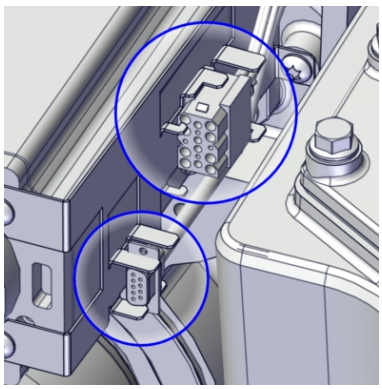
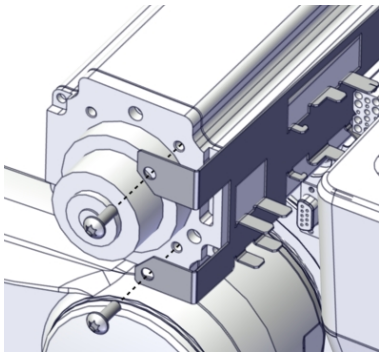
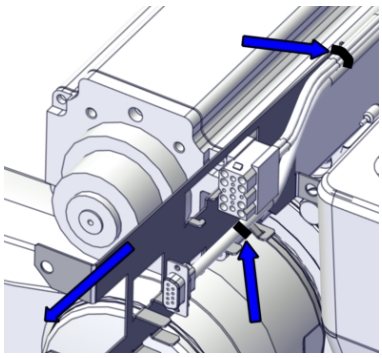
Continued

Removing the top cover

	Action	Note
1	Disconnect connector R1.MP from the base.	 xx2000001006
2	**CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	
3	Remove the SMB battery cover. **Tip** The battery cover is removed to see the battery position during refitting of the top cover.	 xx1900000407
4	Remove the cover by removing the screws and washers. Also remove the sealing.	 xx1900000469

Continues on next page

Disconnecting the axis-1, axis-2 and axis-3 motor cabling

	Action	Note
1	Remove the axis-1, axis-2 and axis-3 motor covers and sealings.	 xx1900000759
2	Cut required cable ties and snap loose the motor connectors from the brackets. **Tip** Take pictures of the cable routing and placement of cable ties, before cutting the ties.	 xx2000001005
3	Disconnect the motor connectors.	
4	Loosen the bracket from the motor.	 xx2000002199
5	Pull out the bracket and cut the remaining cable ties.	 xx2000002200

Continues on next page

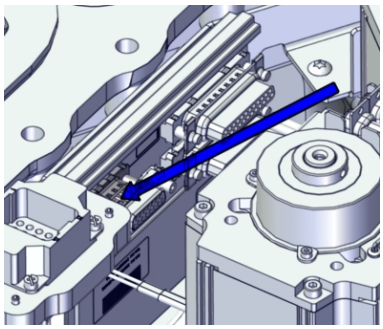
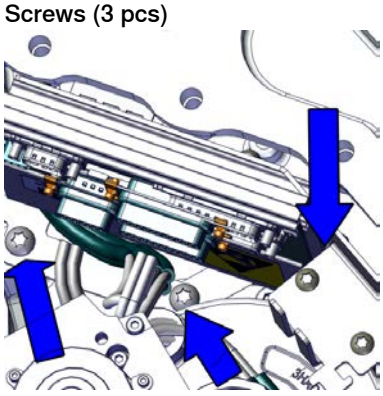
5.4.4 Replacing the cable harness

Continued

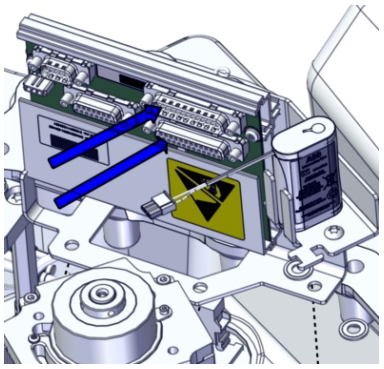
Taking a picture

	Action	Note
1	**Tip** Take pictures of the layout, including cable routing and placement of cable ties and connectors, before removing any components.	

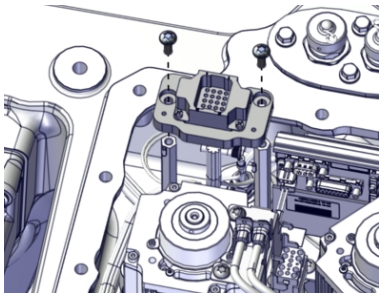
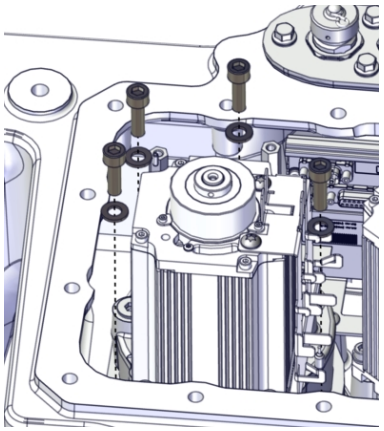
Removing the complete SMB unit

	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 43*.	
2	Disconnect the connector from X1 on the SMB board.	 xx2000002210
3	Cut the cable tie located at the battery.	
4	Remove the screws that secure the SMB unit bracket.	Screws (3 pcs)  xx1900000753

Continues on next page

	Action	Note
5	Pull out the SMB unit assembly a little and disconnect the connectors from the SMB board: • R2.FB1-4, R2.FB5 (IRB 390 - 10/1300)	 xx2000002201
6	Put the complete assembly in an ESD bag.	

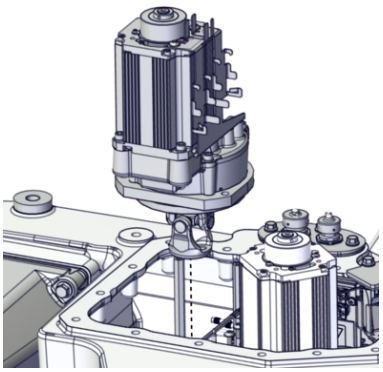
Removing the axis-4 motor and gear unit

	Action	Note
1	Loosen the holder for connector R1.MP1 and move it out of the way to get access to the gear unit attachment screws.	 xx1900001842
2	Cut cable ties, snap loose all motor connectors and disconnect them.	
3	Remove the gear unit attachment screws and washers.	 xx1900001843

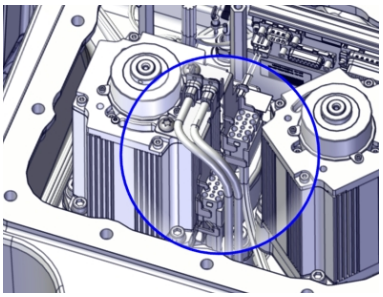
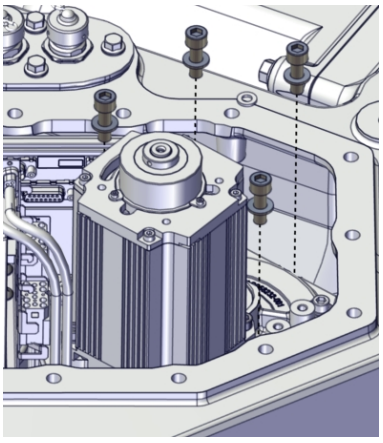
Continues on next page

5.4.4 Replacing the cable harness

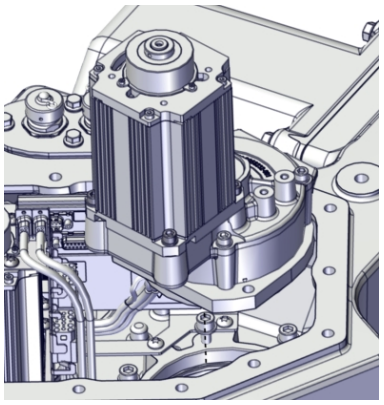
Continued

	Action	Note
4	Lift the complete motor and gear unit out from the base.	 xx1900002167

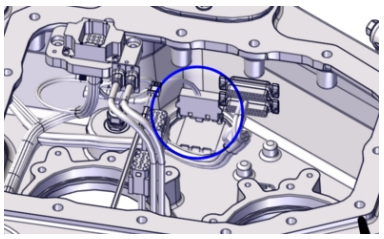
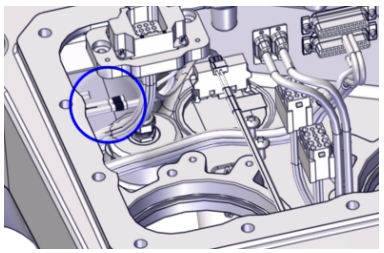
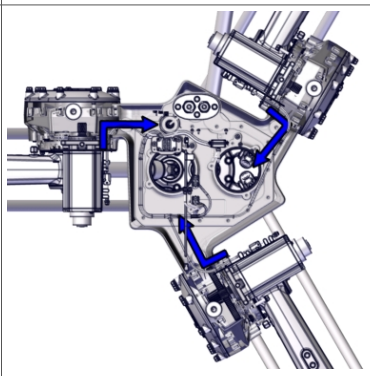
Removing the axis-5 motor and gear unit

	Action	Note
1	Snap loose the connectors from the connector bracket and disconnect the motor connectors.	 xx1900001845
2	Remove the gear unit attachment screws and washers.	 xx1900002171

Continues on next page

	Action	Note
3	Lift the complete motor and gear unit out from the base.	 xx1900002170

Removing the cable harness

	Action	Note
1	Disconnect the brake release connector.	 xx2000001023
2	Disconnect the signal lamp connectors H1 and H2.	 xx2000002211
3	Push through the connectors for axis-1, axis-2 and axis-3 motors into the base unit compartment, and remove the cable harness.	 xx2000001029

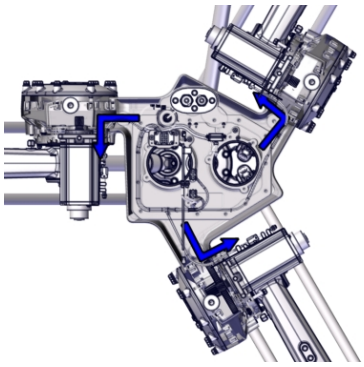
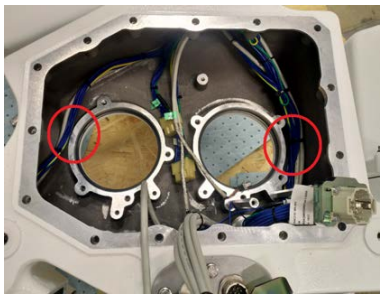
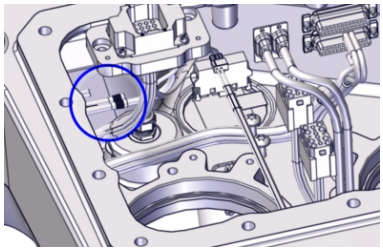
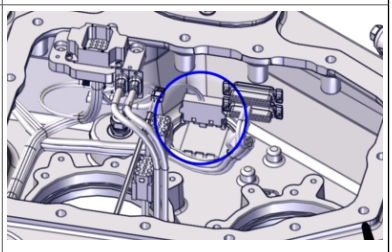
Continues on next page

5.4.4 Replacing the cable harness
Continued

Refitting the cable harness

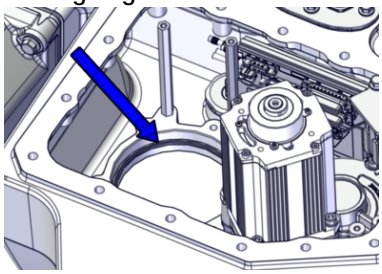
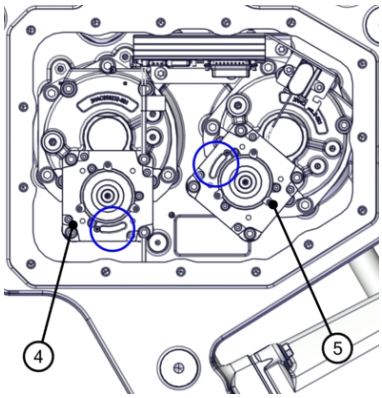
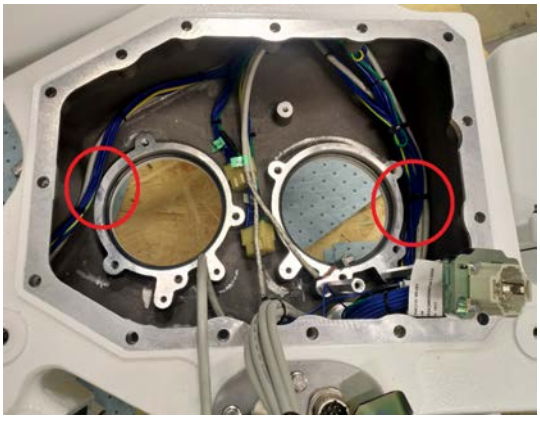
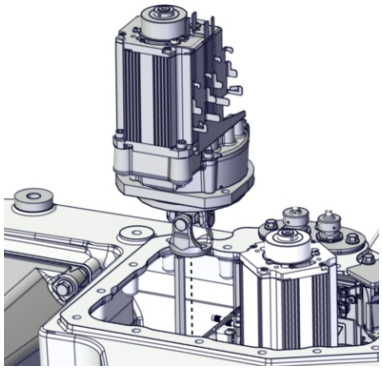
Use these procedures to refit the cable harness.

Refitting the cable harness

	Action	Note
1	Place the new cable harness inside the base unit.	Cable harness: 3HAC060469-001.
2	Push through the connectors for axis-1, axis-2 and axis-3 motors to the motor units. **DANGER** Check the labels on the motor cables, to make sure the correct cabling is routed to the correct motor.	 xx2000001030
3	Tie the cabling with cable ties inside the base unit. **CAUTION** Be aware of the pinch points where the cabling passes next to the gear flanges. Route and tie the cable to avoid pinching between the flange and the gear unit during refitting later on.	Cable ties  xx2000001025
4	Reconnect the signal lamp connectors H1 and H2.	 xx2000002211
5	Reconnect the brake release connector.	 xx2000001023

Continues on next page

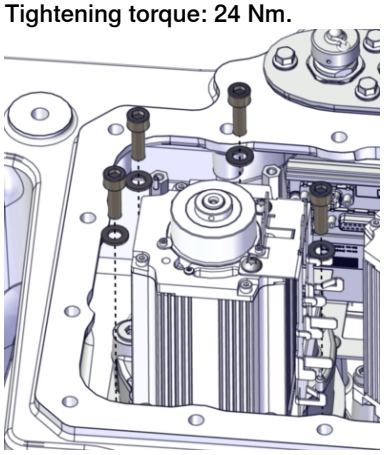
Refitting the axis-4 motor and gear unit

	Action	Note
1	Check the sealing ring in the base and make sure it is properly seated on the tab. Replace if damaged.	Sealing ring: 3HAC059017-002.  xx2000000049
2	The motors are oriented differently on the axis-4 and axis-5 gear unit assemblies, in regard to the cable outlet on top. Check that the motor is oriented according to the figure before securing the unit, for each axis respectively.	 xx2000001032
3	Lift the gear unit into the base. **CAUTION** Risk of pinching! Do not pinch the cabling routed next to the gear unit flange.  xx2000001025	 xx1900002167

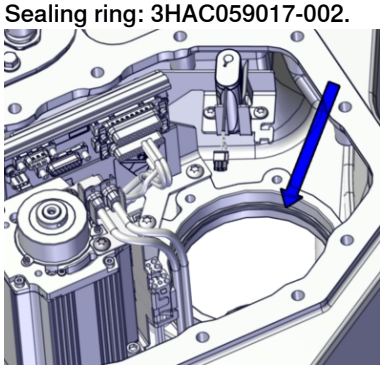
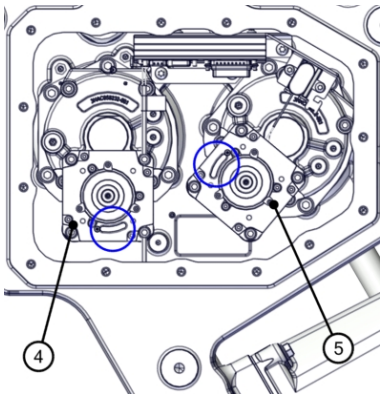
Continues on next page

5.4.4 Replacing the cable harness

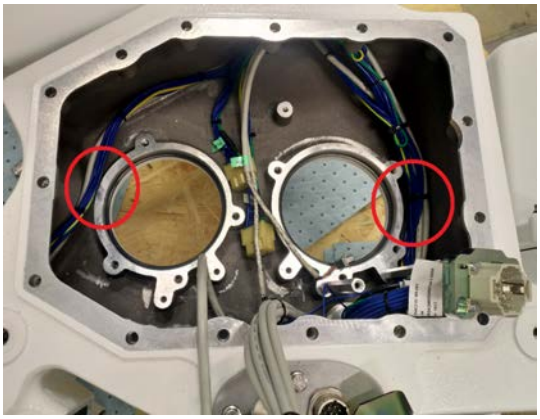
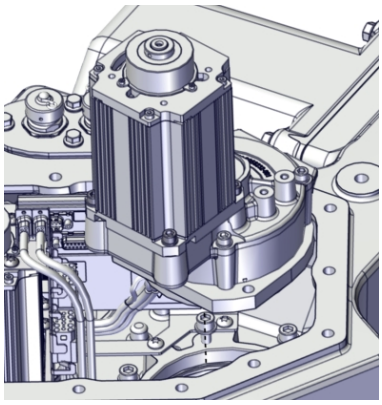
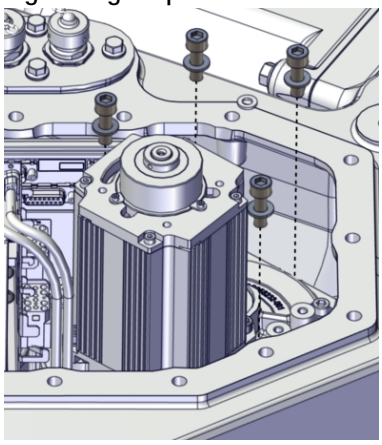
Continued

	Action	Note
4	Secure the unit with attachment screws and washers.	Hex socket head cap screw: M8x25 Steel 8.8-A2F (4 pcs). Plain washer, DIN 125: 8.4x16x1.6 steel-A2F (4 pcs). Tightening torque: 24 Nm.  xx1900001843

Refitting the axis-5 motor and gear unit

	Action	Note
1	Check the sealing ring in the base and make sure it is properly seated on the tab. Replace if damged.	Sealing ring: 3HAC059017-002.  xx2000000055
2	The motors are oriented differently on the axis-4 and axis-5 gear unit assemblies, in regard to the cable outlet on top. Check that the motor is oriented according to the figure before securing the unit, for each axis respectively.	 xx2000001032

Continues on next page

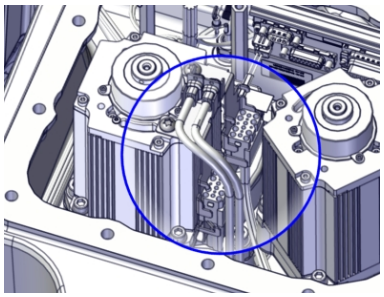
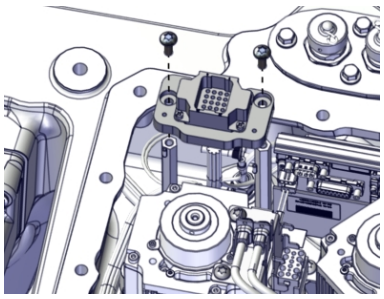
	Action	Note
3	Lift the gear unit into the base. **CAUTION** Risk of pinching! Do not pinch the cabling routed next to the gear unit flange.  xx2000001025	 xx1900002170
4	Secure the unit with attachment screws and washers.	Hex socket head cap screw: M8x25 Steel 8.8-A2F (4 pcs). Plain washer, DIN 125: 8.4x16x1.6 steel-A2F (4 pcs). Tightening torque: 24 Nm.  xx1900002171

Continues on next page

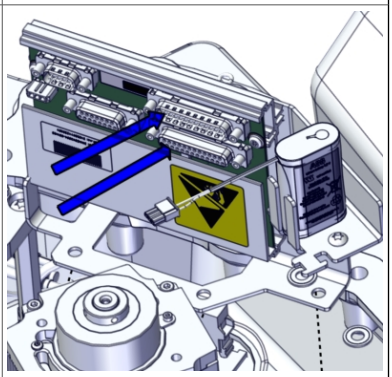
5.4.4 Replacing the cable harness

Continued

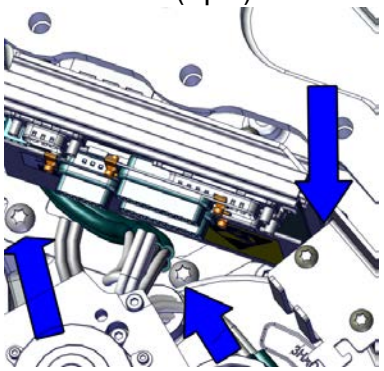
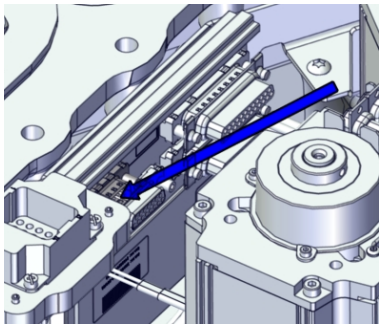
Reconnecting the cabling

	Action	Note
1	Connect the motor connectors and fasten the connectors to the connector bracket by snapping them into place.	 xx1900001845
2	Secure the cabling and connectors with cable ties.	
3	Refit the holder for connector R1.MP1.	 xx1900001842

Refitting the complete SMB unit

	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 43*.	
2	Secure the cables to connectors R2.FB1-4, R2.FB5 (IRB 390 - 10/1300) with a cable tie at the battery bracket.	
3	Connect the connectors: • R2.FB1-4, R2.FB5 (IRB 390 - 10/1300)	 xx2000002201

Continues on next page

	Action	Note
4	Secure the SMB bracket with the screws.	M6x16 8.8-A2F (3 pcs)  xx1900000753
5	Reconnect the connector to X1 on the SMB board.	 xx2000002210

Checking the layout

	Action	Note
1	Compare the cable layout to the picture previously taken and verify that everything is connected and routed correctly.	

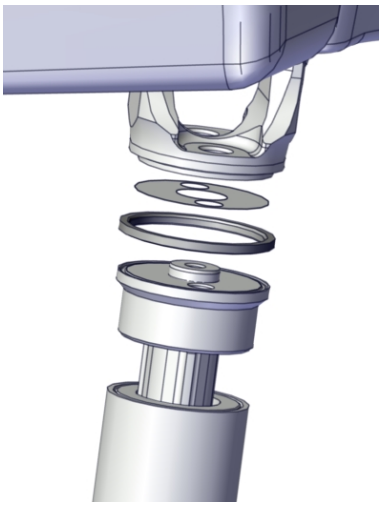
Refitting the upper end of the telescopic shaft

	Action	Note
1	Clean the friction shim, the sealing ring and the contact surfaces with isopropanol. Inspect for damage. Replace if damaged.	Cleaning agent: Isopropanol. Friction shim: 3HAC060200-001. Sealing ring: 3HAC060263-001

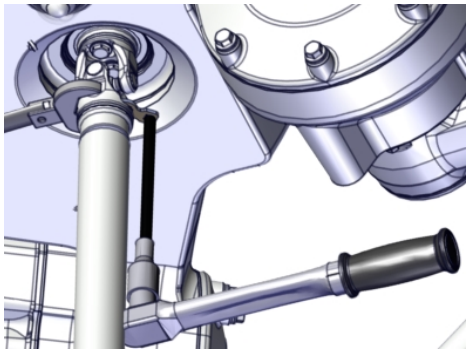
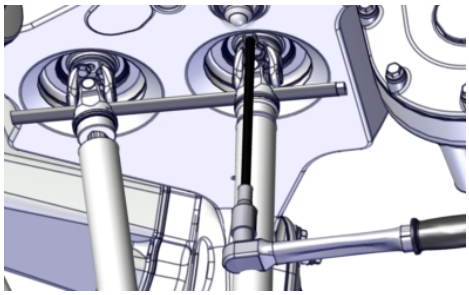
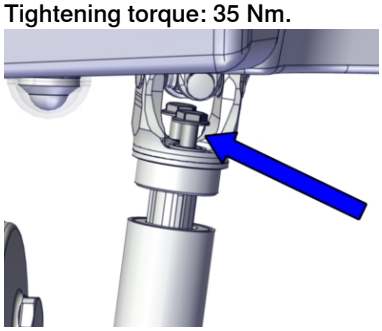
Continues on next page

5.4.4 Replacing the cable harness

Continued

	Action	Note
2	Fit the upper end of the telescopic shaft by installing the friction shim, sealing ring and the telescopic shaft at the joint. **CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	Telescopic shaft unit: 3HAC059382-003  xx1900001825

Continues on next page

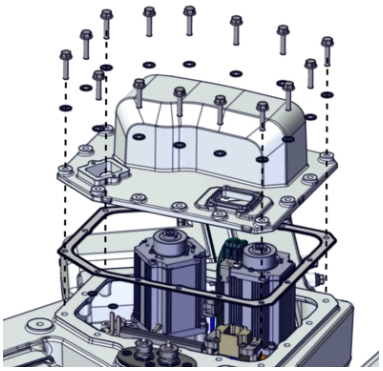
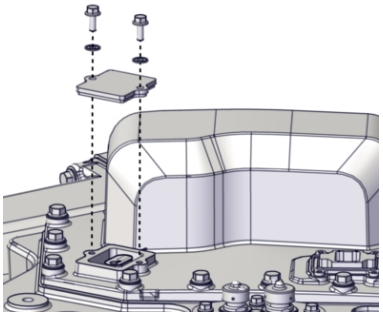
	Action	Note
3	Lubricate the screw thread and the washer surface underneath the screw head. Secure with the lubricated screws and washers and tighten, using the torque wrench head with a closed end. **Tip** The shaft rotates when loosening/fastening the screws. Use one of two alternatives to hold the shaft still: 1 Hold the motor shaft still with an open-end wrench (47 mm) at the joint while loosening/tightening the screws. Requires two persons.  xx2000000346 2 Hold the motor shaft still by inserting a pin through the joints (5-axis robot) or through the joint and against the casting. Choose an appropriate material for the pin, that does not damage the surface of the joints.  xx2000000688 **CAUTION** There is a risk of damage to the joint if not handled with care.	Anti-seize paste: 3HAC070875-002 (Molykote P1900) Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: 3HAC058626-004 Tightening torque: 35 Nm.  xx1900001823

Continues on next page

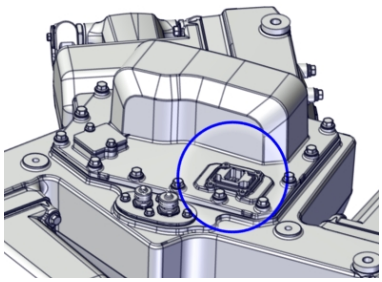
5.4.4 Replacing the cable harness

Continued

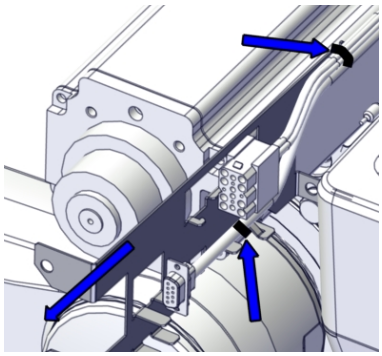
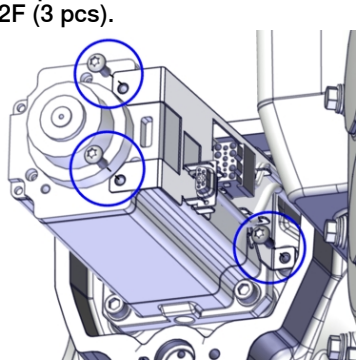
Refitting the top cover

	Action	Note
1	Refit the sealing and tighten the cover with lubricated screws. **CAUTION** Check that the SMB battery does not get squeezed under the cover.	Sealing washer: 3HAC058649-003 Hexagon flange bolt: 3HAC060233-008 (M8x40 stainless steel/A4-80, 15 pcs) Washer: 3HAC058626-004 (M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose., 15 pcs) Anti-seize paste: Molykote P1900 (3HAC070875-002) Tightening torque: 21 Nm.  xx1900000469
2	Check that the battery is located correctly in the battery compartment and not pinched under the top cover. Then fasten the battery cover and sealing, with lubricated screws and washers. **Note** Do not overtighten to avoid damaging the sealing.	Tightening torque: 4 Nm. Hexagon flange bolt: 3HAC060233-006 (M6x16 stainless steel/A4-80) Washer: 3HAC058626-003 (M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.) Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx1900000407

Continues on next page

	Action	Note
3	Reconnect connector R1.MP to the base.	 xx2000001006

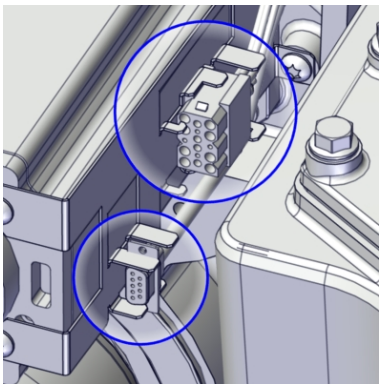
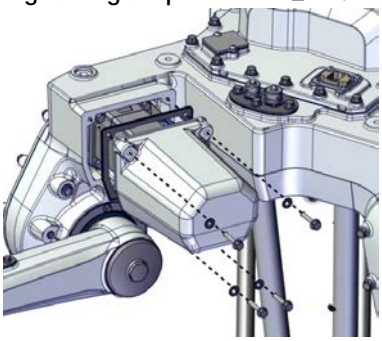
Refitting cable bracket and motor cover

	Action	Note
1	Secure the cabling to the cable bracket with cable ties, if removed.	 xx2000002200
2	Refit the cable bracket with attachment screws, if removed.	Torx pan head screw: M6x16 8.8-A2F (3 pcs).  xx1900001837

Continues on next page

5.4.4 Replacing the cable harness

Continued

	Action	Note
3	Reconnect the motor cabling and snap the cable connectors to the cable bracket.	 xx2000001005
4	Secure the cabling to the cable bracket with cable ties.	Cable ties
5	Refit the motor cover and the sealing washer with lubricated screws and washers. Replace if damaged.	Sealing washer: 3HAC063720-001 Hexagon flange bolt: 3HAC060233-003 (M8x45 stainless steel/A4-80, 4 pcs) Washer: 3HAC058626-004 (4 pcs). Anti-seize paste: 3HAC070875-002 (Molykote P1900) Tightening torque: 22 Nm ± 10%.  xx1900000759

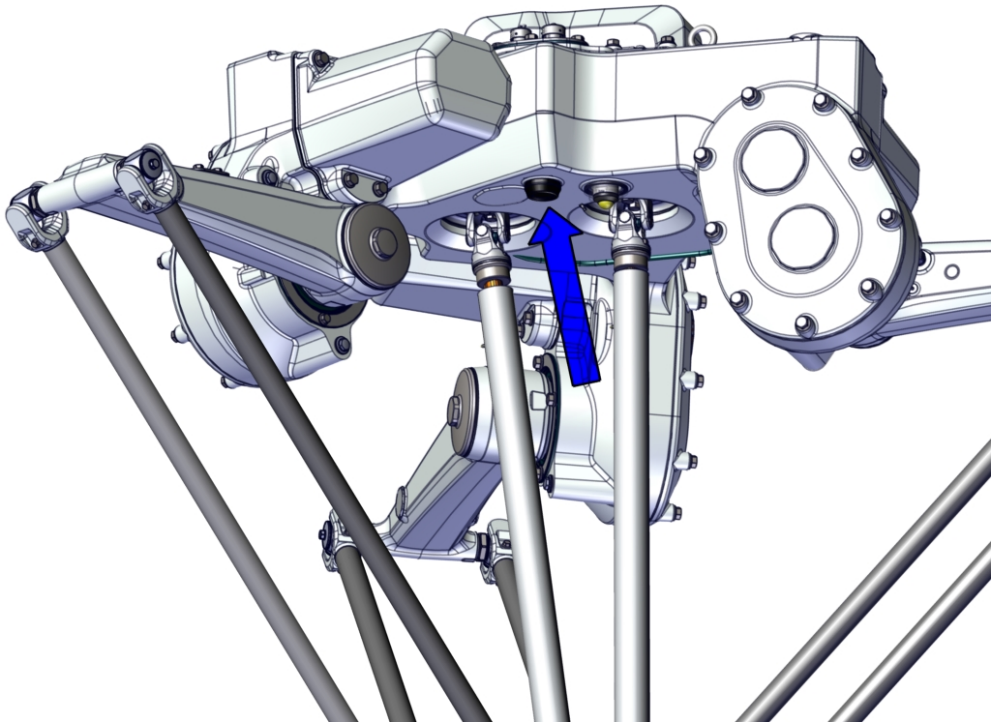
Concluding procedure

	Action	Note
1	Update the revolution counters.	See *Updating revolution counters on page 326*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.4.5 Replacing the brake release unit

Location of the brake release unit

The brake release unit is located as shown in the figure.



xx1900000252

Note

This repair procedure requires sufficient free space above the robot for removal of the top cover and affected spare parts.

Read more about access ways in *Minimum required free space above the robot on page 49*.

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Brake release unit	1SFA616105R4006	Push button, heavy duty. Includes new sealing.	L2

Continues on next page

5.4.5 Replacing the brake release unit
Continued

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Sealing	3HAC059429-003	For the brake release button.
Sealing washer	3HAC058649-003	Base unit top cover.
Hexagon flange bolt	3HAC060233-008	M8x40 stainless steel/A4-80
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Hexagon flange bolt	3HAC060233-006	M6x16 stainless steel/A4-80
Washer	3HAC058626-003	M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the brake release button

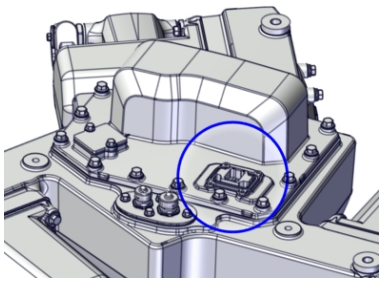
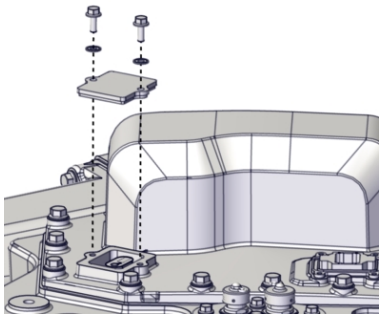
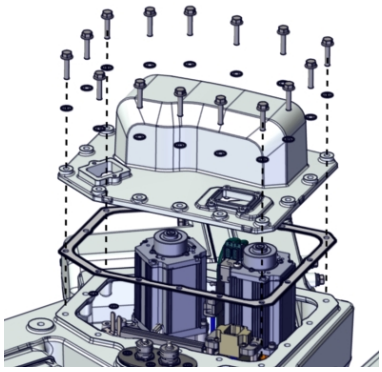
Use these procedures to remove the brake release button.

Preparations before removing the brake release button

	Action	Note
1	Jog the robot to an appropriate working position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Continues on next page

Removing the top cover

	Action	Note
1	Disconnect connector R1.MP from the base.	 xx2000001006
2	**CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	
3	Remove the SMB battery cover. **Tip** The battery cover is removed to see the battery position during refitting of the top cover.	 xx1900000407
4	Remove the cover by removing the screws and washers. Also remove the sealing.	 xx1900000469

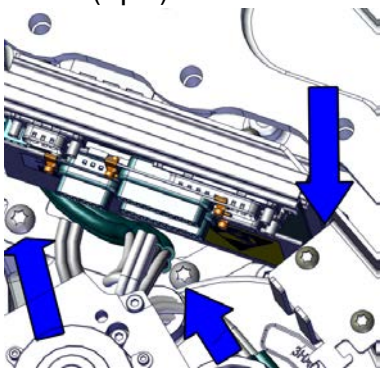
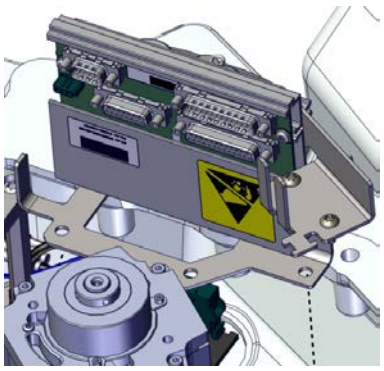
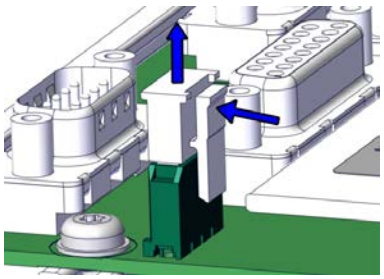
Removing the SMB unit

	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 43*.	

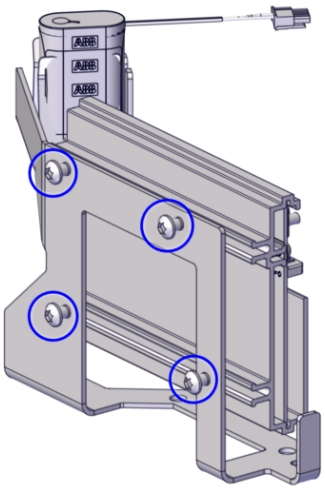
Continues on next page

5.4.5 Replacing the brake release unit

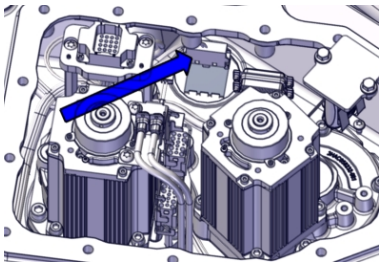
Continued

	Action	Note
2	Cut the cable tie	
3	Remove the screws that secure the SMB unit bracket.	Screws (3 pcs)  xx1900000753
4	Pull out the SMB unit assembly a little and disconnect the connectors from the SMB board: • R2.FB1-4, R2.FB5 (IRB 390 - 10/1300) • Battery cable connector R2.G. Disconnect the battery cable by pressing down the upper lip of the R2.G connector to release the lock while pulling the connector upwards.	 xx1900000754  xx1700000993

Continues on next page

	Action	Note
5	If replacing the SMB board with a new, loosen the four screws enough for the board to be removed. Otherwise, leave it mounted. Put the SMB board or the complete assembly in an ESD bag.	 xx2000001051

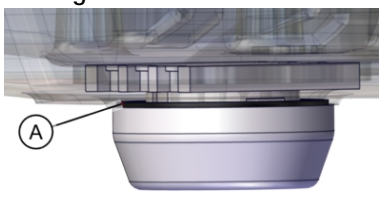
Removing the brake release button

	Action	Note
1	Disconnect the brake release connector.	 xx2000001050
2	Separate the upper and lower part of the brake release push button and remove from the robot.	

Refitting the brake release button

Use these procedures to refit the brake release button.

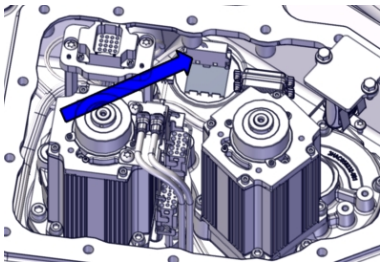
Refitting the brake release button

	Action	Note
1	Fit the brake release push button to the robot, with the sealing (A) underneath the base.	Brake release unit: 1SFA616105R4006. Sealing: 3HAC059429-003.  xx2000001060

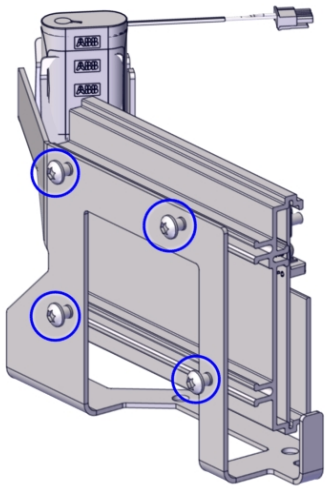
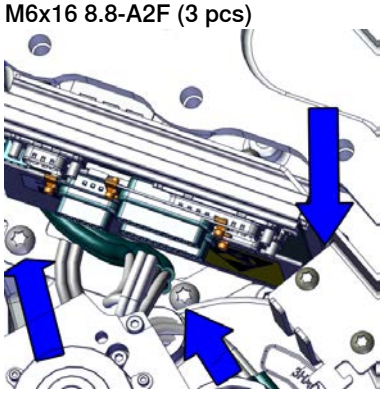
Continues on next page

5.4.5 Replacing the brake release unit

Continued

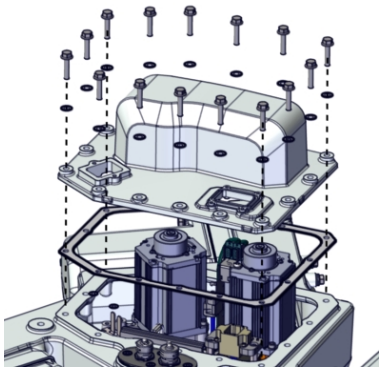
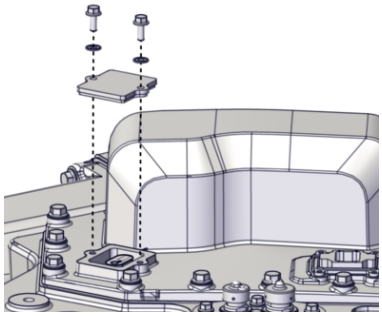
	Action	Note
2	Reconnect the brake release connector.	 xx2000001050

Refitting the SMB unit

	Action	Note
1	Put the SMB unit into the SMB bracket and secure with the four screws.	 xx2000001051
2	Connect the connectors: • R2.FB1-4, R2.FB5 (IRB 390 - 10/1300) • Battery cable connector R2.G.	
3	Secure the SMB bracket with the screws.	M6x16 8.8-A2F (3 pcs)  xx1900000753

Continues on next page

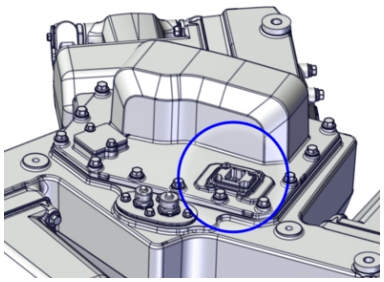
Refitting the top cover

	Action	Note
1	Refit the sealing and tighten the cover with lubricated screws. **CAUTION** Check that the SMB battery does not get squeezed under the cover.	Sealing washer: 3HAC058649-003 Hexagon flange bolt: 3HAC060233-008 (M8x40 stainless steel/A4-80, 15 pcs) Washer: 3HAC058626-004 (M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose., 15 pcs) Anti-seize paste: Molykote P1900 (3HAC070875-002) Tightening torque: 21 Nm.  xx1900000469
2	Check that the battery is located correctly in the battery compartment and not pinched under the top cover. Then fasten the battery cover and sealing, with lubricated screws and washers. **Note** Do not overtighten to avoid damaging the sealing.	Tightening torque: 4 Nm. Hexagon flange bolt: 3HAC060233-006 (M6x16 stainless steel/A4-80) Washer: 3HAC058626-003 (M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.) Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx1900000407

Continues on next page

5.4.5 Replacing the brake release unit

Continued

	Action	Note
3	Reconnect connector R1.MP to the base.	 xx2000001006

Concluding procedure

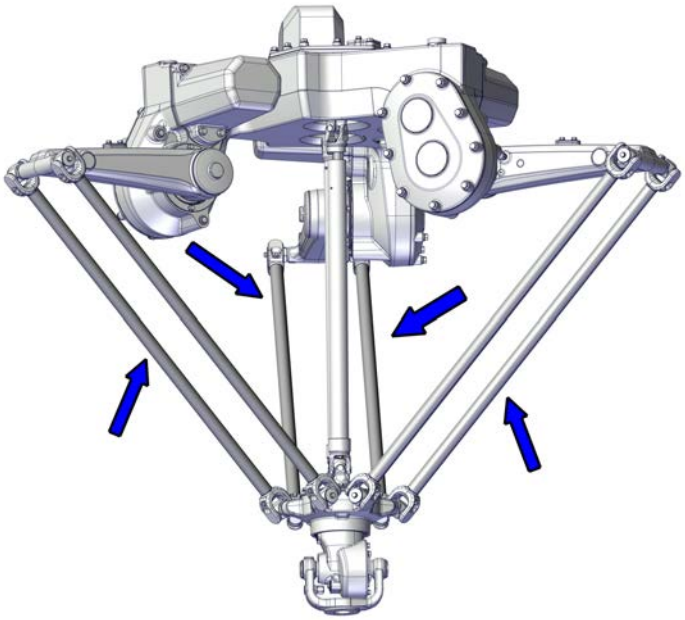
	Action	Note
1	Perform a function test of the brake release button.	See *Manually releasing the brakes on page 69*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.5 Upper and lower arms

5.5.1 Replacing the lower arm

Location of the lower arms

The lower arms are located as shown in the figure.



xx1900001427

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Lower arm / parallel bar	3HAC060138-001		L1

Required consumables

Consumable	Article number	Note
Anti-seize paste	3HAC070875-002	Molykote P1900

Other spare parts

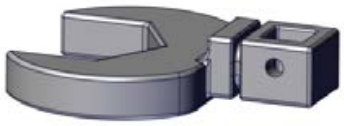
Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Sealing washer	3HAC062123-001	To the lower arm.

Continues on next page

5.5.1 Replacing the lower arm
Continued

Required tools and equipment

Equipment	Article number	Note
Lashing strap	-	Width 25 mm Length 2.5 m
Torque wrench head, open-end insert	3HAC073854-001	Included in robot delivery.  xx1900002148 Used with an interchangeable head torque wrench (not included in delivery). Interface: 14x18 mm.
Interchangeable head torque wrench	-	
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the lower arm

Use these procedures to remove the lower arm.

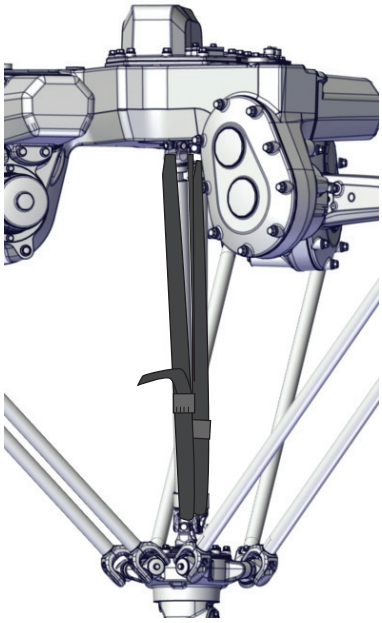
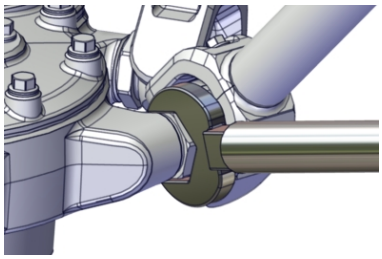
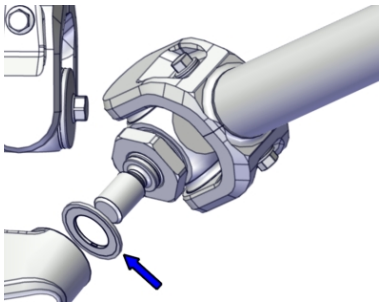
Preparations before removing the lower arm

	Action	Note
1	The robot does not need to be jogged into any specific position due to repair activity. Do not move the position of the robot arms during lower arm replacement.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
3	Remove any loads or tools attached to the turning disk.	

Removing the lower arm

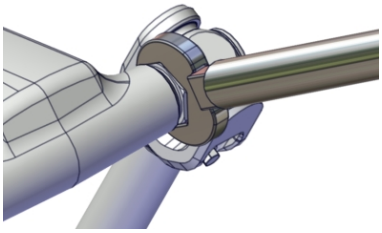
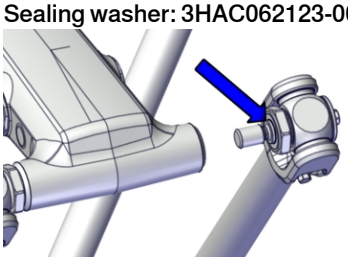
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	

Continues on next page

	Action	Note
2	**CAUTION** The delta unit will become unstable when a lower arm is removed. Support the weight of the delta unit before removing the arm to minimize the movement. Either support the weight from underneath or secure the weight with a lashing strap through the universal joints closest to the telescopic shaft.	Lashing strap  xx2000000334
3	Loosen the lower shaft from the delta unit by loosening the nut. Use an interchangeable head torque wrench and the open-end head insert.	Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002150
4	Remove the lower end of the arm from the delta unit. Save the sealing washer for refitting, or replace it if damaged.	 xx1900001801

Continues on next page

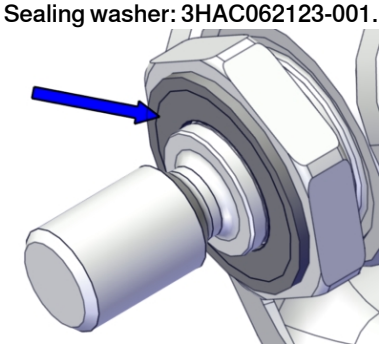
5.5.1 Replacing the lower arm
Continued

	Action	Note
5	Loosen the upper shaft from the upper arm by loosening the nut. Use an interchangeable head torque wrench and the open-end head insert.	Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002152
6	Remove the lower arm. Save the sealing washer for refitting, or replace it if damaged.	Sealing washer: 3HAC062123-001.  xx1900001796

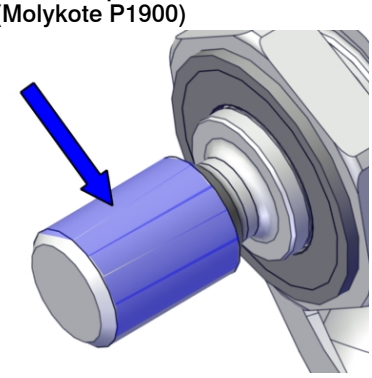
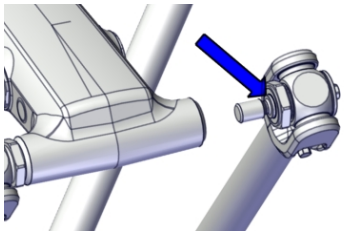
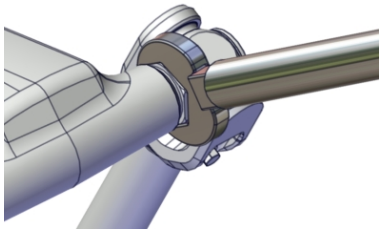
Refitting the lower arm

Use these procedures to refit the lower arm.

Refitting the lower arm to the upper arm

	Action	Note
1	Fit the sealing washer to the lower arm. Replace the sealing washer if damaged.	Sealing washer: 3HAC062123-001.  xx2000000861

Continues on next page

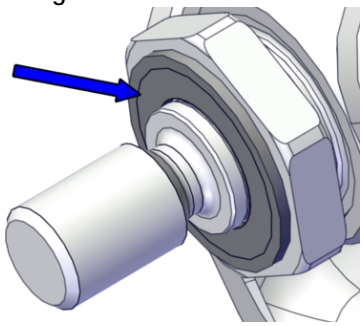
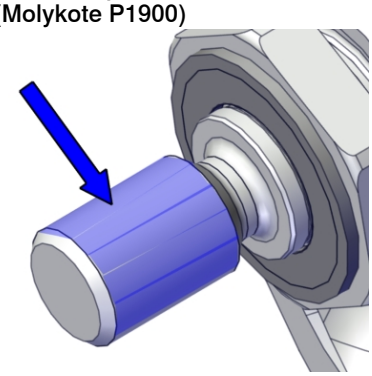
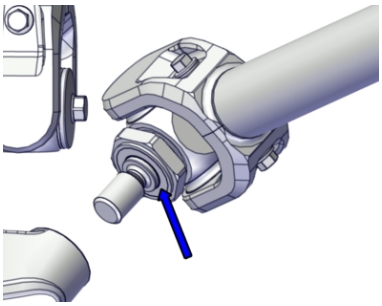
	Action	Note
2	Lubricate only the thread of the lower arm where the arrow is pointing, see figure. **Note** Do not lubricate the parts marked with the red color.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000684
3	Fit the lower arm. Make sure the sealing washer is in place. **Note** The lower arm can be turned either way, the orientation has no significance.	Lower arm / parallel bar: 3HAC060138-001.  xx1900001796
4	Tighten the shaft. Start by hand, then use an interchangeable head torque wrench and the open-end head insert to apply tightening torque.	Tightening torque: 100 Nm. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002152

Continues on next page

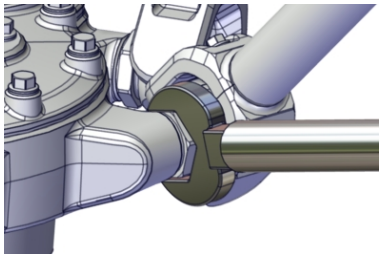
5.5.1 Replacing the lower arm

Continued

Refitting the lower arm to the delta unit

	Action	Note
1	Fit the sealing washer to the lower arm. Replace the sealing washer if damaged.	Sealing washer: 3HAC062123-001.  xx2000000861
2	Lubricate the lower arm thread. **Note** The surface under the thread head must be dry and not contain grease.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000684
3	Fit the lower arm. Make sure the sealing washer is in place.	Lower arm / parallel bar: 3HAC060138-001.  xx2000001063

Continues on next page

	Action	Note
4	Tighten the shaft. Start by hand, then use an interchangeable head torque wrench and the open-end head insert to apply tightening torque.	Tightening torque: 100 Nm. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002150

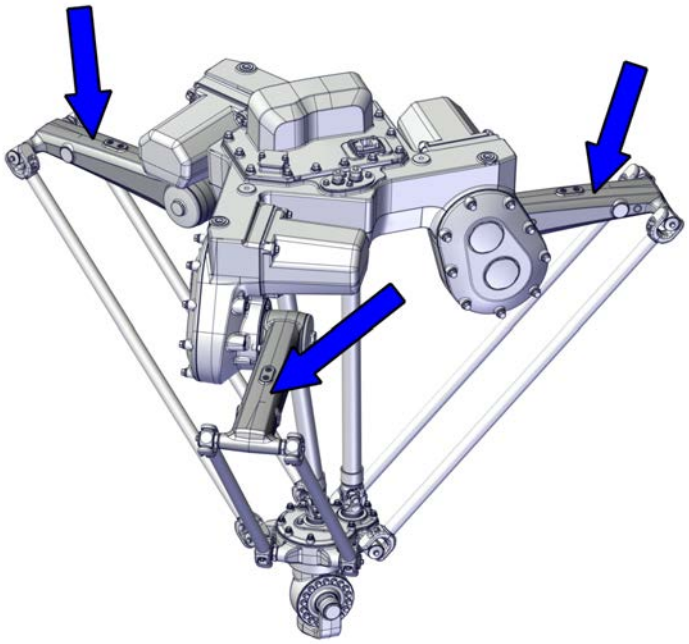
Concluding procedure

	Action	Note
1	Remove the lashing strap, if used.	
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.5.2 Replacing the upper arm

Location of the upper arms

The upper arms are located as shown in the figure.



xx1900001426

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Upper arm	3HAC060604-003		L1

Required consumables

Consumable	Article number	Note
Anti-seize paste	3HAC070875-002	Molykote P1900
Cable ties	-	

Other spare parts

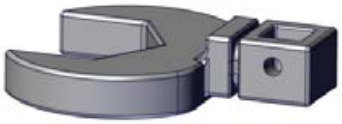
Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Sealing washer	3HAC062123-001	To the lower arm.

Continues on next page

Spare part	Article number	Note
Sealing ring	3HAC062067-001	Between base unit and upper arm.
Gasket	3HAC058619-001	For the upper arm cover.
Washers, 12 pcs	3HAC043799-001	

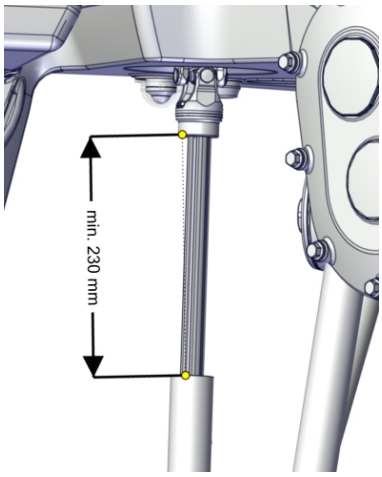
Required tools and equipment

Equipment	Article number	Note
Lashing strap	-	Width 25 mm Length 2.5 m
Torque wrench head, open-end insert	3HAC073854-001	Included in robot delivery.  xx1900002148 Used with an interchangeable head torque wrench (not included in delivery). Interface: 14x18 mm.
Interchangeable head torque wrench	-	
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the upper arm

Use these procedures to remove the upper arm.

Preparations before removing the upper arm

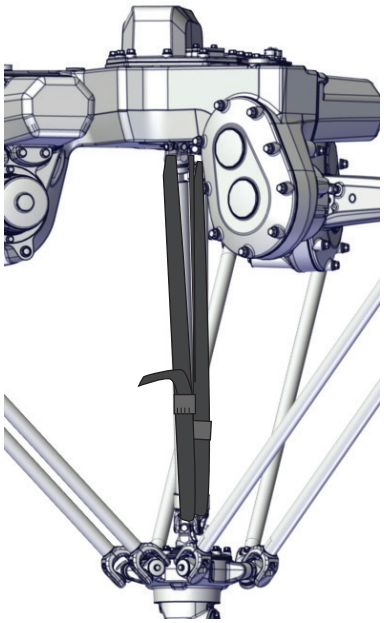
	Action	Note
1	Jog the upper arms to an appropriate working position. Move the robot so that the telescopic shaft is extended 230 mm as minimum, to be able to secure the lower arms against the shaft further on in the procedure.	 xx2000000927

Continues on next page

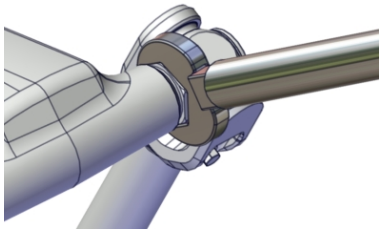
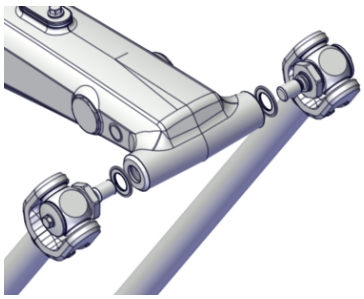
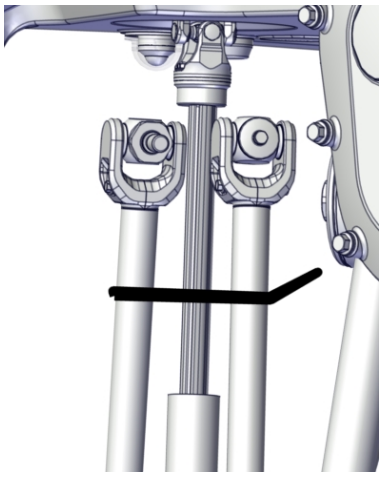
5.5.2 Replacing the upper arm
Continued

	Action	Note
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
3	Remove any loads or tools attached to the turning disk.	

Loosening the lower arm shafts

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	**CAUTION** The delta unit will become unstable when a lower arm is removed. Support the weight of the delta unit before removing the arm to minimize the movement. Either support the weight from underneath or secure the weight with a lashing strap through the universal joints closest to the telescopic shaft.	Lashing strap  xx2000000334

Continues on next page

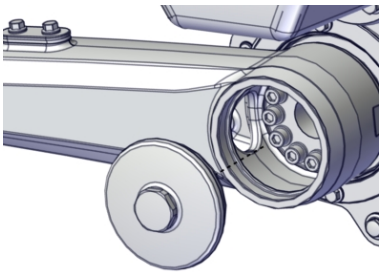
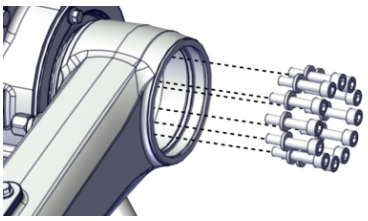
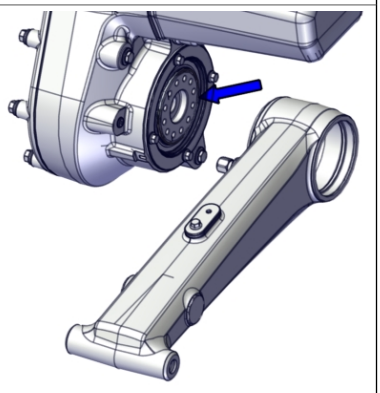
	Action	Note
3	Loosen the both lower arm shafts from the upper arm by loosening the bolts. Use an interchangeable head torque wrench and the open-end head insert.	Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002152
4	Disconnect the lower arms from the upper arm.	 xx1900001802
5	Secure the lower arms against the telescope shaft with a cable tie. **CAUTION** Put some soft material between the surfaces, to protect them from scratches etc.	Cable ties  xx2000000921

Continues on next page

5.5.2 Replacing the upper arm

Continued

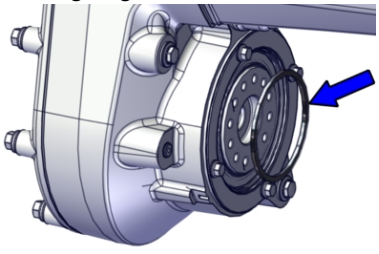
Removing the upper arm

	Action	Note
1	Remove the upper arm cover. **Note** Keep the sealing for refitting.	 xx1900001799
2	Remove the screws and washers.	 xx1900001800
3	Remove the upper arm from the base unit. **Note** Keep the sealing ring for refitting.	 xx1900001820

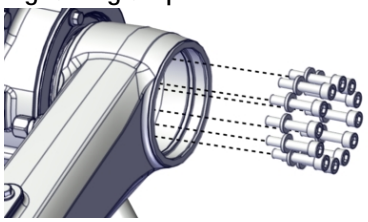
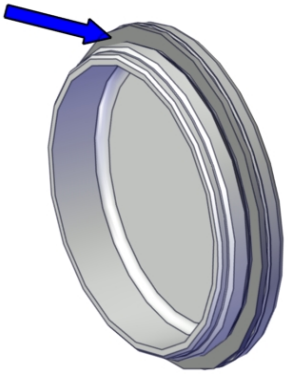
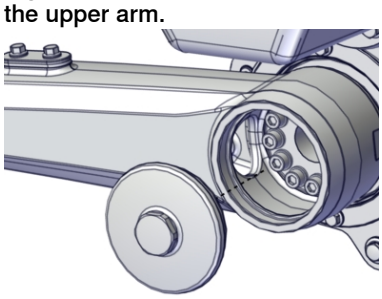
Refitting the upper arm

Use these procedures to refit the upper arm.

Refitting the upper arm

	Action	Note
1	Clean and fit the sealing ring. Replace if damaged.	Sealing ring: 3HAC062067-001.  xx1900001821

Continues on next page

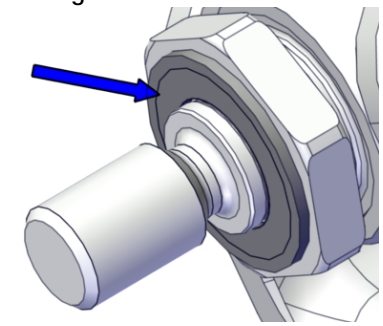
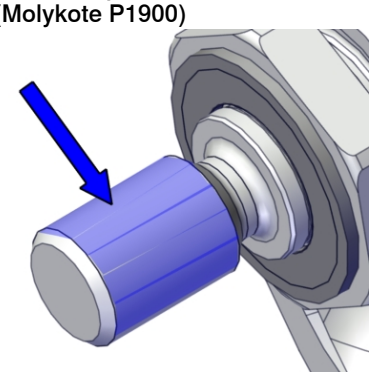
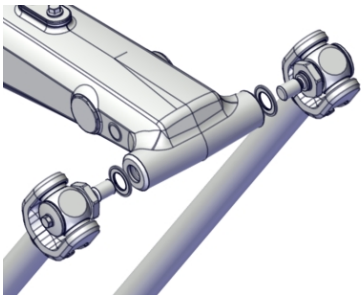
	Action	Note
2	Fit the upper arm to the base unit and secure with 12 attachment screws and washers.	Upper arm: 3HAC060604-003. Hex socket head cap screw: M8x40 12.9 Gleitmo 603+Geomet 500 (12 pcs) Washers, 12 pcs: 3HAC043799-001 (12 pcs) Tightening torque: 35 Nm.  xx1900001800
3	Check the upper arm cover gasket. Replace if damaged.	Gasket: 3HAC058619-001.  xx1900001822
4	Lubricate the thread of the upper arm cover and the gasket with grease.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)
5	Refit the upper arm cover including the gasket.	Tightening torque: approximately 45 Nm. Tighten until the cover bottoms on the upper arm.  xx1900001799

Continues on next page

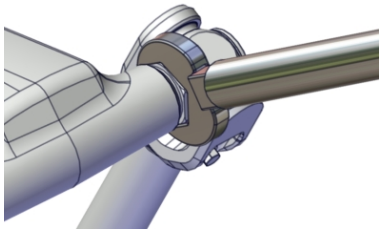
5.5.2 Replacing the upper arm

Continued

Refitting the lower arm shafts

	Action	Note
1	Fit sealing washers to the lower arm. Replace the sealing washers if damaged.	Sealing washer: 3HAC062123-001.  xx2000000861
2	Lubricate the lower arm thread with grease. **Note** The surface under the thread head must be dry and not contain grease.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000684
3	Secure the lower arms including the sealing washers to the upper arm. Make sure the sealing washers are in place.	Lower arm / parallel bar: 3HAC060138-001.  xx1900001802

Continues on next page

	Action	Note
4	Tighten the shafts. Start by hand, then use an interchangeable head torque wrench and the open-end head insert to apply tightening torque.	Tightening torque: 100 Nm. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002152

Concluding procedure

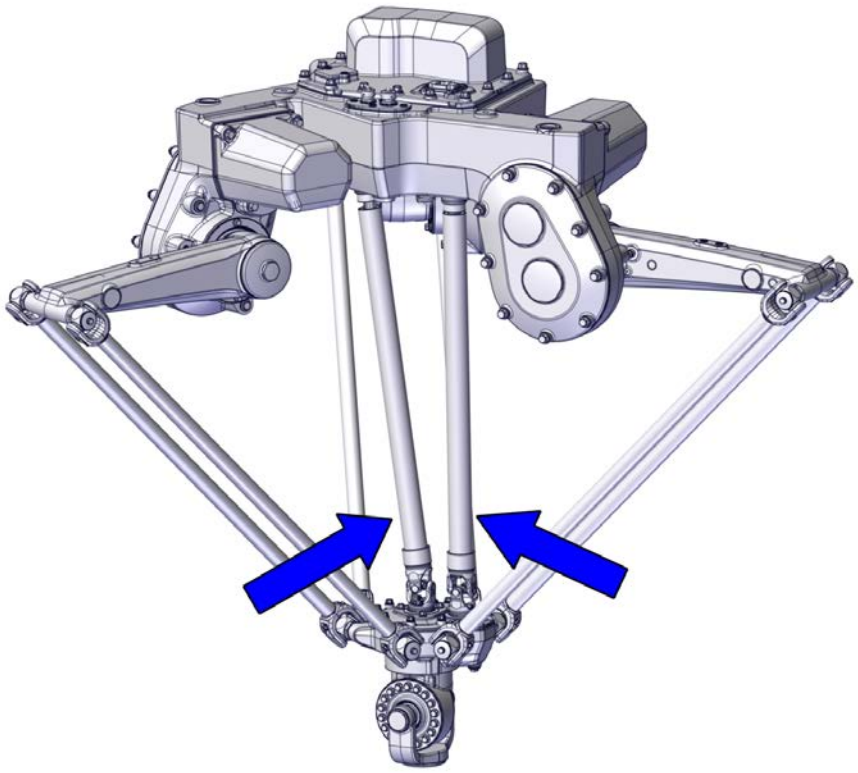
	Action	Note
1	Calibrate the robot.	See *Calibration on page 321*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.5.3 Replacing the telescopic shafts and universal joints

Location of the telescopic shafts

The telescopic shafts are located as shown in the figure.

The figure shows an 5-axis IRB 390.



xx1900000253

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Telescopic shaft unit	3HAC059382-003	Nipple dimension: DIN 3402	L1
Universal joint	3HAC059503-001		L1

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Anti-seize paste	3HAC070875-002	Molykote P1900

Continues on next page

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Sealing ring	3HAC060263-001	Between universal joint and telescopic shaft/base unit/delta unit.
Friction shim	3HAC060200-001	Between universal joint and telescopic shaft/base unit/delta unit.
Hexagon flange bolt	3HAC058625-001	M8x16 Bumax 109
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.

Required tools and equipment

Equipment	Article number	Note
Torque wrench head, closed end	3HAC063379-001	Included in robot delivery.  xx2000000282 Used with a torque wrench (not included in delivery) to loosen and tighten the universal joint and telescopic shaft screws. Hole interface: 1/4" square.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the telescopic shaft

Use these procedures to remove the telescopic shaft.

Preparations before removing the telescopic shaft

	Action	Note
1	Jog the robot to synchronization position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

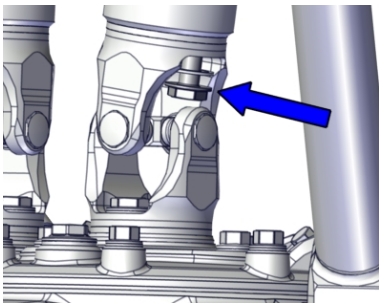
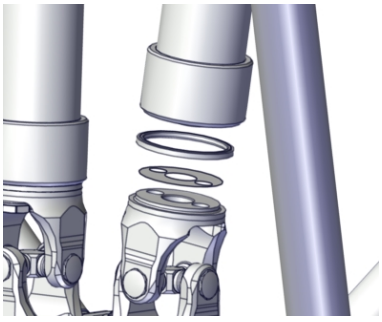
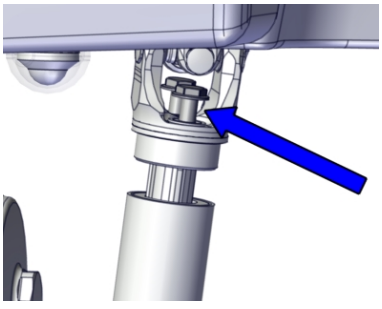
Continues on next page

5.5.3 Replacing the telescopic shafts and universal joints

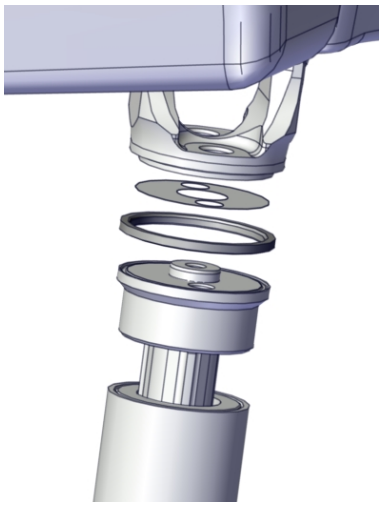
Continued

	Action	Note
3	Remove any loads or tools attached to the turning disk.	

Removing the telescopic shaft

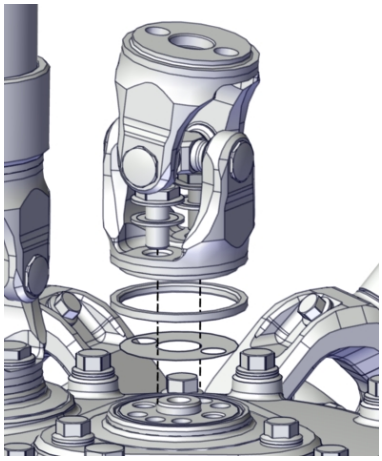
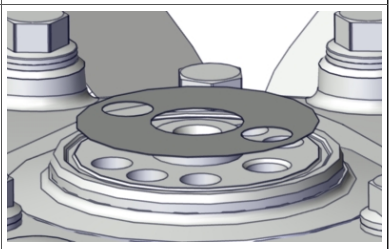
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the lower screws and washers, using a special torque wrench head.	Torque wrench head, closed end: 3HAC063379-001.  xx1900001824
3	Loosen the lower end of the telescopic shaft. **Note** Keep the sealing ring and friction shim for refitting.	 xx1900001831
4	Remove the upper screws and washers, using a special torque wrench head.	Torque wrench head, closed end: 3HAC063379-001.  xx1900001823

Continues on next page

	Action	Note
5	Remove the telescopic shaft. **Note** Keep the sealing ring and friction shim for refitting.	 xx1900001825

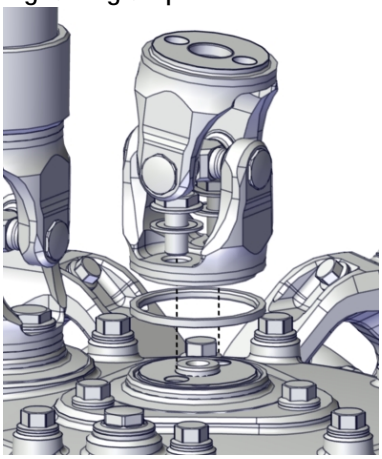
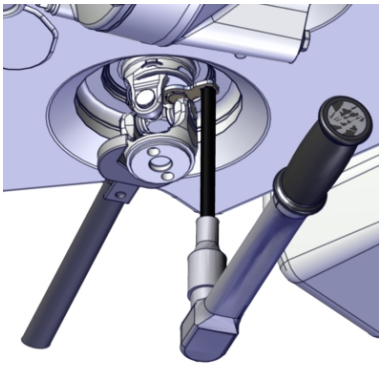
Replacing the universal joint

Use this procedure if the universal joint is to be replaced.

	Action	Note
1	Remove the universal joint by removing the screws and washers, using a special torque wrench head. **Note** Keep the sealing ring and friction shim for refitting.	Torque wrench head, closed end: 3HAC063379-001.  xx1900001832
2	Clean the friction shim and the contact surfaces with isopropanol. Inspect the friction shim. Replace if damaged.	Cleaning agent: Cleaning agent. Friction shim: 3HAC060200-001.
3	Fit the friction shim.	 xx1900001829

Continues on next page

5.5.3 Replacing the telescopic shafts and universal joints
Continued

	Action	Note
4	Fit the sealing ring and the new joint.	Universal joint: 3HAC059503-001 Sealing ring: 3HAC060263-001. Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: M8 hygienic (3HAC058626-004) Anti-seize paste: Molykote P1900 (3HAC070875-002) Tightening torque: 35 Nm.  xx1900001827  xx2000001061
5	Lubricate the screw thread and the washer surface underneath the screw head. Secure with the lubricated screws and washers and tighten, using a special torque wrench head. Hold the motor shaft still with an open-end wrench (47 mm) at the joint while tightening the screws. Requires two persons. **Note** Replace the washers with new, for hygienic purpose, if the rubber is damaged.	

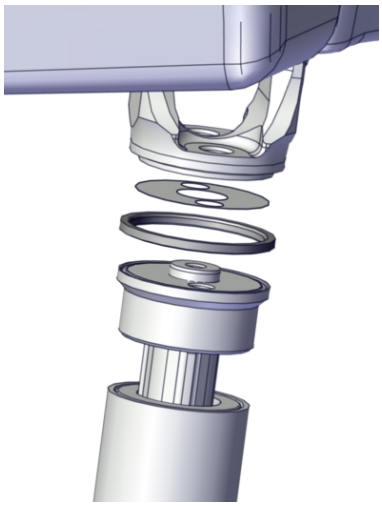
Refitting the telescopic shaft

Use these procedures to refit the telescopic shaft.

Refitting the upper end of the telescopic shaft

	Action	Note
1	Clean the friction shim, the sealing ring and the contact surfaces with isopropanol. Inspect for damage. Replace if damaged.	Cleaning agent: Isopropanol. Friction shim: 3HAC060200-001. Sealing ring: 3HAC060263-001

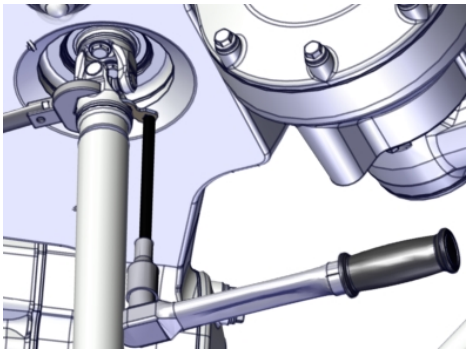
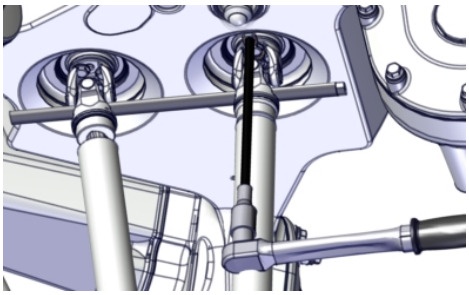
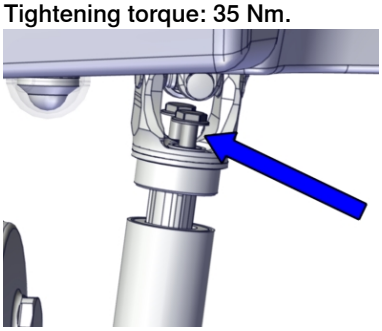
Continues on next page

	Action	Note
2	Fit the upper end of the telescopic shaft by installing the friction shim, sealing ring and the telescopic shaft at the joint. **CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	Telescopic shaft unit: 3HAC059382-003  xx1900001825

Continues on next page

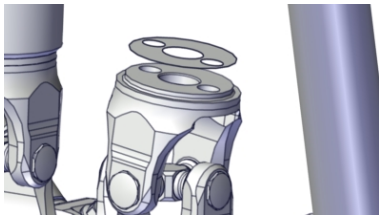
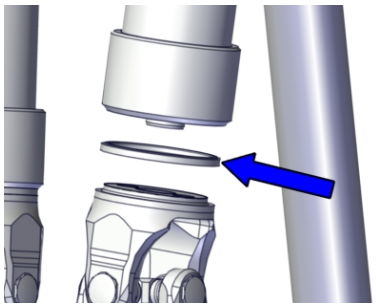
5.5.3 Replacing the telescopic shafts and universal joints

Continued

	Action	Note
3	Lubricate the screw thread and the washer surface underneath the screw head. Secure with the lubricated screws and washers and tighten, using the torque wrench head with a closed end. **Tip** The shaft rotates when loosening/fastening the screws. Use one of two alternatives to hold the shaft still: 1 Hold the motor shaft still with an open-end wrench (47 mm) at the joint while loosening/tightening the screws. Requires two persons.  xx2000000346 2 Hold the motor shaft still by inserting a pin through the joints (5-axis robot) or through the joint and against the casting. Choose an appropriate material for the pin, that does not damage the surface of the joints.  xx2000000688 **CAUTION** There is a risk of damage to the joint if not handled with care.	Anti-seize paste: 3HAC070875-002 (Molykote P1900) Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: 3HAC058626-004 Tightening torque: 35 Nm.  xx1900001823

Continues on next page

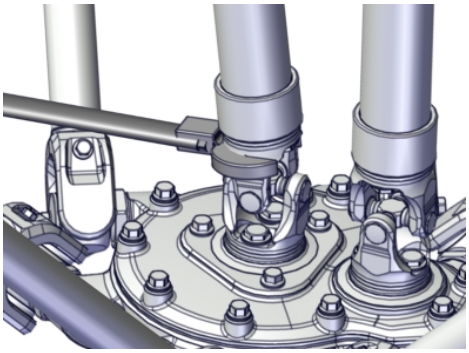
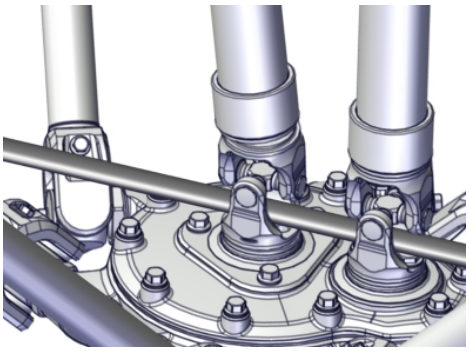
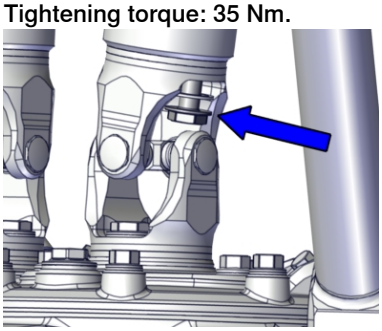
Refitting the lower end of the telescopic shaft

	Action	Note
1	**CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	
2	Clean the friction shim and sealing ring with isopropanol. Inspect the friction shim and sealing ring. Replace if damaged.	Cleaning agent: Isopropanol. Friction shim: 3HAC060200-001. Sealing ring: 3HAC060263-001
3	Fit the friction shim to the telescopic shaft lower joint.	 xx1900001830
4	Install the sealing ring at the lower joint and guide the telescopic shaft into place. **CAUTION** Hold the telescopic unit carefully, the tube may slide and get damaged.	 xx1900001826

Continues on next page

5.5.3 Replacing the telescopic shafts and universal joints

Continued

	Action	Note
5	Lubricate the screw thread and the washer surface underneath the screw head. Secure with the lubricated screws and washers and tighten, using the torque wrench head with a closed end. **Tip** The shaft rotates when loosening/fastening the screws. Use one of two alternatives to hold the shaft still: 1 Hold the motor shaft still with an open-end wrench (47 mm) at the joint while loosening/tightening the screws. Requires two persons.  xx2000001103 2 Hold the motor shaft still by inserting a pin through the joints (5-axis robot) or through the joint and against the casting. Choose an appropriate material for the pin, that does not damage the surface of the joints.  xx2000001104 **CAUTION** There is a risk of damage to the joint if not handled with care.	Anti-seize paste: 3HAC070875-002 (Molykote P1900) Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: 3HAC058626-004 Tightening torque: 35 Nm.  xx1900001824

Continues on next page

Concluding procedure

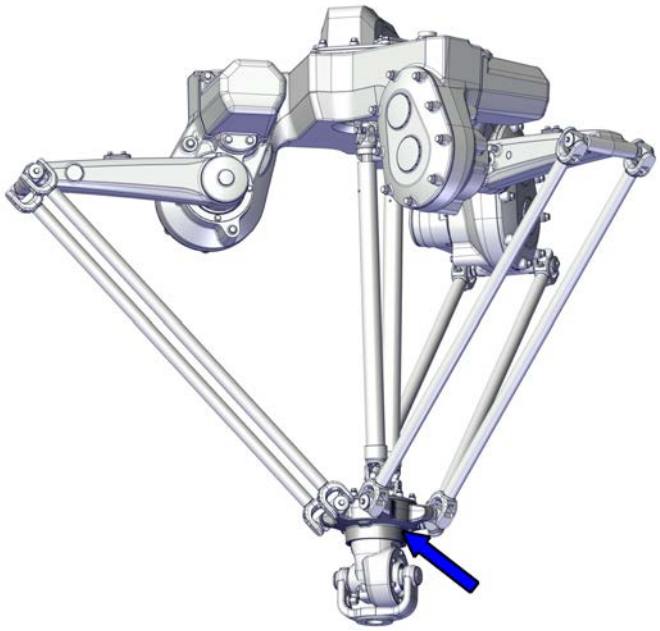
	Action	Note
1	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.5.4 Replacing the delta unit

Location of the delta unit

The delta unit is located as shown in the figure.

The figure shows an 5-axis IRB 390.



xx1900001428

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Delta unit, axis 4	3HAC058371-003		L1
Delta unit, axis 4-5	3HAC058372-002		L1

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Anti-seize paste	3HAC070875-002	Molykote P1900

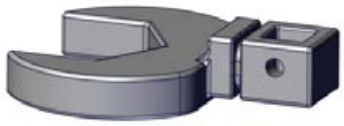
Continues on next page

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Sealing washer	3HAC062123-001	To the lower arm.
Friction shim	3HAC060200-001	Between universal joint and telescopic shaft/base unit/delta unit.
Sealing ring	3HAC060263-001	Between universal joint and telescopic shaft/base unit/delta unit.
Hexagon flange bolt	3HAC058625-001	M8x16 Bumax 109
Washer	3HAC058626-004	M8 hygienic

Required tools and equipment

Equipment	Article number	Note
Lashing strap	-	Width 25 mm Length 2.5 m
Torque wrench head, open-end insert	3HAC073854-001	Included in robot delivery.  xx1900002148 Used with an interchangeable head torque wrench (not included in delivery). Interface: 14x18 mm.
Interchangeable head torque wrench	-	
Torque wrench head, closed end	3HAC063379-001	Included in robot delivery.  xx2000000282 Used with a torque wrench (not included in delivery) to loosen and tighten the universal joint and telescopic shaft screws. Hole interface: 1/4" square.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.

Continues on next page

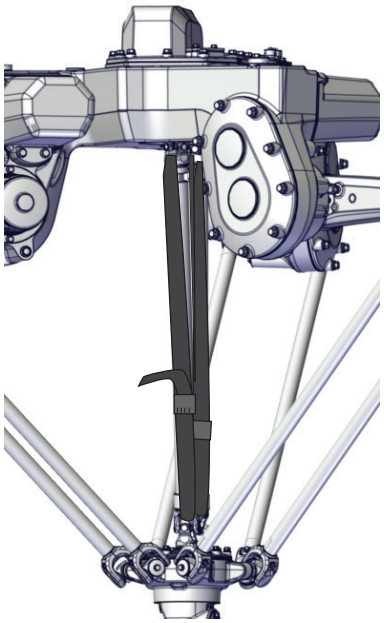
5.5.4 Replacing the delta unit
Continued

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the delta unit

Use these procedures to remove the delta unit.

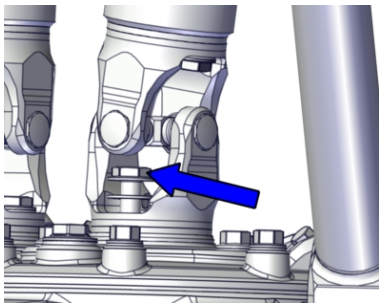
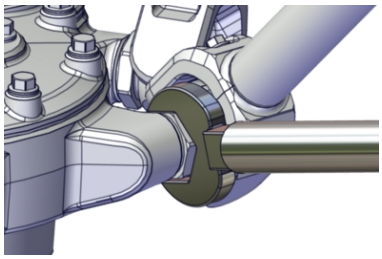
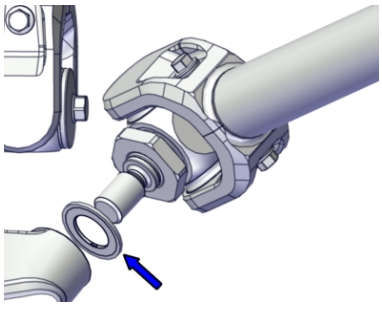
Preparations before removing the delta unit

	Action	Note
1	Jog the robot to synchronization position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
3	Remove any loads or tools attached to the turning disk.	
4	Secure the telescopic shaft with a lashing strap through the universal joints closest to the telescopic shaft (shortest way). For IRB 390 - 10/1300 both shafts must be secured. **CAUTION** The telescopic shaft will extend if not secured with the lashing strap, when the delta unit is removed.	Lashing strap  xx2000000334

Removing the delta unit

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	

Continues on next page

	Action	Note
2	Hold or place the delta unit on a workbench. **CAUTION** Axis 5 on the delta unit is not stable. There is a risk of pinching or tipping the unit if holding or putting down the delta unit on its tilt arm. **Tip** This operation is best performed by two persons working together.	
3	Loosen the universal joints from the delta unit by removing the screws and washers. **Note** Keep the sealing rings and frictions shims for refitting.	 xx2000001062
4	Loosen the lower arm shafts from the delta unit by loosening the nuts. Use an interchangeable head torque wrench and the open-end head insert.	Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002150
5	Loosen all lower arms from the delta unit and remove the delta unit. Save the sealing washer for refitting, or replace it if damaged.	 xx1900001801

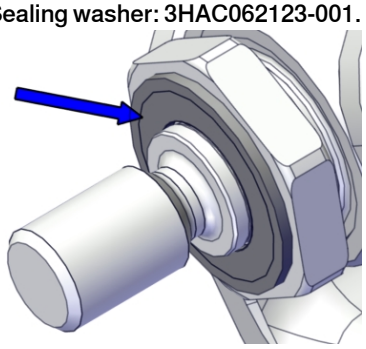
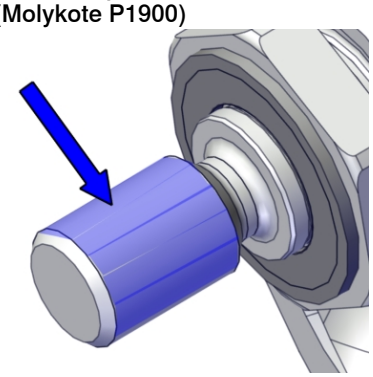
Continues on next page

5.5.4 Replacing the delta unit
Continued

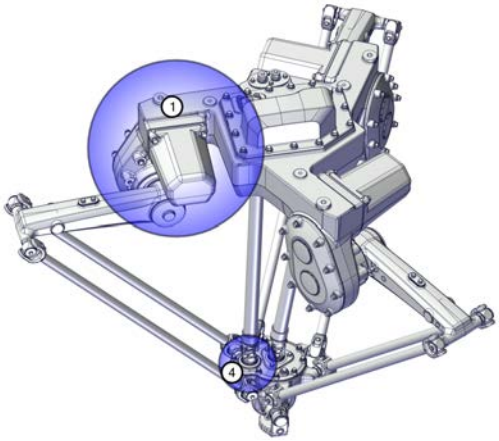
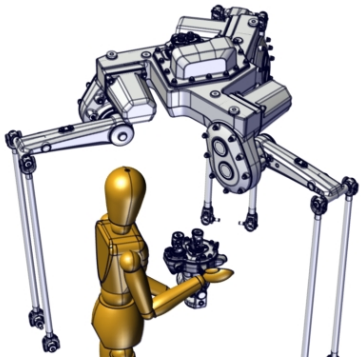
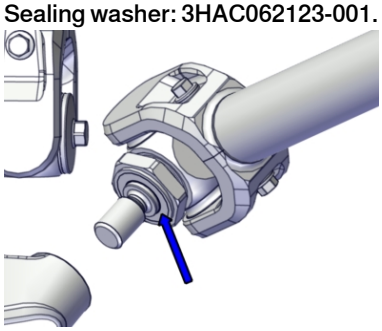
Refitting the delta unit

Use these procedures to refit the delta unit.

Refitting the delta unit

	Action	Note
1	Fit sealing washers to the lower arms. Replace the sealing washers if damaged.	Sealing washer: 3HAC062123-001.  xx2000000861
2	Lubricate only the thread on the joint of the lower arm. **Note** There must be no grease outside the thread.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000684

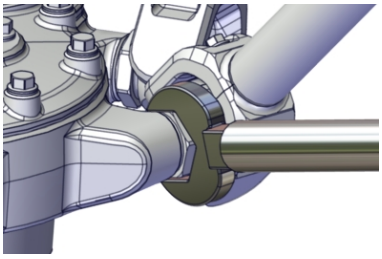
Continues on next page

	Action	Note
3	Lift and hold the delta unit or place the delta unit on a workbench. Orientation of delta unit: axis-4 universal joint side of delta unit directed towards axis-1 side of robot.  xx2000000685 **CAUTION** Axis 5 on the delta unit is not stable. There is a risk of pinching or tipping the unit if holding or putting down the delta unit on its tilt arm. **Tip** This operation is best performed by two persons working together.	Delta unit, axis 4: 3HAC058371-003. Delta unit, axis 4-5: 3HAC058372-002.  xx2000000687
4	Fit all lower arms to the delta unit. Make sure the sealing washers are in place.	Sealing washer: 3HAC062123-001.  xx2000001063

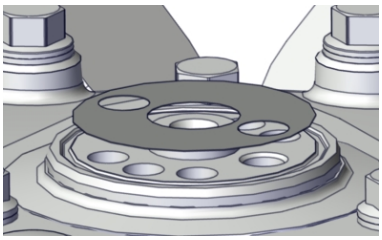
Continues on next page

5.5.4 Replacing the delta unit

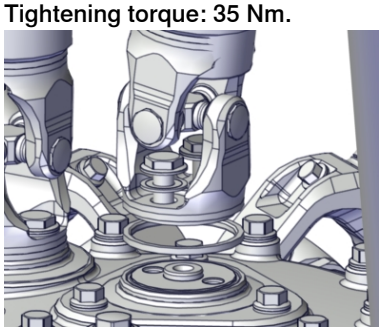
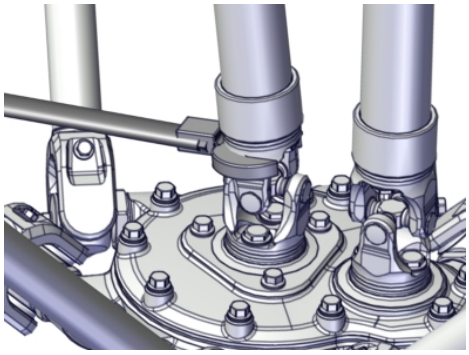
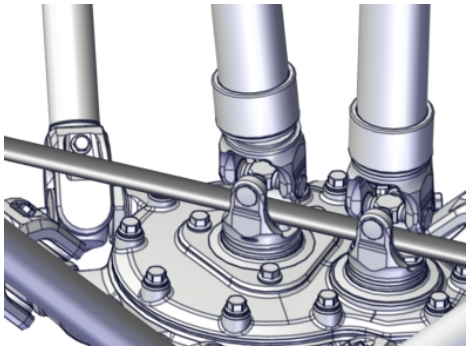
Continued

	Action	Note
5	Tighten the lower arm shafts. Start by hand, then use an interchangeable head torque wrench and the open-end head insert to apply tightening torque.	Tightening torque: 100 Nm. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002150

Refitting the telescopic shaft/shafts

	Action	Note
1	Clean the friction shim and the contact surfaces with isopropanol. Inspect the friction shim. Replace if damaged.	Cleaning agent: Cleaning agent. Friction shim: 3HAC060200-001.
2	Fit the friction shim.	 xx1900001829

Continues on next page

	Action	Note
3	Fit the sealing ring and the joint.	Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: M8 hygienic (3HAC058626-004) Anti-seize paste: Molykote P1900 (3HAC070875-002) Tightening torque: 35 Nm.  xx2000001081
4	Apply grease to the screw thread and between the washer and the screw head. Secure with the lubricated screws and washers and tighten, using the torque wrench head with a closed end. **Tip** The shaft rotates when loosening/fastening the screws. Use one of two alternatives to hold the shaft still: 1 Hold the motor shaft still with an open-end wrench (47 mm) at the joint while loosening/tightening the screws. Requires two persons.  xx2000001103 2 Hold the motor shaft still by inserting a pin through the joints (5-axis robot) or through the joint and against the casting. Choose an appropriate material for the pin, that does not damage the surface of the joints.  xx2000001104 **CAUTION** There is a risk of damage to the joint if not handled with care.	

Continues on next page

5.5.4 Replacing the delta unit

Continued

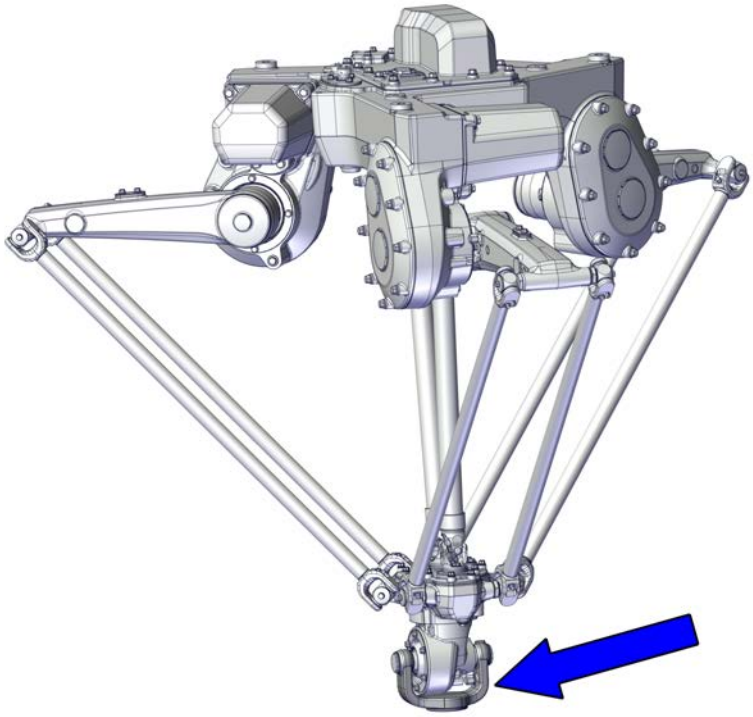
Concluding procedure

	Action	Note
1	Remove the lashing strap.	
2	Calibrate the robot.	See *Calibration on page 321*.
3	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.5.5 Replacing the tilt arm

Location of the tilt arm

The tilt arm is located as shown in the figure.



xx2000000037

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Tilt arm	3HAC059345-001		L2
Friction shim	3HAC061398-001	2 pcs Always use new friction shims.	L2
Hex socket head cap screw	3HAB3409-69	M12x50 12.9 Gleitmo 603+Geomet 500 2 pcs. Always use new screws.	L2

Continues on next page

5.5.5 Replacing the tilt arm
Continued

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Cover	3HAC070382-001	Replace if damaged.
Sealing	3HAC070381-001	
Sealing ring	3HAC061399-001	
Sleeve	3HAC061440-001	

Required tools and equipment

Equipment	Article number	Note
Blind hole bearing puller	-	Capacity: 12 mm.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the tilt arm

Use these procedures to remove the tilt arm.

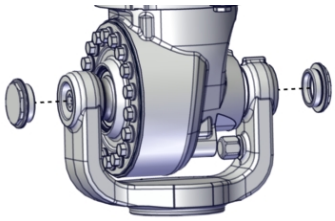
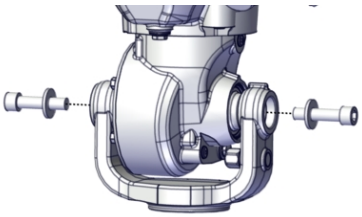
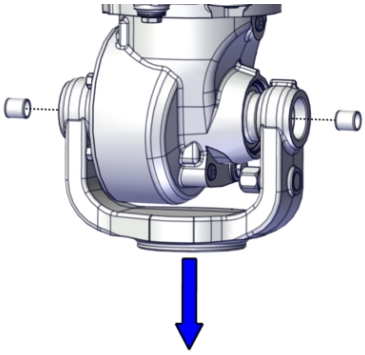
Preparations before removing the tilt arm

	Action	Note
1	Jog the robot to an appropriate working position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the tilt arm

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	

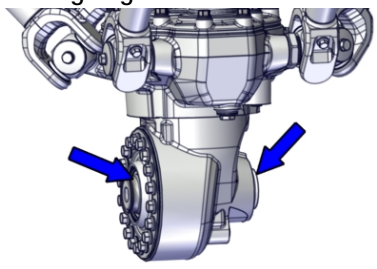
Continues on next page

	Action	Note
2	Remove the covers.	 xx2000000043
3	Remove the screws and washers. Discard the screws.	 xx2000000042
4	Remove the sleeves with a blind hole bearing puller and pick down the tilt arm. Discard the friction shims.	 xx2000000047

Refitting the tilt arm

Use these procedures to refit the tilt arm.

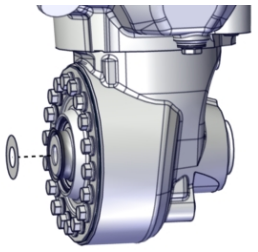
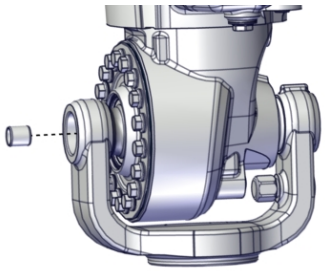
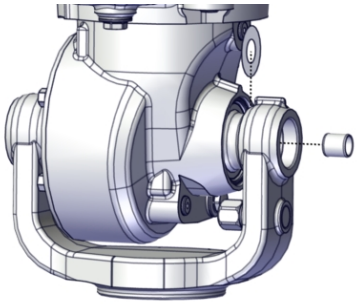
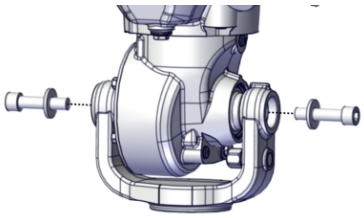
Refitting the tilt arm

	Action	Note
1	Check the two sealing rings. Replace if damage.	Sealing ring: 3HAC061399-001  xx2000000038

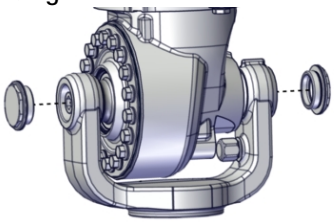
Continues on next page

5.5.5 Replacing the tilt arm

Continued

	Action	Note
2	Fit a new friction shim to the shaft end. **Note** Do not reuse the friction shims.	Friction shim: 3HAC061398-001.  xx2000000039
3	Fit the tilt arm and push the sleeve into place. Replace the sleeve if damaged.	Tilt arm: 3HAC059345-001. Sleeve: 3HAC061440-001.  xx2000000040
4	Fit the friction shim between the sealing ring and tilt arm on the other side, and then push the sleeve in.	Friction shim: 3HAC061398-001. Sleeve: 3HAC061440-001.  xx2000000041
5	Secure with two washers and two new screws. Tighten. **Note** Do not reuse the screws.	Hex socket head cap screw: 3HAB3409-69 (M12x50 12.9 Gleitmo 603+Geomet 500, 2 pcs) Spring washer, conical: 9ADA334-9 (2 pcs) Tightening torque: 80 Nm +90° ± 10°.  xx2000000042

Continues on next page

	Action	Note
6	Fit the covers, including the sealings. Replace if damaged.	Cover: 3HAC070382-001. Sealing: 3HAC070381-001.  xx2000000043

Concluding procedure

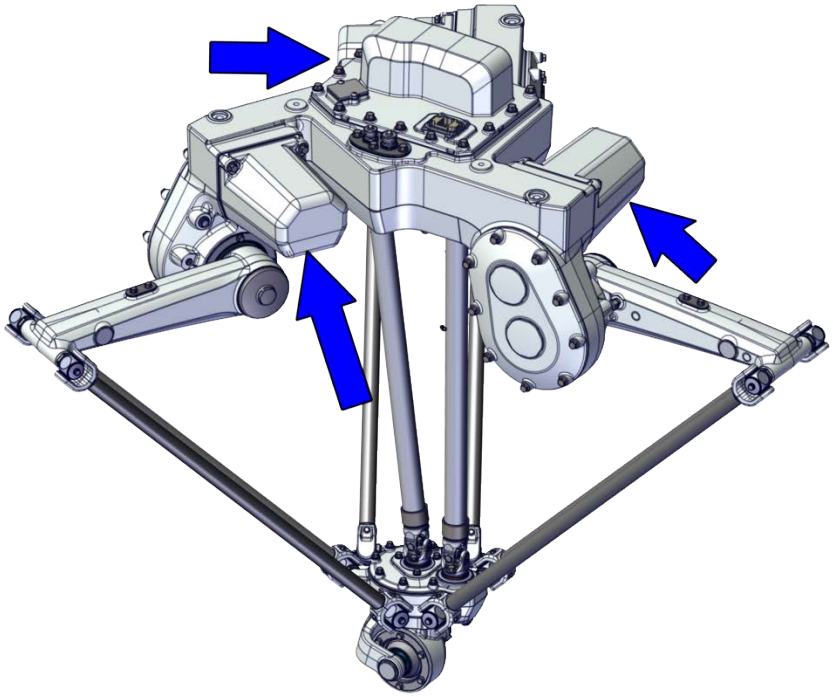
	Action	Note
1	Calibrate the robot.	See *Calibration on page 321*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.6 Motors and gears

5.6.1 Replacing the axis-1, axis 2 and axis-3 motor

Location of the motors

The motors are located as shown in the figure.

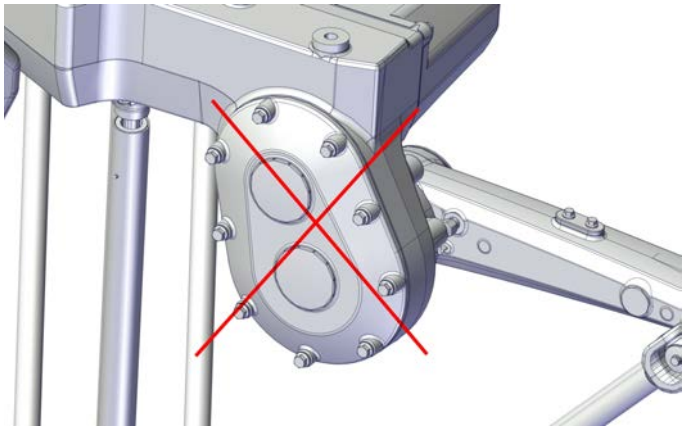


xx1900000758

Strictly forbidden to open the cover on the axis-1, axis-2 and axis-3 gears

Note

Do not, under any circumstances, open the cover on the axis-1, axis-2 and axis-3 gears! It is strictly forbidden to do any repair work on the gears.



xx2000001263

Continues on next page

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Rotating AC motor M106.1 with pinion	3HAC058368-003	Does not include o-ring (3HAB3772-102).	L2

Required consumables

Consumable	Article number	Note
Anti-seize paste	3HAC070875-002	Molykote P1900
O-ring	3HAB3772-102	
Cable ties	-	

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

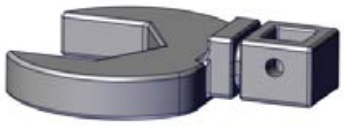
Spare part	Article number	Note
Sealing washer	3HAC063720-001	
Hexagon flange bolt	3HAC060233-003	M8x45 stainless steel/A4-80
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Sealing washer	3HAC062123-001	To the lower arm.

Required tools and equipment

Equipment	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 113*.
Lashing strap	-	Width 25 mm Length 2.5 m
Guide pin, M8x150	3HAC15520-2	Always use guide pins in pairs.
24 VDC power supply	-	Used to release the motor brakes.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
Leak-down tester	-	

Continues on next page

5.6.1 Replacing the axis-1, axis 2 and axis-3 motor
Continued

Equipment	Article number	Note
Torque wrench head, open-end insert	3HAC073854-001	Included in robot delivery.  xx1900002148 Used with an interchangeable head torque wrench (not included in delivery). Interface: 14x18 mm.
Interchangeable head torque wrench	-	
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

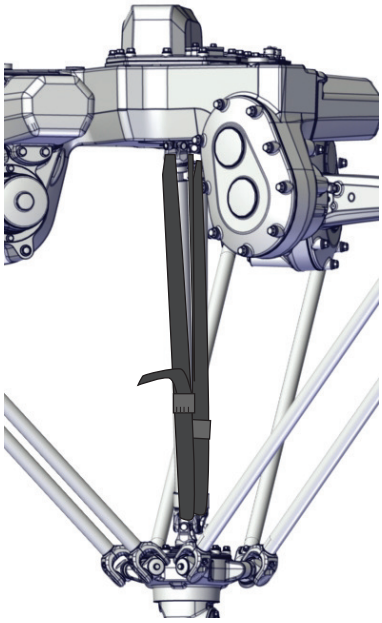
Removing the motor

Use these procedures to remove the axis-1, axis-2 or axis-3 motor.

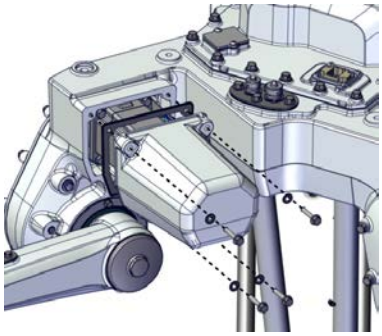
Preparations before removing the axis-1, axis-2 or axis-3 motor

	Action	Note
1	Jog the robot to synchronization position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Continues on next page

	Action	Note
3	Secure the robot arm system with a lashing strap through the universal joints closest to the telescopic shaft.	Lashing strap  xx2000000334

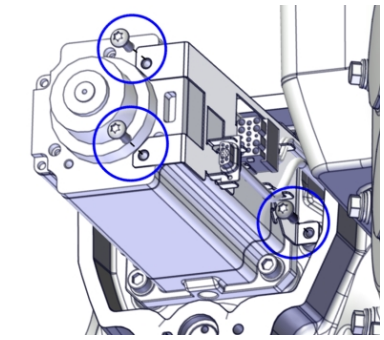
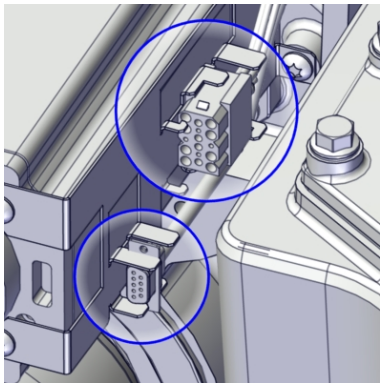
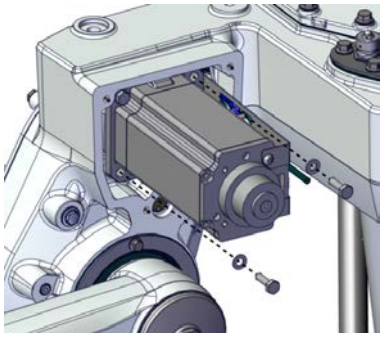
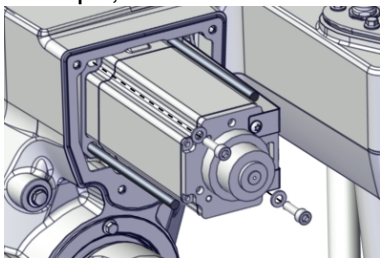
Removing the axis-1, axis-2 or axis-3 motor

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the motor cover and the sealing.	 xx1900000759
3	Cut all cable ties. **Tip** Take pictures of the cable routing and placement of cable ties, before cutting the ties.	

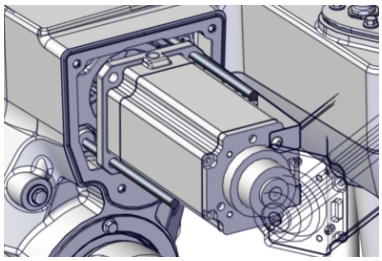
Continues on next page

5.6.1 Replacing the axis-1, axis 2 and axis-3 motor

Continued

	Action	Note
4	Remove the cable bracket attachment screws.	 xx1900001837
5	Snap loose the cable connectors from the cable bracket and disconnect the motor cabling.	 xx2000001005
6	To release the brakes, connect the 24 VDC power supply. Connect to R3.MP1/R3.MP2/R3.MP3-connector: • + = pin 2 • - = pin 5	24 VDC power supply
7	Remove two of the screws and washers securing the motor.	 xx1900000760
8	Fasten two guide pins. **Tip** Lubricate the guide pins with some grease to make the motor slide better.	Guide pin, M8x150: 3HAC15520-2 
9	Remove the two remaining screws and washers.	xx1900001835

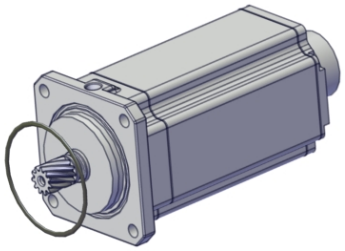
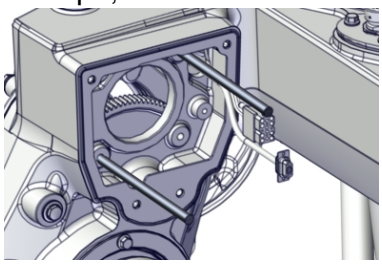
Continues on next page

	Action	Note
10	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
11	Remove the motor by sliding it out on the guide pins and lift it off.	 xx1900001834

Refitting the motor

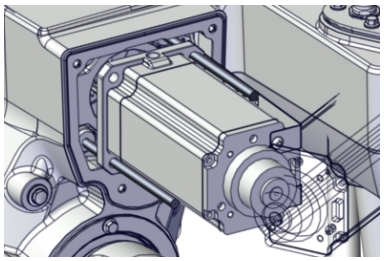
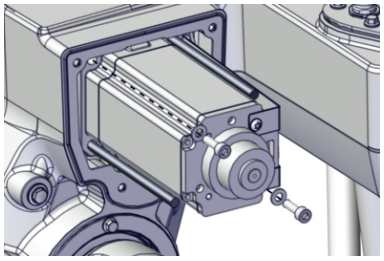
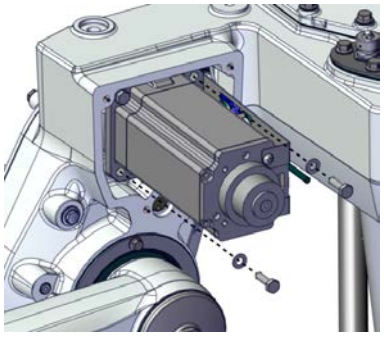
Use these procedures to refit the axis-1 motor.

Refitting the axis-1, axis-2 or axis-3 motor

	Action	Note
1	Lubricate the new o-ring with grease and fit it to the motor flange.	O-ring: 3HAB3772-102 Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx1900001962
2	If not already fitted, fasten two guide pins to opposite screw holes. **Tip** Lubricate the guide pins with some grease to make the motor slide better.	Guide pin, M8x150: 3HAC15520-2  xx1900001836
3	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

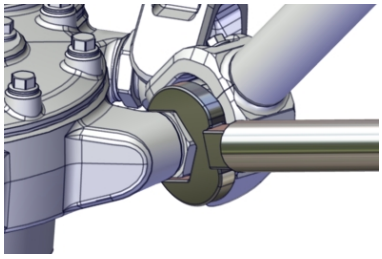
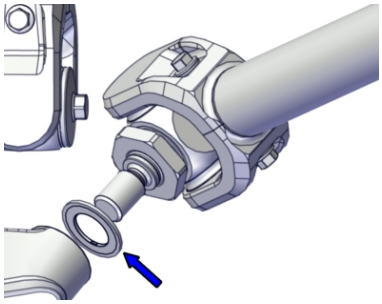
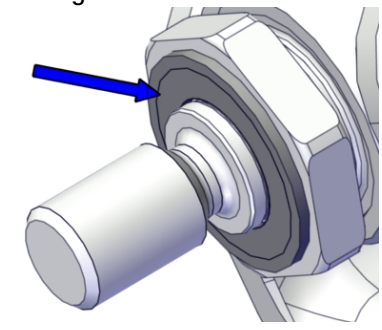
Continues on next page

5.6.1 Replacing the axis-1, axis 2 and axis-3 motor
Continued

	Action	Note
4	Lift the motor and put it on the guide pins as close as possible to its final position without pushing the motor pinion into the gear.	 xx1900001834
5	To release the brakes, connect the 24 VDC power supply. Connect to R3.MP1/R3.MP2/R3.MP3-connector: • + = pin 2 • - = pin 5	24 VDC power supply
6	Use the rotation tool to rotate the pinion when mating it into the gear. Leave the rotation tool and 24 VDC power supply connected for play adjustment.	Rotation tool: 3HAB7887-1
7	Fit the attachment screws and washers. Tighten by hand.	Hex socket head cap screw: M8x25 Steel 8.8-A2F Plain washer, DIN 125: 8.4x16x1.6 steel-A2F  xx1900001835
8	Remove the guide pins and fit the remaining two screws and washers. Tighten by hand. Do not tighten with a torque yet.	 xx1900000760

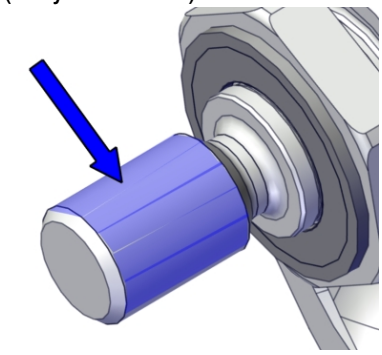
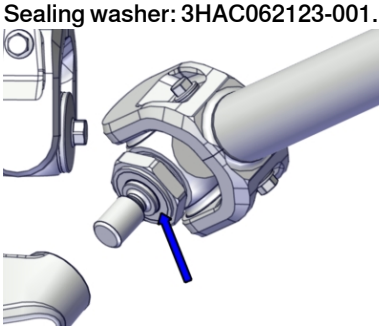
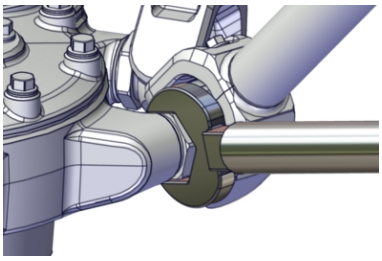
Continues on next page

Adjusting the gear play

	Action	Note
1	Remove both lower arms that belong to the current upper arm from the delta unit: 1 Loosen the lower shaft from the delta unit by loosening the nut. Use an interchangeable head torque wrench and the open-end head insert. Save the sealing washer for refitting, or replace it if damaged.	This is done to simplify the adjustment of the gear play. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002150  xx1900001801
2	Adjust the play on the motor by starting with a big play and then gradually finding the smallest play. Turn the motor shaft seven turns and find the smallest play within this range. Push or tap the motor in radial direction so that the play becomes minimal within one motor turn, without the gear "chewing".	
3	Tighten the motor attachment screws.	Tightening torque: 24 Nm.
4	Fit sealing washers to the lower arms. Replace the sealing washers if damaged.	Sealing washer: 3HAC062123-001.  xx2000000861

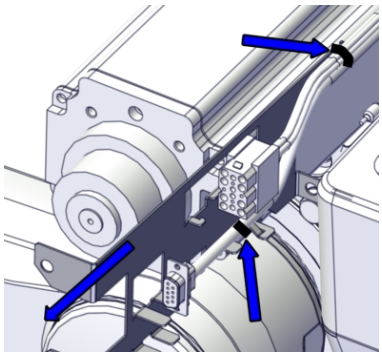
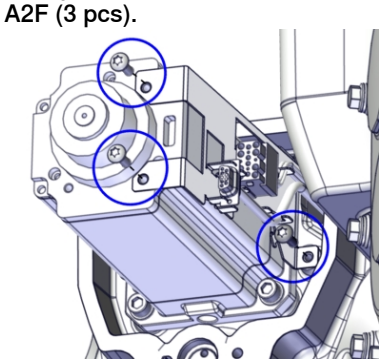
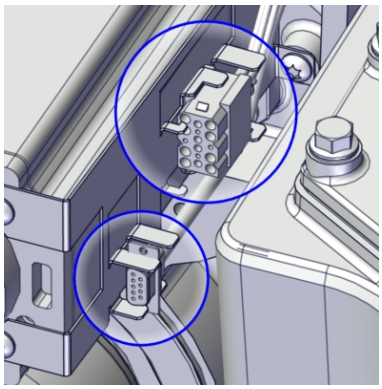
Continues on next page

5.6.1 Replacing the axis-1, axis 2 and axis-3 motor
Continued

	Action	Note
5	Lubricate the lower arm thread. **Note** The surface under the thread head must be dry and not contain grease.	Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx2000000684
6	Fit all lower arms to the delta unit. Make sure the sealing washers are in place.	Sealing washer: 3HAC062123-001.  xx2000001063
7	Tighten the lower arm shafts. Use an interchangeable head torque wrench and the open-end head insert.	Tightening torque: 100 Nm. Interchangeable head torque wrench Torque wrench head, open-end insert: 3HAC073854-001  xx1900002150

Continues on next page

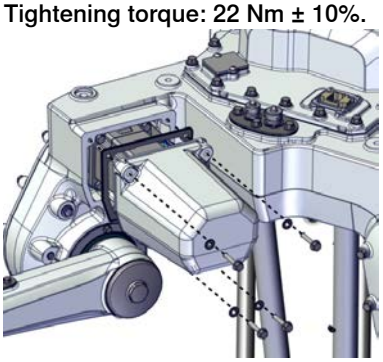
Refitting cable bracket and motor cover

	Action	Note
1	Secure the cabling to the cable bracket with cable ties, if removed.	 xx2000002200
2	Refit the cable bracket with attachment screws, if removed.	Torx pan head screw: M6x16 8.8-A2F (3 pcs).  xx1900001837
3	Reconnect the motor cabling and snap the cable connectors to the cable bracket.	 xx2000001005
4	Secure the cabling to the cable bracket with cable ties.	Cable ties

Continues on next page

5.6.1 Replacing the axis-1, axis 2 and axis-3 motor

Continued

	Action	Note
5	Refit the motor cover and the sealing washer with lubricated screws and washers. Replace if damaged.	Sealing washer: 3HAC063720-001 Hexagon flange bolt: 3HAC060233-003 (M8x45 stainless steel/A4-80, 4 pcs) Washer: 3HAC058626-004 (4 pcs). Anti-seize paste: 3HAC070875-002 (Molykote P1900) Tightening torque: 22 Nm ± 10%.  xx1900000759

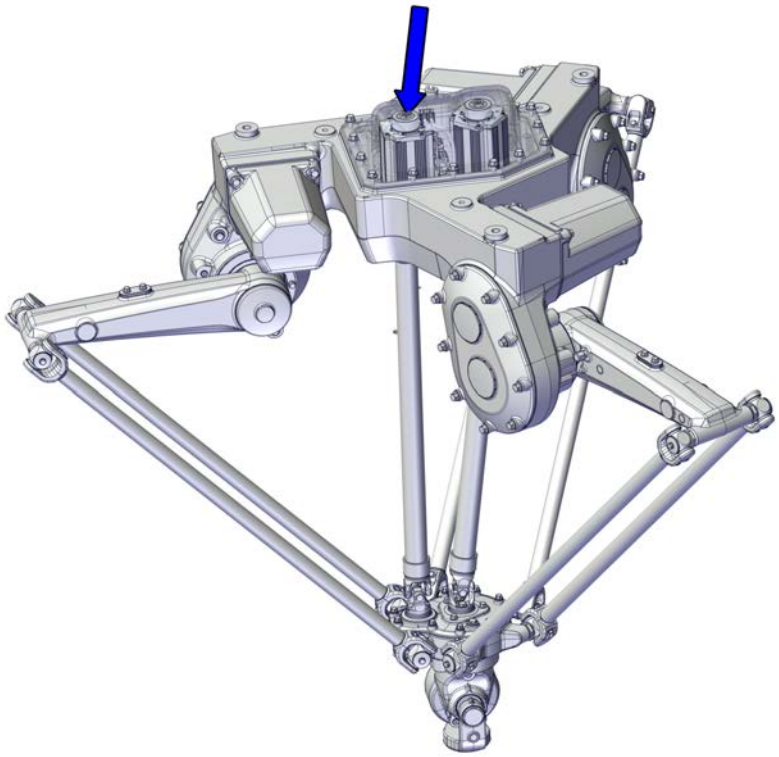
Concluding procedure

	Action	Note
1	Remove the lashing strap, if used.	
2	Calibrate the robot.	See *Calibration on page 321*.
3	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.6.2 Replacing the axis-4 motor

Location of the motor

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



xx1900001838

Note

This repair procedure requires sufficient free space above the robot for removal of the top cover and affected spare parts.

Read more about access ways in *Minimum required free space above the robot on page 49*.

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Rotating AC motor M104 with pinion	3HAC058581-003	Includes o-ring 3HAB3772-163 and pinion.	L2

Continues on next page

5.6.2 Replacing the axis-4 motor
Continued

Required consumables

Consumable	Article number	Note
Anti-seize paste	3HAC070875-002	Molykote P1900
O-ring	3HAB3772-163	
Cable ties	-	

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Sealing washer	3HAC058649-003	Base unit top cover.
Hexagon flange bolt	3HAC060233-008	M8x40 stainless steel/A4-80
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Hexagon flange bolt	3HAC060233-006	M6x16 stainless steel/A4-80
Washer	3HAC058626-003	M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.

Required tools and equipment

Equipment	Article number	Note
24 VDC power supply	-	Used to release the motor brakes.
Guide pin, M6x150	3HAC080345-001	Always use guide pins in pairs.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the motor

Use these procedures to remove the axis-4 motor.

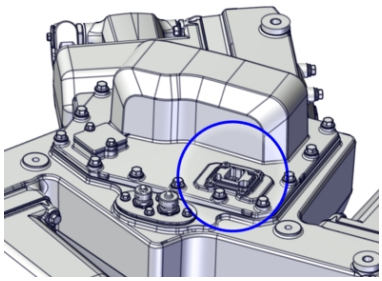
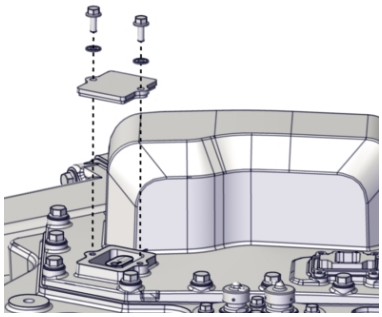
Preparations before removing the axis-4 motor

	Action	Note
1	Jog the robot to calibration position.	This is done to facilitate updating of the revolution counter.

Continues on next page

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

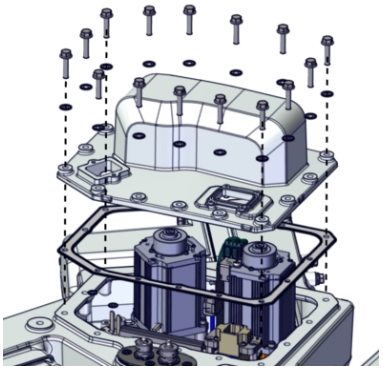
Removing the top cover

	Action	Note
1	Disconnect connector R1.MP from the base.	 xx2000001006
2	**CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	
3	Remove the SMB battery cover. **Tip** The battery cover is removed to see the battery position during refitting of the top cover.	 xx1900000407

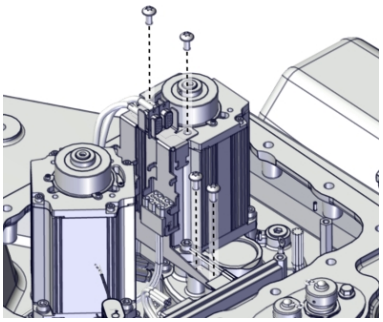
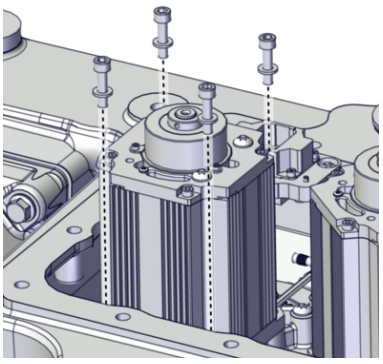
Continues on next page

5.6.2 Replacing the axis-4 motor

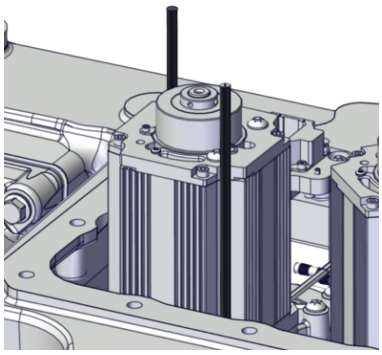
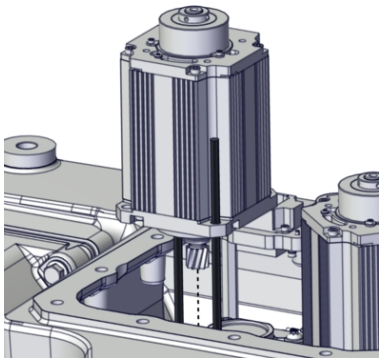
Continued

	Action	Note
4	Remove the cover by removing the screws and washers. Also remove the sealing.	 xx1900000469

Removing the axis-4 motor

	Action	Note
1	Remove the cable bracket from the motor by removing the four screws.	 xx2000001031
2	Snap loose the connectors from the connector bracket and disconnect the motor connectors.	
3	To release the brakes, connect the 24 VDC power supply. Connect to R3.MP4-connector: • + = pin 2 • - = pin 5	24 VDC power supply
4	Remove the motor attachment screws and washers.	 xx2000001082

Continues on next page

	Action	Note
5	Fit guide pins in opposite holes.	Guide pin, M6x150 Always use guide pins in pairs.  xx2000001084
6	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
7	Use caution and lift the motor straight up to get the pinion parted from the gear.	 xx2000001083
8	Disconnect the 24 VDC power supply.	

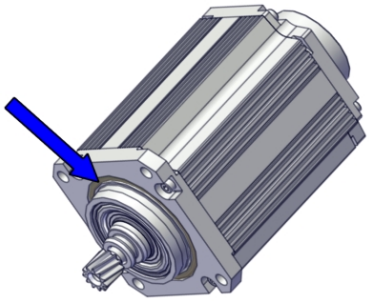
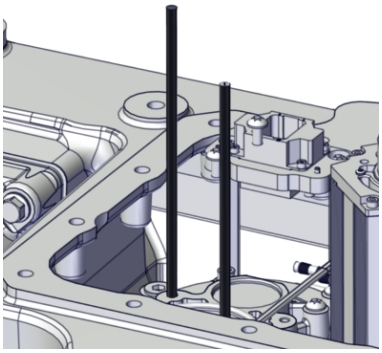
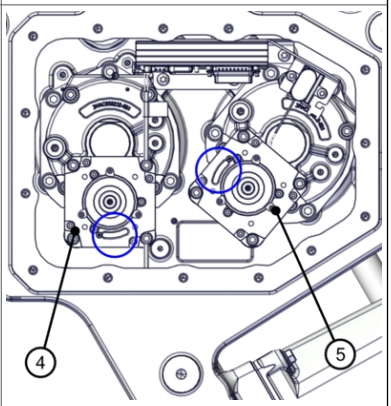
Continues on next page

5.6.2 Replacing the axis-4 motor
Continued

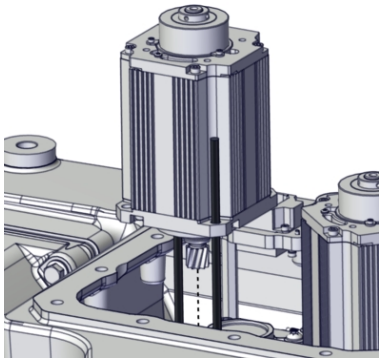
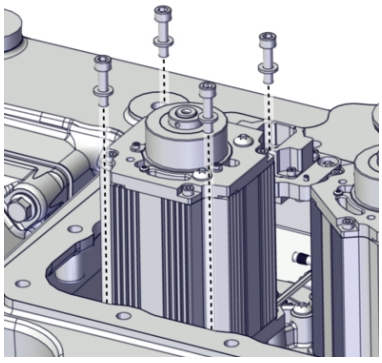
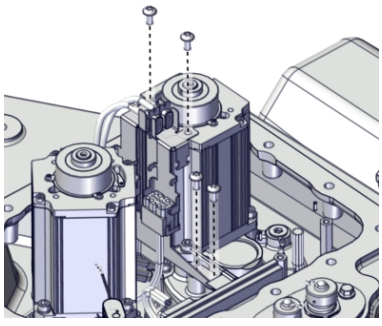
Refitting the motor

Use these procedures to refit the axis-4 motor.

Refitting the axis-4 motor

	Action	Note
1	Check the o-ring. Replace if damaged.	O-ring: 3HAB3772-163.  xx2000001087
2	If not already fitted, fit two guide pins to the motor attachment holes.	Guide pin, M6x150 Always use guide pins in pairs.  xx2000001088
3	To release the brakes, connect the 24 VDC power supply. Connect to R3.MP4-connector: • + = pin 2 • - = pin 5	24 VDC power supply
4	The motors are oriented differently on the axis-4 and axis-5 gear unit assemblies, in regard to the cable outlet on top. Check that the motor is oriented according to the figure before securing the unit, for each axis respectively.	 xx2000001032 • 4: Axis-4 motor • 5: Axis-5 motor

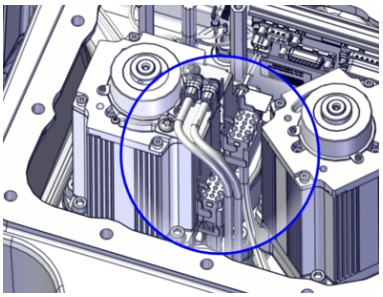
Continues on next page

	Action	Note
5	Lift the motor into the base. Use the rotation tool to rotate the pinion when mating it into the gear.	Rotating AC motor M104 with pinion: 3HAC058581-003. Rotation tool: 3HAB7887-1  xx2000001083
6	Secure the unit with attachment screws and washers.	Hex socket head cap screw: M6x25 Steel 8.8-A2F (4 pcs). Plain washer: 6.4x12x1.6 steel-A2F (4 pcs). Tightening torque: 10 Nm.  xx2000001082
7	Refit the cable bracket to the motor with four screws.	Torx pan head screw: M6x12 Steel 8.8-A2F (4 pcs)  xx2000001031
8	Disconnect the 24 VDC power supply.	

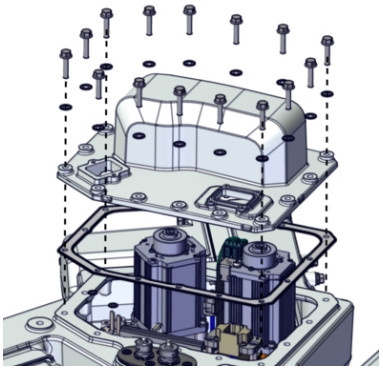
Continues on next page

5.6.2 Replacing the axis-4 motor

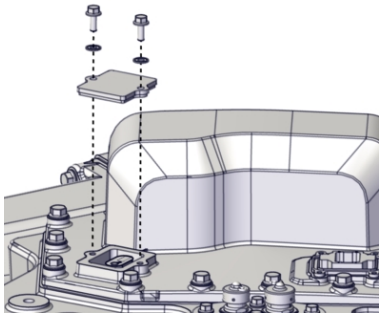
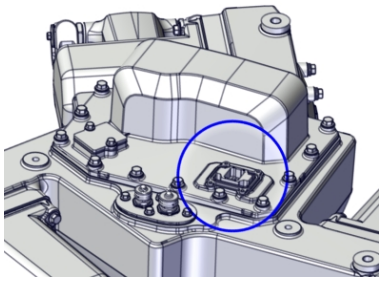
Continued

	Action	Note
9	Connect the motor connectors and fasten the connectors to the connector bracket by snapping them into place.	 xx1900001845

Refitting the top cover

	Action	Note
1	Refit the sealing and tighten the cover with lubricated screws. **CAUTION** Check that the SMB battery does not get squeezed under the cover.	Sealing washer: 3HAC058649-003 Hexagon flange bolt: 3HAC060233-008 (M8x40 stainless steel/A4-80, 15 pcs) Washer: 3HAC058626-004 (M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose., 15 pcs) Anti-seize paste: Molykote P1900 (3HAC070875-002) Tightening torque: 21 Nm.  xx1900000469

Continues on next page

	Action	Note
2	Check that the battery is located correctly in the battery compartment and not pinched under the top cover. Then fasten the battery cover and sealing, with lubricated screws and washers. **Note** Do not overtighten to avoid damaging the sealing.	Tightening torque: 4 Nm. Hexagon flange bolt: 3HAC060233-006 (M6x16 stainless steel/A4-80) Washer: 3HAC058626-003 (M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.) Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx1900000407
3	Reconnect connector R1.MP to the base.	 xx2000001006

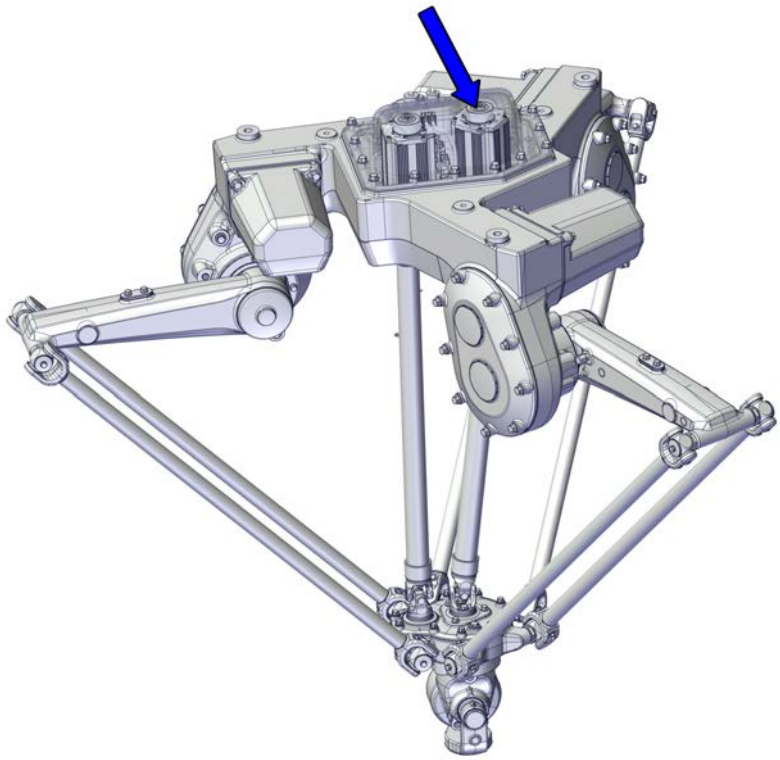
Concluding procedure

	Action	Note
1	Calibrate the robot.	See *Calibration on page 321*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.6.3 Replacing the axis-5 motor

Location of the motor

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



xx1900001839

Note

This repair procedure requires sufficient free space above the robot for removal of the top cover and affected spare parts.

Read more about access ways in *Minimum required free space above the robot on page 49*.

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Rotating AC motor M104 with pinion	3HAC058581-003	Includes o-ring 3HAB3772-163 and pinion.	L2

Continues on next page

Required consumables

Consumable	Article number	Note
Anti-seize paste	3HAC070875-002	Molykote P1900
O-ring	3HAB3772-163	
Cable ties	-	

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Sealing washer	3HAC058649-003	Base unit top cover.
Hexagon flange bolt	3HAC060233-008	M8x40 stainless steel/A4-80
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Hexagon flange bolt	3HAC060233-006	M6x16 stainless steel/A4-80
Washer	3HAC058626-003	M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.

Required tools and equipment

Equipment	Article number	Note
24 VDC power supply	-	Used to release the motor brakes.
Guide pin, M6x150	3HAC080345-001	Always use guide pins in pairs.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

Removing the motor

Use these procedures to remove the axis-5 motor.

Preparations before removing the axis-5 motor

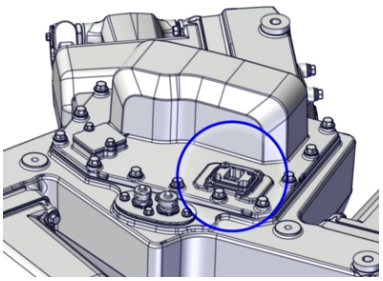
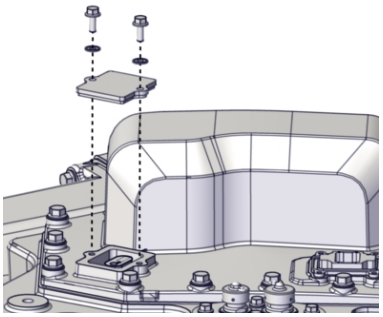
	Action	Note
1	Jog the robot to calibration position.	This is done to facilitate updating of the revolution counter.

Continues on next page

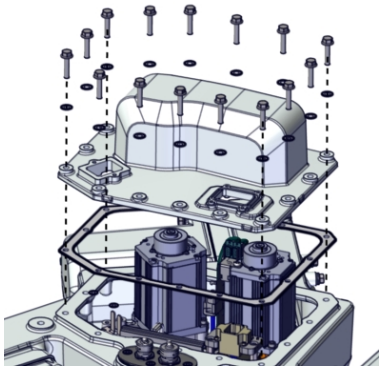
5.6.3 Replacing the axis-5 motor
Continued

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

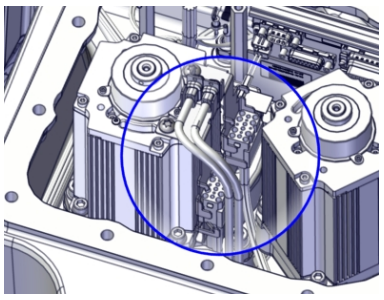
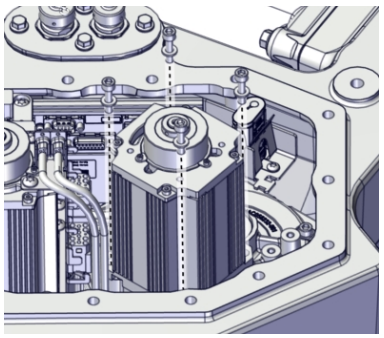
Removing the top cover

	Action	Note
1	Disconnect connector R1.MP from the base.	 xx2000001006
2	**CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	
3	Remove the SMB battery cover. **Tip** The battery cover is removed to see the battery position during refitting of the top cover.	 xx1900000407

Continues on next page

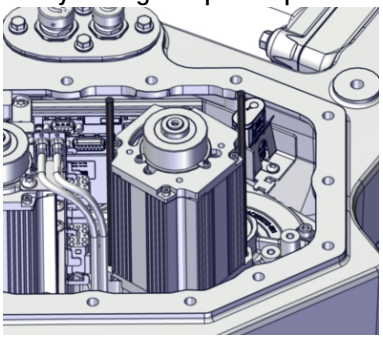
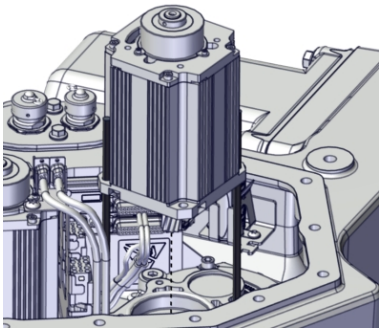
	Action	Note
4	Remove the cover by removing the screws and washers. Also remove the sealing.	 xx1900000469

Removing the axis-5 motor

	Action	Note
1	Snap loose the connectors from the connector bracket and disconnect the motor connectors.	 xx1900001845
2	To release the brakes, connect the 24 VDC power supply. Connect to R3.MP5-connector: • + = pin 2 • - = pin 5	24 VDC power supply
3	Remove the motor attachment screws and washers.	 xx2000001089

Continues on next page

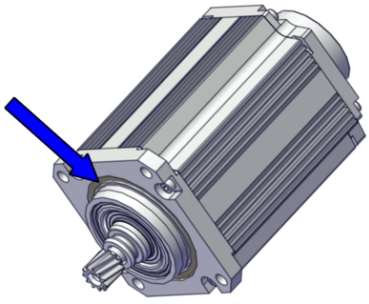
5.6.3 Replacing the axis-5 motor
Continued

	Action	Note
4	Fit guide pins in opposite holes.	Guide pin, M6x150 Always use guide pins in pairs.  xx2000001090
5	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
6	Use caution and lift the motor straight up to get the pinion parted from the gear.	 xx2000001091
7	Disconnect the 24 VDC power supply.	

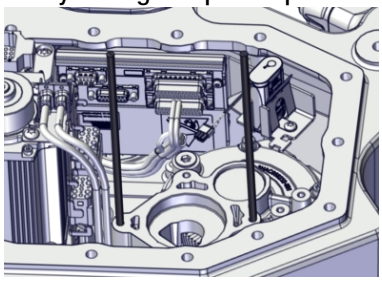
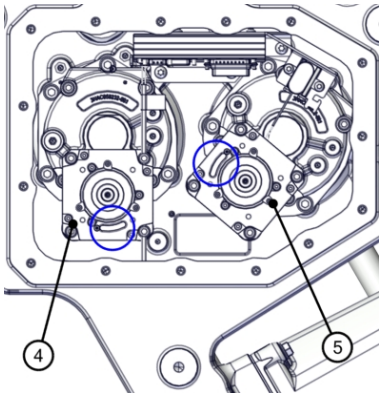
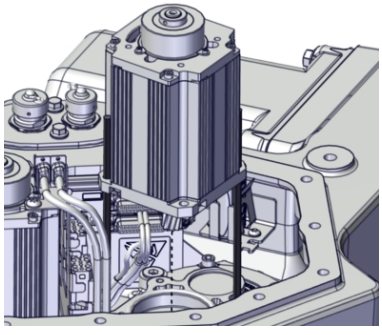
Refitting the motor

Use these procedures to refit the axis-5 motor.

Refitting the axis-5 motor

	Action	Note
1	Check the o-ring. Replace if damaged.	O-ring: 3HAB3772-163.  xx2000001087

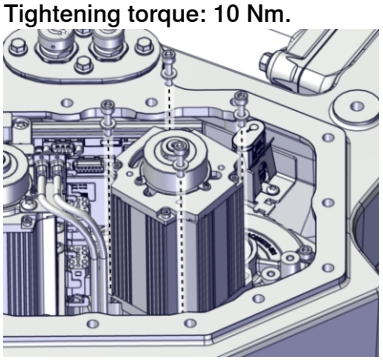
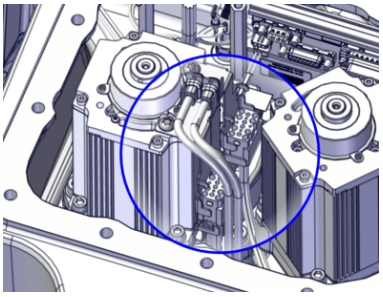
Continues on next page

	Action	Note
2	If not already fitted, fit two guide pins to the motor attachment holes.	Guide pin, M6x150 Always use guide pins in pairs.  xx2000001092
3	To release the brakes, connect the 24 VDC power supply. Connect to R3.MP5-connector: • + = pin 2 • - = pin 5	24 VDC power supply
4	The motors are oriented differently on the axis-4 and axis-5 gear unit assemblies, in regard to the cable outlet on top. Check that the motor is oriented according to the figure before securing the unit, for each axis respectively.	 xx2000001032 • 4: Axis-4 motor • 5: Axis-5 motor
5	Lift the motor into the base. Use the rotation tool to rotate the pinion when mating it into the gear.	Rotating AC motor M104 with pinion: 3HAC058581-003. Rotation tool: 3HAB7887-1  xx2000001091

Continues on next page

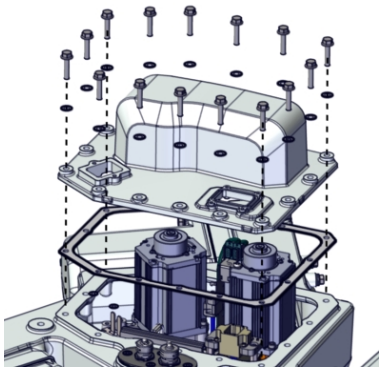
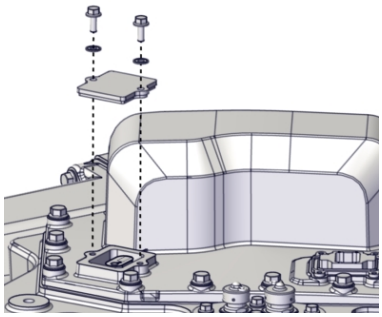
5.6.3 Replacing the axis-5 motor

Continued

	Action	Note
6	Secure the unit with attachment screws and washers.	Hex socket head cap screw: M6x25 Steel 8.8-A2F (4 pcs). Plain washer: 6.4x12x1.6 steel-A2F (4 pcs). Tightening torque: 10 Nm.  xx2000001089
7	Disconnect the 24 VDC power supply.	
8	Connect the motor connectors and fasten the connectors to the connector bracket by snapping them into place.	 xx1900001845

Continues on next page

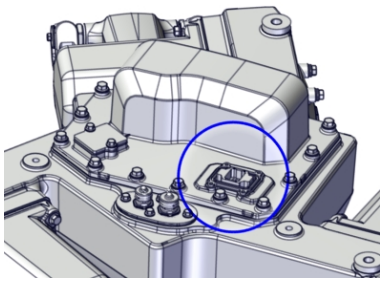
Refitting the top cover

	Action	Note
1	Refit the sealing and tighten the cover with lubricated screws. **CAUTION** Check that the SMB battery does not get squeezed under the cover.	Sealing washer: 3HAC058649-003 Hexagon flange bolt: 3HAC060233-008 (M8x40 stainless steel/A4-80, 15 pcs) Washer: 3HAC058626-004 (M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose., 15 pcs) Anti-seize paste: Molykote P1900 (3HAC070875-002) Tightening torque: 21 Nm.  xx1900000469
2	Check that the battery is located correctly in the battery compartment and not pinched under the top cover. Then fasten the battery cover and sealing, with lubricated screws and washers. **Note** Do not overtighten to avoid damaging the sealing.	Tightening torque: 4 Nm. Hexagon flange bolt: 3HAC060233-006 (M6x16 stainless steel/A4-80) Washer: 3HAC058626-003 (M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.) Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx1900000407

Continues on next page

5.6.3 Replacing the axis-5 motor

Continued

	Action	Note
3	Reconnect connector R1.MP to the base.	 xx2000001006

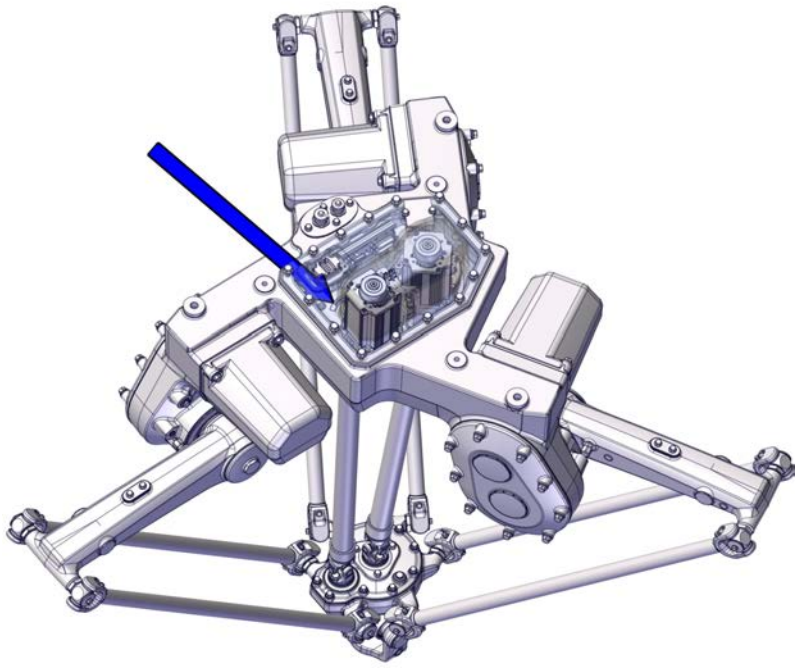
Concluding procedure

	Action	Note
1	Calibrate the robot.	See *Calibration on page 321*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.6.4 Replacing the axis-4 gear unit pre-stage

Location of the gear unit pre-stage

The axis-4 gear unit pre-stage is located as shown in the figure.



xx2000001270

Note

This repair procedure requires sufficient free space above the robot for removal of the top cover and affected spare parts.

Read more about access ways in *Minimum required free space above the robot on page 49*.

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Gear unit, pre-stage	3HAC060588-003	Does not include motor.	L2

Required consumables

Consumable	Article number	Note
Cable ties	-	

Continues on next page

5.6.4 Replacing the axis-4 gear unit pre-stage
Continued

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Anti-seize paste	3HAC070875-002	Molykote P1900
Lubricating oil	-	See *Type and amount of oil in gearboxes on page 113*.

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Sealing ring	3HAC059017-002	For the gear unit.
Friction shim	3HAC060200-001	Between universal joint and telescopic shaft/base unit/delta unit.
Sealing ring	3HAC060263-001	Between universal joint and telescopic shaft/base unit/delta unit.
Hexagon flange bolt	3HAC058625-001	M8x16 Bumax 109
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Sealing washer	3HAC058649-003	Base unit top cover.
Hexagon flange bolt	3HAC060233-008	M8x40 stainless steel/A4-80
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Hexagon flange bolt	3HAC060233-006	M6x16 stainless steel/A4-80
Washer	3HAC058626-003	M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.

Required tools and equipment

Equipment	Article number	Note
Torque wrench head, closed end	3HAC063379-001	Included in robot delivery.  xx2000000282 Used with a torque wrench (not included in delivery) to loosen and tighten the universal joint and telescopic shaft screws. Hole interface: 1/4" square.
24 VDC power supply	-	Used to release the motor brakes.

Continues on next page

Equipment	Article number	Note
Guide pin, M6x150	3HAC080345-001	Always use guide pins in pairs.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

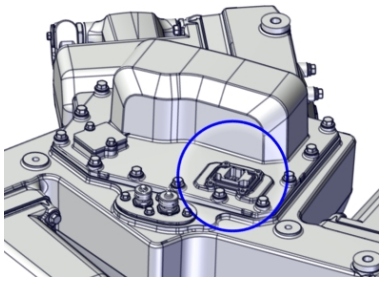
Removing the gear unit pre-stage

Use these procedures to remove the axis-4 gear unit pre-stage.

Preparations before removing the axis-4 gear unit pre-stage

	Action	Note
1	Jog the robot to calibration position.	This is done to facilitate updating of the revolution counter.
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

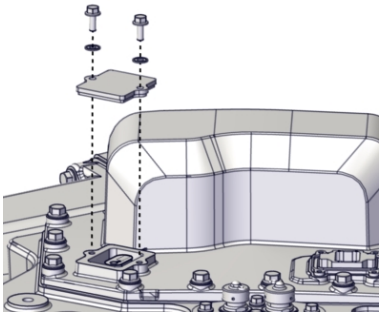
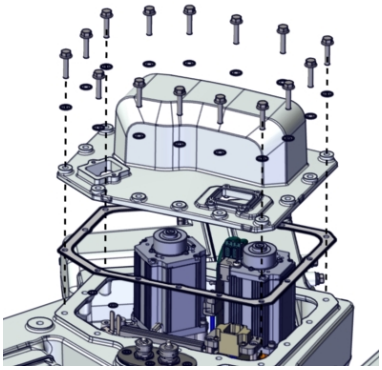
Removing the top cover

	Action	Note
1	Disconnect connector R1.MP from the base.	 xx2000001006
2	**CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	

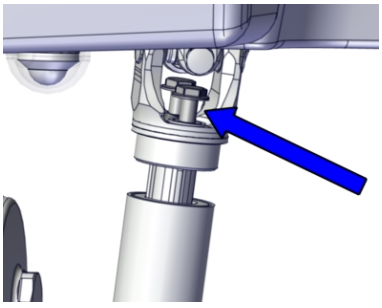
Continues on next page

5.6.4 Replacing the axis-4 gear unit pre-stage

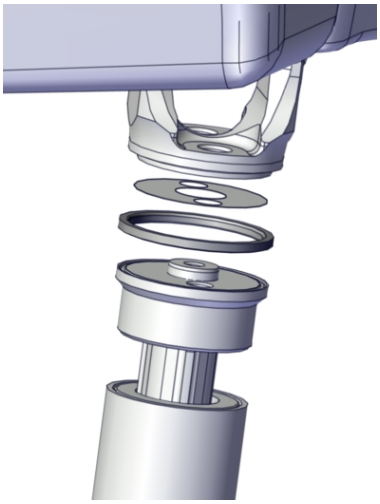
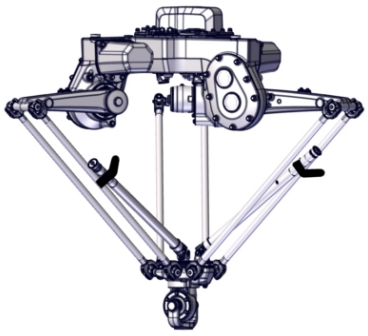
Continued

	Action	Note
3	Remove the SMB battery cover. **Tip** The battery cover is removed to see the battery position during refitting of the top cover.	 xx1900000407
4	Remove the cover by removing the screws and washers. Also remove the sealing.	 xx1900000469

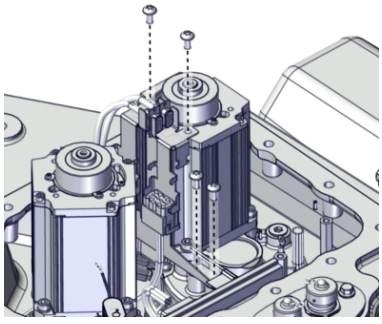
Loosening the telescopic shaft

	Action	Note
1	Remove the upper screws and washers of the telescopic shaft, using a special torque wrench head.	Torque wrench head, closed end: 3HAC063379-001.  xx1900001823

Continues on next page

	Action	Note
2	Loosen the upper end of the telescopic shaft and secure the shaft against a part of the robot with a cable tie. **CAUTION** Put some soft material between the surfaces, to protect them from scratches etc. **Note** Keep the sealing ring and friction shim for refitting.  xx1900001825	 xx2000001022

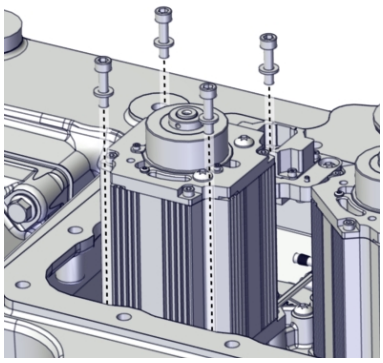
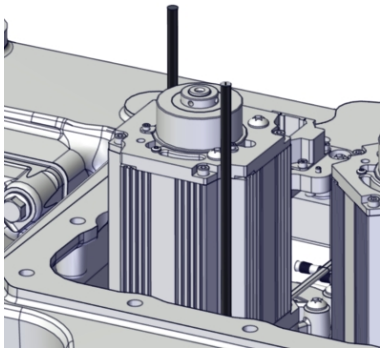
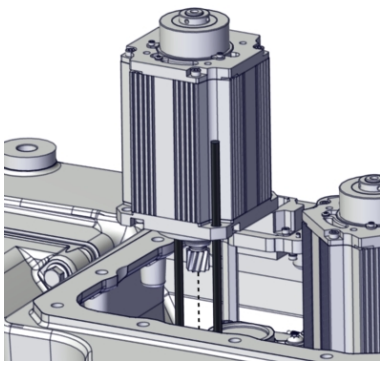
Removing the axis-4 motor

	Action	Note
1	Remove the cable bracket from the motor by removing the four screws.	 xx2000001031
2	Snap loose the connectors from the connector bracket and disconnect the motor connectors.	
3	To release the brakes, connect the 24 VDC power supply. Connect to R3.MP4-connector: • + = pin 2 • - = pin 5	24 VDC power supply

Continues on next page

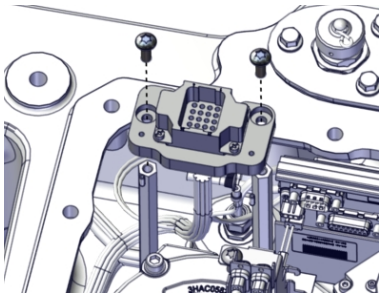
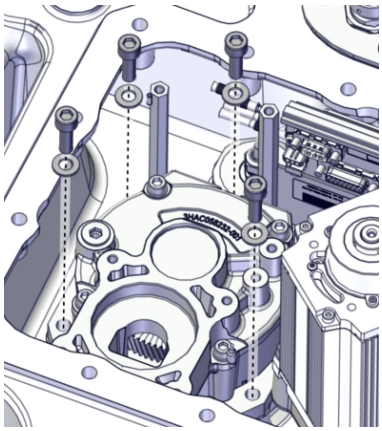
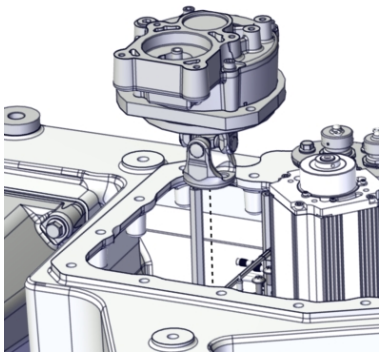
5.6.4 Replacing the axis-4 gear unit pre-stage

Continued

	Action	Note
4	Remove the motor attachment screws and washers.	 xx2000001082
5	Fit guide pins in opposite holes.	Guide pin, M6x150 Always use guide pins in pairs.  xx2000001084
6	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
7	Use caution and lift the motor straight up to get the pinion parted from the gear.	 xx2000001083
8	Disconnect the 24 VDC power supply.	

Continues on next page

Removing the axis-4 gear unit pre-stage

	Action	Note
1	Loosen the holder for connector R1.MP1 and move it out of the way to get access to the gear unit attachment screws.	 xx2000001274
2	Remove the gear unit attachment screws and washers.	 xx2000001275
3	Lift the gear unit out from the base.	 xx2000001276
4	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*. **WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 353* for more information.	
5	Dispose the gear oil in a safe way.	

Continues on next page

5.6.4 Replacing the axis-4 gear unit pre-stage
Continued

Removing the universal joint

	Action	Note
1	Remove the universal joint from the gear unit by removing the screws and washers, using a special torque wrench head. **Note** Keep the sealing ring and friction shim for refitting.	Torque wrench head, closed end: 3HAC063379-001.  xx2000000335

Refitting the motor and gear unit

Use these procedures to refit the axis-4 motor and gear unit.

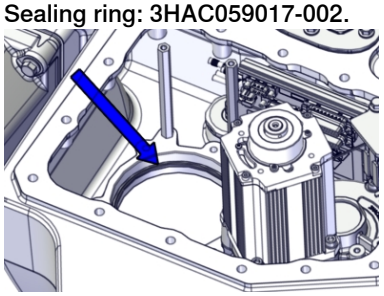
Refitting the universal joint

	Action	Note
1	Clean the friction shim, the sealing ring and the contact surfaces with isopropanol. Inspect for damage. Replace if damaged.	Cleaning agent: Isopropanol. Friction shim: 3HAC060200-001. Sealing ring: 3HAC060263-001.

Continues on next page

	Action	Note
2	Lubricate the screw thread and the washer surface underneath the screw head. Refit the universal joint, friction shim and sealing ring to the gear unit with lubricated screws and washers, using a special torque wrench head. Hold the motor shaft still with an open-end wrench (47 mm) at the joint while tightening the screws. Requires two persons. **Note** Replace the washers with new, for hygienic purpose, if the rubber is damaged.	Anti-seize paste: Molykote P1900 (3HAC070875-002) Sealing ring: 3HAC060263-001. Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: 3HAC058626-004 Tightening torque: 35 Nm.  xx2000000335

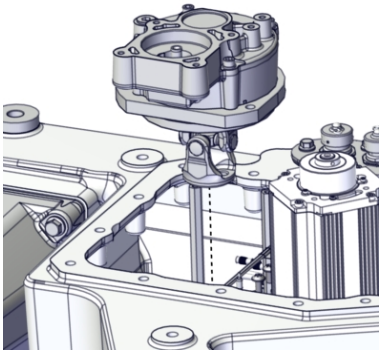
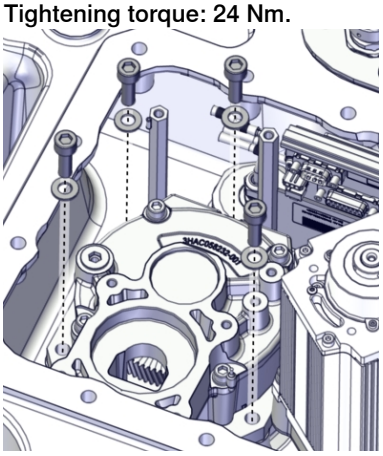
Refitting the axis-4 gear unit pre-stage

	Action	Note
1	Check the sealing ring in the base and make sure it is properly seated on the tab. Replace if damaged.	Sealing ring: 3HAC059017-002.  xx2000000049

Continues on next page

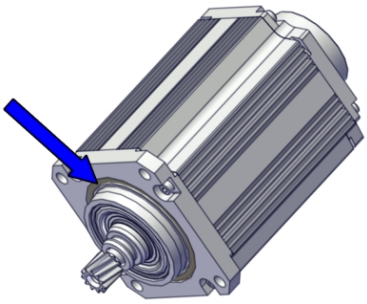
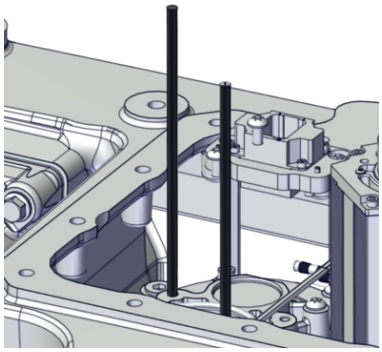
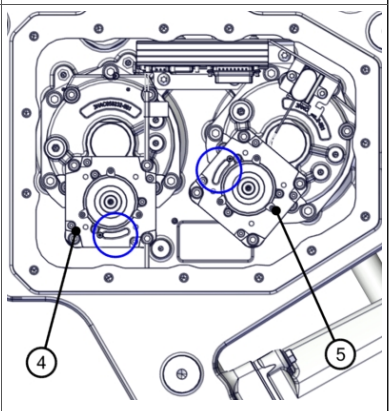
5.6.4 Replacing the axis-4 gear unit pre-stage

Continued

	Action	Note
2	Lift the gear unit into the base. **CAUTION** Risk of pinching! Do not pinch the cabling routed next to the gear unit flange.	Gear unit, pre-stage: 3HAC060588-003.  xx2000001276
3	Secure the unit with attachment screws and washers.	Hex socket head cap screw: M8x25 Steel 8.8-A2F (4 pcs). Plain washer, DIN 125: 8.4x16x1.6 steel-A2F (4 pcs). Tightening torque: 24 Nm.  xx2000001275
4	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
5	Fill oil into the gear unit pre-stage.	Information about the type of lubrication, article number as well as the amount in the specific gearbox can be found in *Technical reference manual - Lubrication in gearboxes* available for registered users on myABB Business Portal, www.abb.com/myABB.

Continues on next page

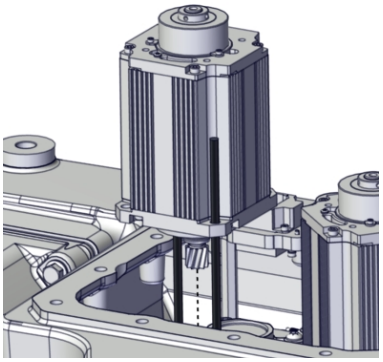
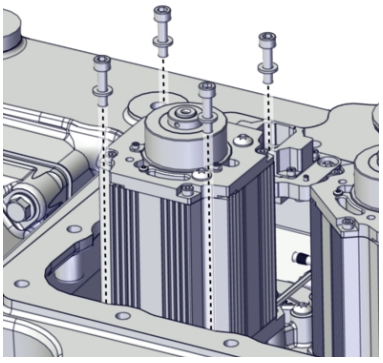
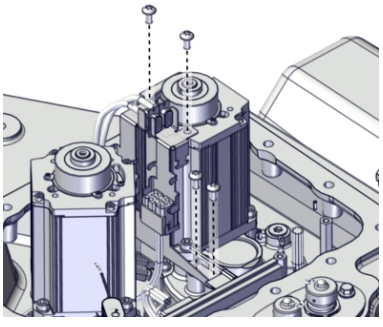
Refitting the axis-4 motor

	Action	Note
1	Check the o-ring. Replace if damaged.	O-ring: 3HAB3772-163.  xx2000001087
2	If not already fitted, fit two guide pins to the motor attachment holes.	Guide pin, M6x150 Always use guide pins in pairs.  xx2000001088
3	To release the brakes, connect the 24 VDC power supply. Connect to R3.MP4-connector: • + = pin 2 • - = pin 5	24 VDC power supply
4	The motors are oriented differently on the axis-4 and axis-5 gear unit assemblies, in regard to the cable outlet on top. Check that the motor is oriented according to the figure before securing the unit, for each axis respectively.	 xx2000001032 • 4: Axis-4 motor • 5: Axis-5 motor

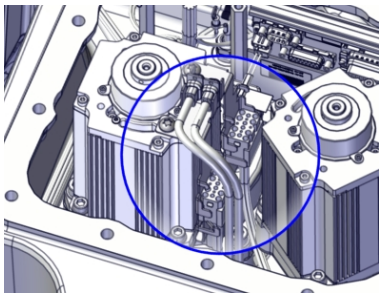
Continues on next page

5.6.4 Replacing the axis-4 gear unit pre-stage

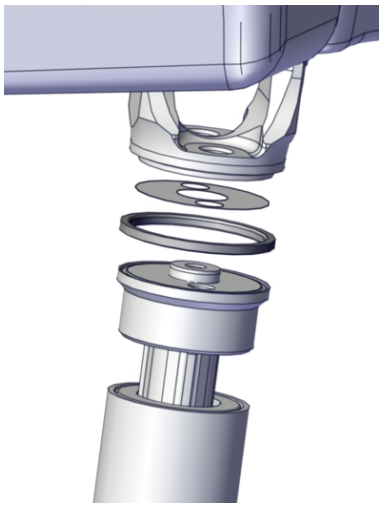
Continued

	Action	Note
5	Lift the motor into the base. Use the rotation tool to rotate the pinion when mating it into the gear.	Rotating AC motor M104 with pinion: 3HAC058581-003. Rotation tool: 3HAB7887-1  xx2000001083
6	Secure the unit with attachment screws and washers.	Hex socket head cap screw: M6x25 Steel 8.8-A2F (4 pcs). Plain washer: 6.4x12x1.6 steel-A2F (4 pcs). Tightening torque: 10 Nm.  xx2000001082
7	Refit the cable bracket to the motor with four screws.	Torx pan head screw: M6x12 Steel 8.8-A2F (4 pcs)  xx2000001031
8	Disconnect the 24 VDC power supply.	

Continues on next page

	Action	Note
9	Connect the motor connectors and fasten the connectors to the connector bracket by snapping them into place.	 xx1900001845

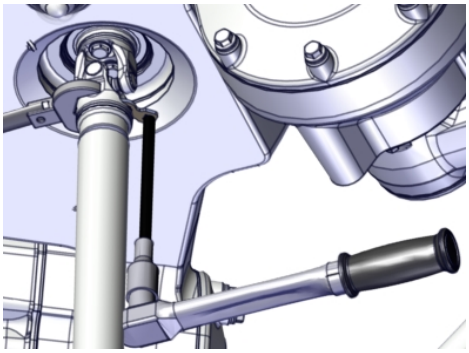
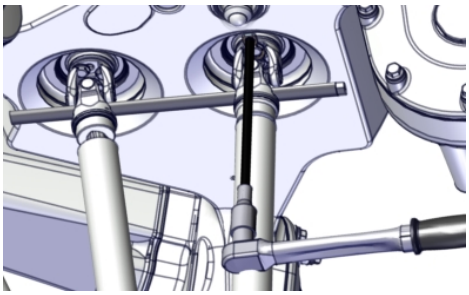
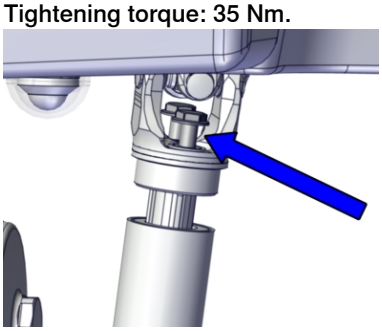
Refitting the upper end of the telescopic shaft

	Action	Note
1	Clean the friction shim, the sealing ring and the contact surfaces with isopropanol. Inspect for damage. Replace if damaged.	Cleaning agent: Isopropanol. Friction shim: 3HAC060200-001. Sealing ring: 3HAC060263-001
2	Fit the upper end of the telescopic shaft by installing the friction shim, sealing ring and the telescopic shaft at the joint. **CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	Telescopic shaft unit: 3HAC059382-003  xx1900001825

Continues on next page

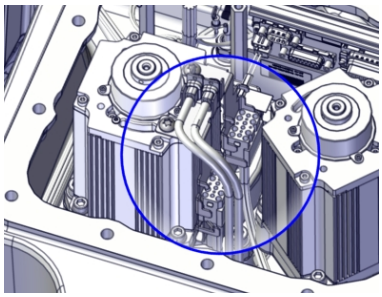
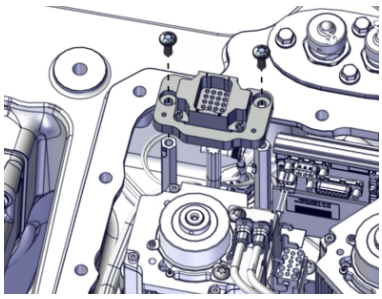
5.6.4 Replacing the axis-4 gear unit pre-stage

Continued

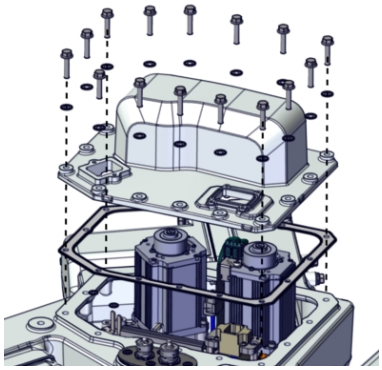
	Action	Note
3	Lubricate the screw thread and the washer surface underneath the screw head. Secure with the lubricated screws and washers and tighten, using the torque wrench head with a closed end. **Tip** The shaft rotates when loosening/fastening the screws. Use one of two alternatives to hold the shaft still: 1 Hold the motor shaft still with an open-end wrench (47 mm) at the joint while loosening/tightening the screws. Requires two persons.  xx2000000346 2 Hold the motor shaft still by inserting a pin through the joints (5-axis robot) or through the joint and against the casting. Choose an appropriate material for the pin, that does not damage the surface of the joints.  xx2000000688 **CAUTION** There is a risk of damage to the joint if not handled with care.	Anti-seize paste: 3HAC070875-002 (Molykote P1900) Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: 3HAC058626-004 Tightening torque: 35 Nm.  xx1900001823

Continues on next page

Reconnecting the cabling

	Action	Note
1	Connect the motor connectors and fasten the connectors to the connector bracket by snapping them into place.	 xx1900001845
2	Secure the cabling and connectors with cable ties.	
3	Refit the holder for connector R1.MP1.	 xx1900001842

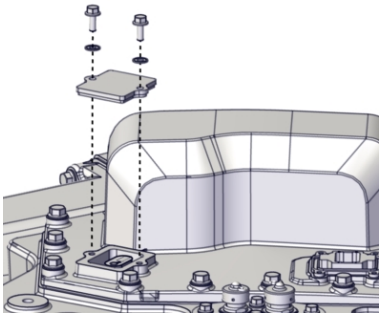
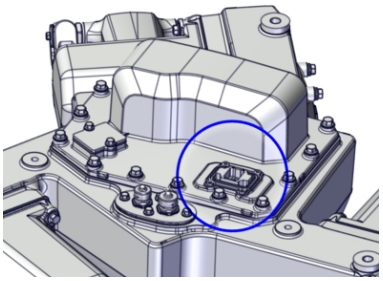
Refitting the top cover

	Action	Note
1	Refit the sealing and tighten the cover with lubricated screws. **CAUTION** Check that the SMB battery does not get squeezed under the cover.	Sealing washer: 3HAC058649-003 Hexagon flange bolt: 3HAC060233-008 (M8x40 stainless steel/A4-80, 15 pcs) Washer: 3HAC058626-004 (M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose., 15 pcs) Anti-seize paste: Molykote P1900 (3HAC070875-002) Tightening torque: 21 Nm.  xx1900000469

Continues on next page

5.6.4 Replacing the axis-4 gear unit pre-stage

Continued

	Action	Note
2	Check that the battery is located correctly in the battery compartment and not pinched under the top cover. Then fasten the battery cover and sealing, with lubricated screws and washers. **Note** Do not overtighten to avoid damaging the sealing.	Tightening torque: 4 Nm. Hexagon flange bolt: 3HAC060233-006 (M6x16 stainless steel/A4-80) Washer: 3HAC058626-003 (M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.) Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx1900000407
3	Reconnect connector R1.MP to the base.	 xx2000001006

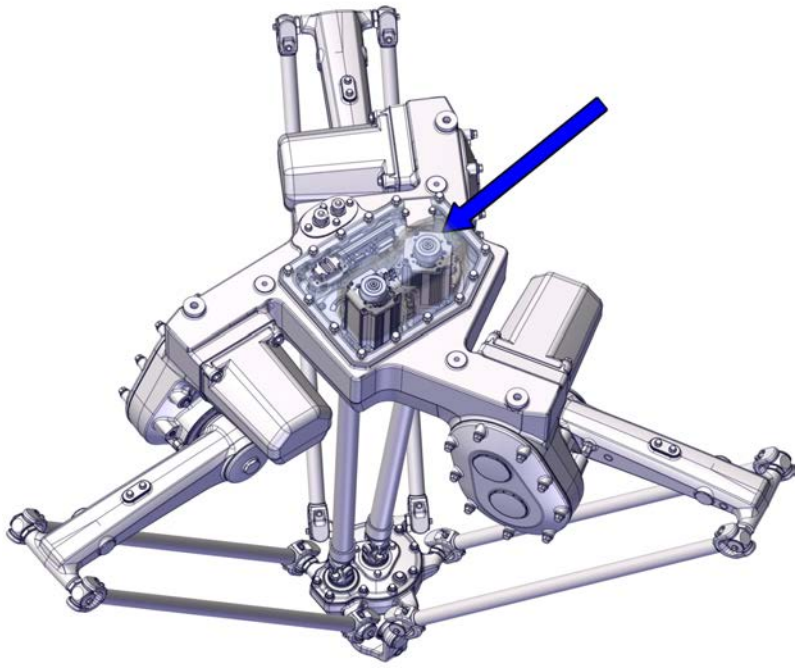
Concluding procedure

	Action	Note
1	Calibrate the robot.	See *Calibration on page 321*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

5.6.5 Replacing the axis-5 gear unit pre-stage

Location of the gear unit

The axis-5 gear unit pre-stage is located as shown in the figure.



xx2000001271

Note

This repair procedure requires sufficient free space above the robot for removal of the top cover and affected spare parts.

Read more about access ways in *Minimum required free space above the robot on page 49*.

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 390 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note	Level
Gear unit, pre-stage	3HAC060588-003	Does not include motor.	L2

Required consumables

Consumable	Article number	Note
Cable ties	-	

Continues on next page

5.6.5 Replacing the axis-5 gear unit pre-stage
Continued

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Anti-seize paste	3HAC070875-002	Molykote P1900
Lubricating oil	-	See *Type and amount of oil in gearboxes on page 113*.

Other spare parts

Following parts are affected during the replacement procedure. Replace if damaged or lost.

Spare part	Article number	Note
Sealing ring	3HAC059017-002	For the gear unit.
Friction shim	3HAC060200-001	Between universal joint and telescopic shaft/base unit/delta unit.
Sealing ring	3HAC060263-001	Between universal joint and telescopic shaft/base unit/delta unit.
Hexagon flange bolt	3HAC058625-001	M8x16 Bumax 109
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Sealing washer	3HAC058649-003	Base unit top cover.
Hexagon flange bolt	3HAC060233-008	M8x40 stainless steel/A4-80
Washer	3HAC058626-004	M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.
Hexagon flange bolt	3HAC060233-006	M6x16 stainless steel/A4-80
Washer	3HAC058626-003	M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.

Required tools and equipment

Equipment	Article number	Note
Torque wrench head, closed end	3HAC063379-001	Included in robot delivery.  xx2000000282 Used with a torque wrench (not included in delivery) to loosen and tighten the universal joint and telescopic shaft screws. Hole interface: 1/4" square.
24 VDC power supply	-	Used to release the motor brakes.

Continues on next page

Equipment	Article number	Note
Guide pin, M6x150	3HAC080345-001	Always use guide pins in pairs.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 361*.

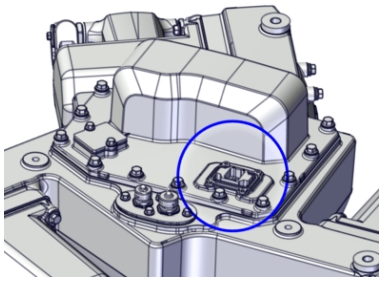
Removing the gear unit pre-stage

Use these procedures to remove the axis-5 gear unit pre-stage.

Preparations before removing the axis-5 gear unit pre-stage

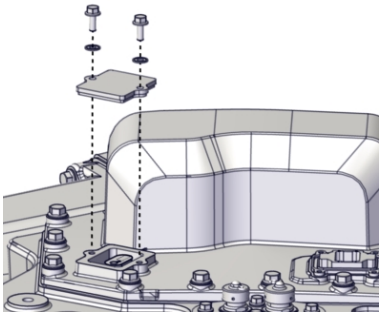
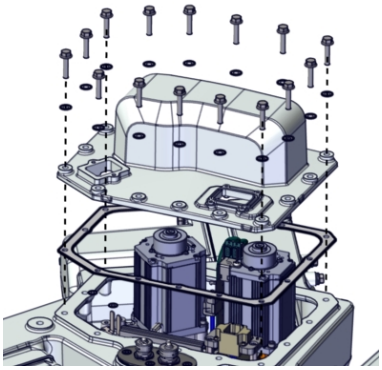
	Action	Note
1	Jog the robot to calibration position.	This is done to facilitate updating of the revolution counter.
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the top cover

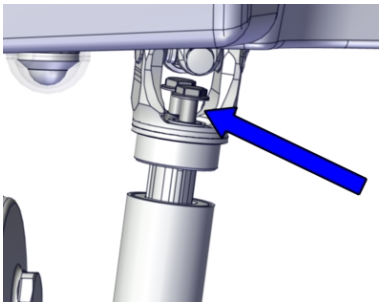
	Action	Note
1	Disconnect connector R1.MP from the base.	 xx2000001006
2	**CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	

Continues on next page

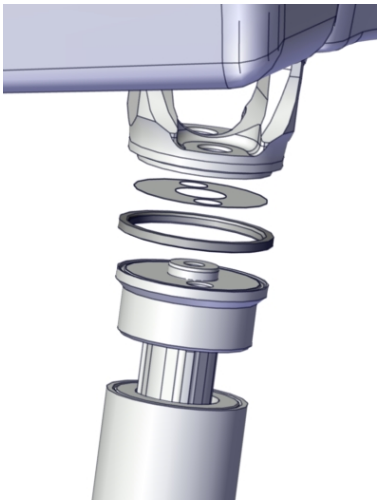
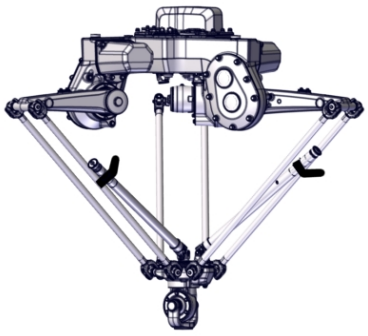
5.6.5 Replacing the axis-5 gear unit pre-stage
Continued

	Action	Note
3	Remove the SMB battery cover. **Tip** The battery cover is removed to see the battery position during refitting of the top cover.	 xx1900000407
4	Remove the cover by removing the screws and washers. Also remove the sealing.	 xx1900000469

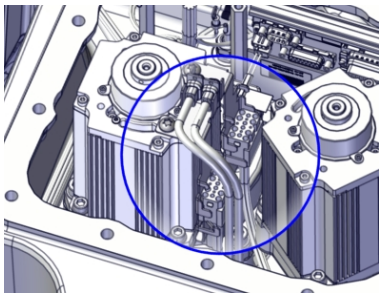
Loosening the telescopic shaft

	Action	Note
1	Remove the upper screws and washers of the telescopic shaft, using a special torque wrench head.	Torque wrench head, closed end: 3HAC063379-001.  xx1900001823

Continues on next page

	Action	Note
2	Loosen the upper end of the telescopic shaft and secure the shaft against a part of the robot with a cable tie. **CAUTION** Put some soft material between the surfaces, to protect them from scratches etc. **Note** Keep the sealing ring and friction shim for refitting.  xx1900001825	 xx2000001022

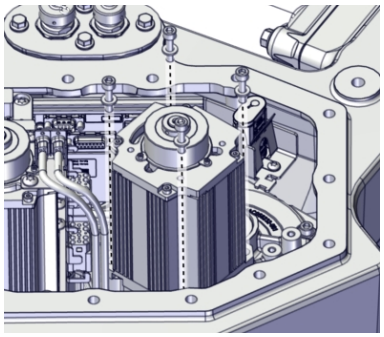
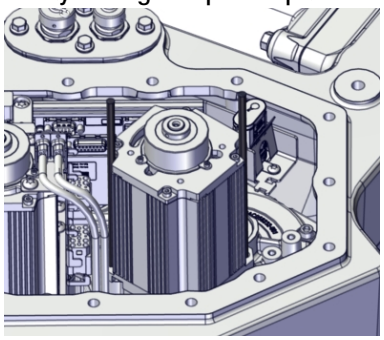
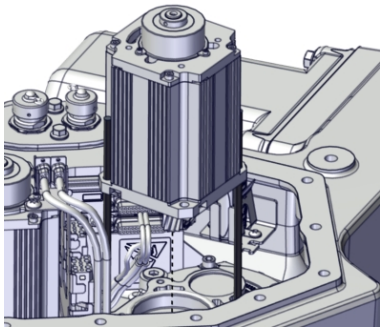
Removing the axis-5 motor

	Action	Note
1	Snap loose the connectors from the connector bracket and disconnect the motor connectors.	 xx1900001845
2	To release the brakes, connect the 24 VDC power supply. Connect to R3.MP5-connector: • + = pin 2 • - = pin 5	24 VDC power supply

Continues on next page

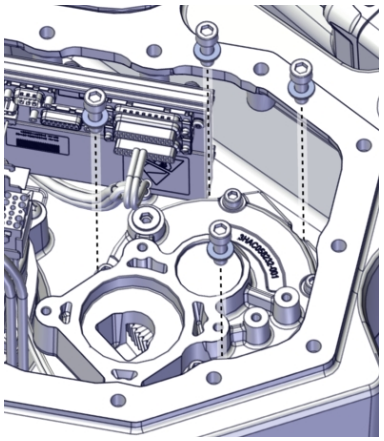
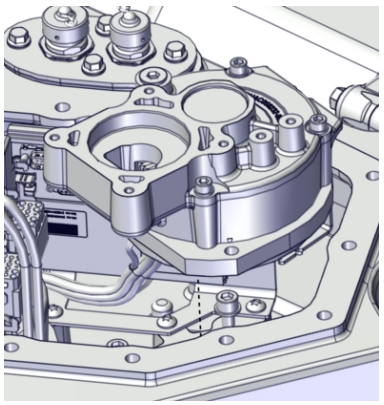
5.6.5 Replacing the axis-5 gear unit pre-stage

Continued

	Action	Note
3	Remove the motor attachment screws and washers.	 xx2000001089
4	Fit guide pins in opposite holes.	Guide pin, M6x150 Always use guide pins in pairs.  xx2000001090
5	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
6	Use caution and lift the motor straight up to get the pinion parted from the gear.	 xx2000001091
7	Disconnect the 24 VDC power supply.	

Continues on next page

Removing the axis-5 gear unit pre-stage

	Action	Note
1	Remove the gear unit attachment screws and washers.	 xx2000001272
2	Lift the gear unit out from the base.	 xx2000001273
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*. **WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 353* for more information.	
4	Dispose the gear oil in a safe way.	

Continues on next page

5.6.5 Replacing the axis-5 gear unit pre-stage
Continued

Removing the universal joint

	Action	Note
1	Remove the universal joint from the gear unit by removing the screws and washers, using a special torque wrench head. **Note** Keep the sealing ring and friction shim for refitting.	Torque wrench head, closed end: 3HAC063379-001.  xx2000000335

Refitting the motor and gear unit

Use these procedures to refit the axis-5 motor and gear unit.

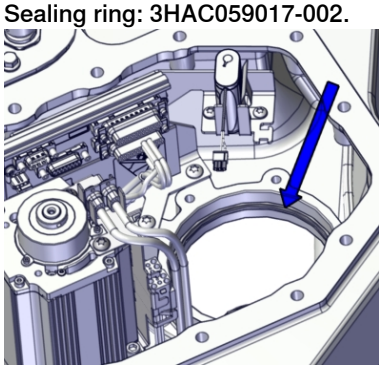
Refitting the universal joint

	Action	Note
1	Clean the friction shim, the sealing ring and the contact surfaces with isopropanol. Inspect for damage. Replace if damaged.	Cleaning agent: Isopropanol. Friction shim: 3HAC060200-001. Sealing ring: 3HAC060263-001.

Continues on next page

	Action	Note
2	Lubricate the screw thread and the washer surface underneath the screw head. Refit the universal joint, friction shim and sealing ring to the gear unit with lubricated screws and washers, using a special torque wrench head. Hold the motor shaft still with an open-end wrench (47 mm) at the joint while tightening the screws. Requires two persons. **Note** Replace the washers with new, for hygienic purpose, if the rubber is damaged.	Anti-seize paste: Molykote P1900 (3HAC070875-002) Sealing ring: 3HAC060263-001. Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: 3HAC058626-004 Tightening torque: 35 Nm.  xx2000000335

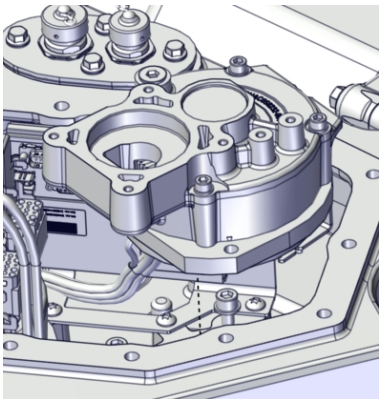
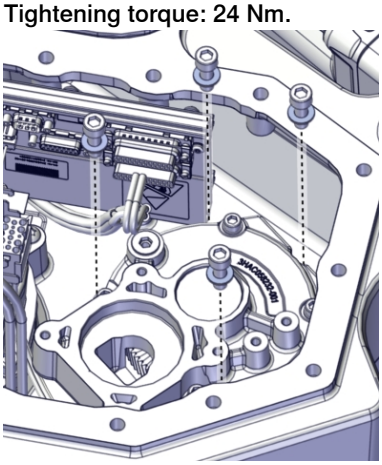
Refitting the axis-5 gear unit pre-stage

	Action	Note
1	Check the sealing ring in the base and make sure it is properly seated on the tab. Replace if damaged.	Sealing ring: 3HAC059017-002.  xx2000000055

Continues on next page

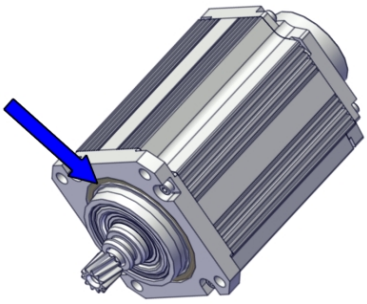
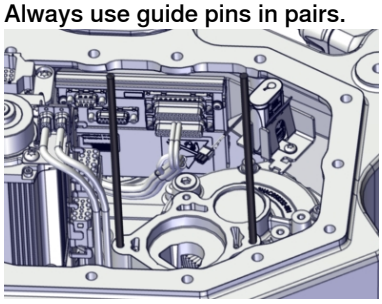
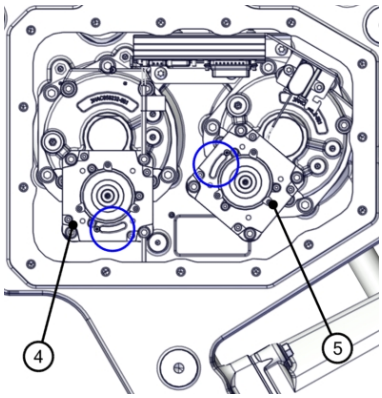
5.6.5 Replacing the axis-5 gear unit pre-stage

Continued

	Action	Note
2	Lift the gear unit into the base. **CAUTION** Risk of pinching! Do not pinch the cabling routed next to the gear unit flange.	Gear unit, pre-stage: 3HAC060588-003.  xx2000001273
3	Secure the unit with attachment screws and washers.	Hex socket head cap screw: M8x25 Steel 8.8-A2F (4 pcs). Plain washer, DIN 125: 8.4x16x1.6 steel-A2F (4 pcs). Tightening torque: 24 Nm.  xx2000001272
4	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
5	Fill oil into the gear unit pre-stage.	Information about the type of lubrication, article number as well as the amount in the specific gearbox can be found in *Technical reference manual - Lubrication in gearboxes* available for registered users on myABB Business Portal, *www.abb.com/myABB*.

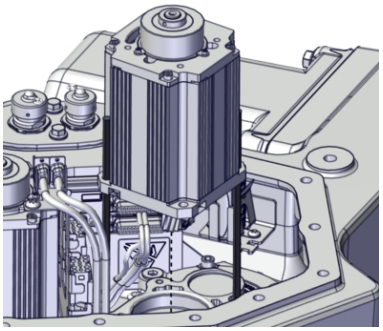
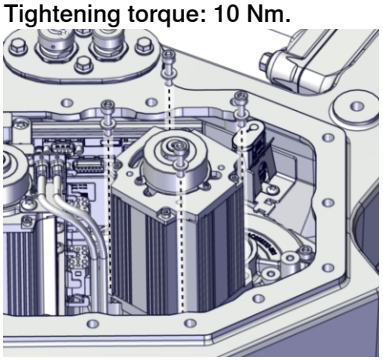
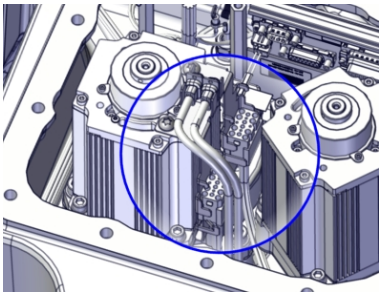
Continues on next page

Refitting the axis-5 motor

	Action	Note
1	Check the o-ring. Replace if damaged.	O-ring: 3HAB3772-163.  xx2000001087
2	If not already fitted, fit two guide pins to the motor attachment holes.	Guide pin, M6x150 Always use guide pins in pairs.  xx2000001092
3	To release the brakes, connect the 24 VDC power supply. Connect to R3.MP5-connector: • + = pin 2 • - = pin 5	24 VDC power supply
4	The motors are oriented differently on the axis-4 and axis-5 gear unit assemblies, in regard to the cable outlet on top. Check that the motor is oriented according to the figure before securing the unit, for each axis respectively.	 xx2000001032 • 4: Axis-4 motor • 5: Axis-5 motor

Continues on next page

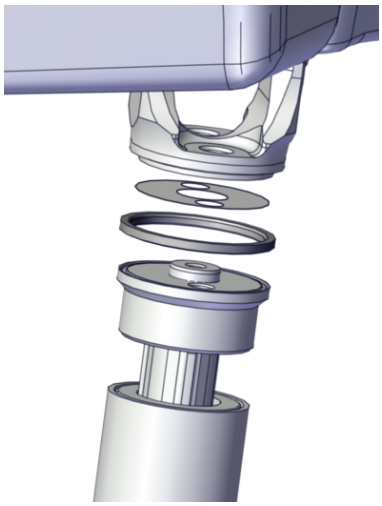
5.6.5 Replacing the axis-5 gear unit pre-stage
Continued

	Action	Note
5	Lift the motor into the base. Use the rotation tool to rotate the pinion when mating it into the gear.	Rotating AC motor M104 with pinion: 3HAC058581-003. Rotation tool: 3HAB7887-1  xx2000001091
6	Secure the unit with attachment screws and washers.	Hex socket head cap screw: M6x25 Steel 8.8-A2F (4 pcs). Plain washer: 6.4x12x1.6 steel-A2F (4 pcs). Tightening torque: 10 Nm.  xx2000001089
7	Disconnect the 24 VDC power supply.	
8	Connect the motor connectors and fasten the connectors to the connector bracket by snapping them into place.	 xx1900001845

Refitting the upper end of the telescopic shaft

	Action	Note
1	Clean the friction shim, the sealing ring and the contact surfaces with isopropanol. Inspect for damage. Replace if damaged.	Cleaning agent: Isopropanol. Friction shim: 3HAC060200-001. Sealing ring: 3HAC060263-001

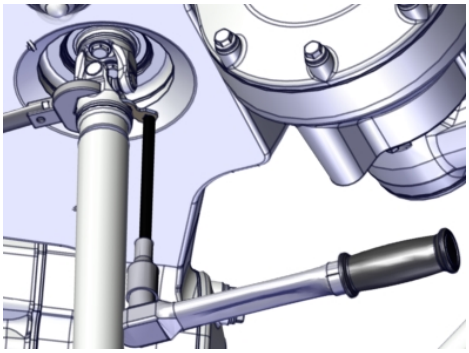
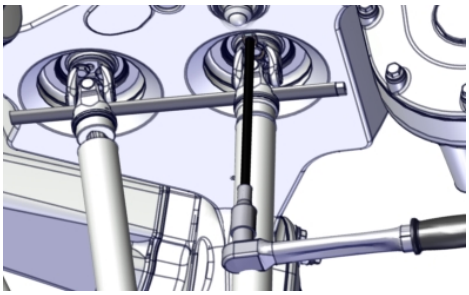
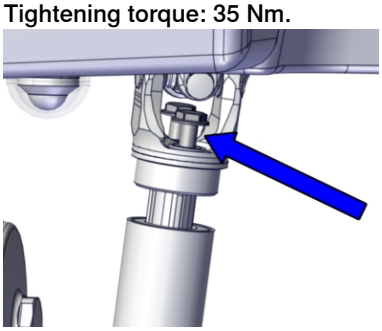
Continues on next page

	Action	Note
2	Fit the upper end of the telescopic shaft by installing the friction shim, sealing ring and the telescopic shaft at the joint. **CAUTION** The telescopic shaft must be oriented correctly, otherwise it is damaged. Always fit the narrow shaft part up against the base unit.	Telescopic shaft unit: 3HAC059382-003  xx1900001825

Continues on next page

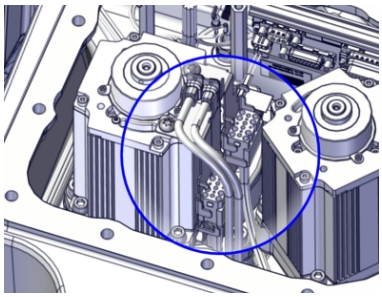
5.6.5 Replacing the axis-5 gear unit pre-stage

Continued

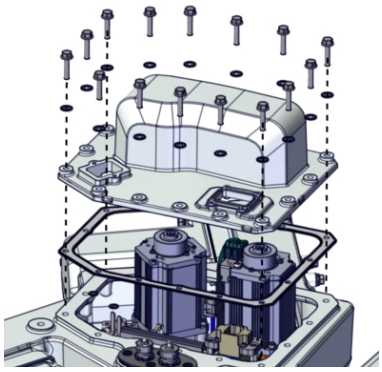
	Action	Note
3	Lubricate the screw thread and the washer surface underneath the screw head. Secure with the lubricated screws and washers and tighten, using the torque wrench head with a closed end. **Tip** The shaft rotates when loosening/fastening the screws. Use one of two alternatives to hold the shaft still: 1 Hold the motor shaft still with an open-end wrench (47 mm) at the joint while loosening/tightening the screws. Requires two persons.  xx2000000346 2 Hold the motor shaft still by inserting a pin through the joints (5-axis robot) or through the joint and against the casting. Choose an appropriate material for the pin, that does not damage the surface of the joints.  xx2000000688 **CAUTION** There is a risk of damage to the joint if not handled with care.	Anti-seize paste: 3HAC070875-002 (Molykote P1900) Torque wrench head, closed end: 3HAC063379-001. Hexagon flange bolt: 3HAC058625-001 Washer: 3HAC058626-004 Tightening torque: 35 Nm.  xx1900001823

Continues on next page

Reconnecting the cabling

	Action	Note
1	Connect the motor connectors and fasten the connectors to the connector bracket by snapping them into place.	 xx1900001845

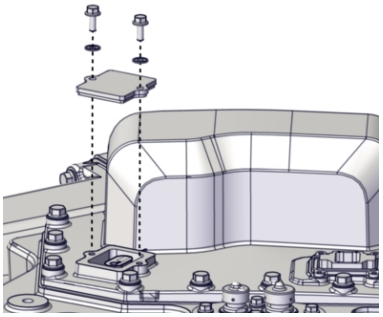
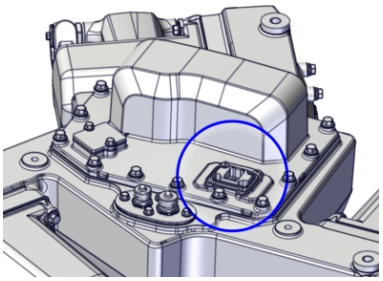
Refitting the top cover

	Action	Note
1	Refit the sealing and tighten the cover with lubricated screws. **CAUTION** Check that the SMB battery does not get squeezed under the cover.	Sealing washer: 3HAC058649-003 Hexagon flange bolt: 3HAC060233-008 (M8x40 stainless steel/A4-80, 15 pcs) Washer: 3HAC058626-004 (M8 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose., 15 pcs) Anti-seize paste: Molykote P1900 (3HAC070875-002) Tightening torque: 21 Nm.  xx1900000469

Continues on next page

5.6.5 Replacing the axis-5 gear unit pre-stage

Continued

	Action	Note
2	Check that the battery is located correctly in the battery compartment and not pinched under the top cover. Then fasten the battery cover and sealing, with lubricated screws and washers. **Note** Do not overtighten to avoid damaging the sealing.	Tightening torque: 4 Nm. Hexagon flange bolt: 3HAC060233-006 (M6x16 stainless steel/A4-80) Washer: 3HAC058626-003 (M6 hygienic. If the rubber is damaged, replace the washer with new for hygienic purpose.) Anti-seize paste: 3HAC070875-002 (Molykote P1900)  xx1900000407
3	Reconnect connector R1.MP to the base.	 xx2000001006

Concluding procedure

	Action	Note
1	Calibrate the robot.	See *Calibration on page 321*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

6 Calibration

6.1 Introduction to calibration

6.1.1 Introduction and calibration terminology

Calibration information

This chapter includes general information about the recommended calibration methods and also the detailed procedures for updating the revolution counters, checking the calibration position etc.

Detailed instructions of how to perform Axis Calibration are given on the FlexPendant during the calibration procedure. To prepare calibration with Axis Calibration method, see *Calibrating with Axis Calibration method on page 330*.

Calibration terminology

Term	Definition
Calibration method	A collective term for several methods that might be available for calibrating the ABB robot. Each method contains calibration routines.
Synchronization position	Known position of the complete robot where the angle of each axis can be checked against visual synchronization marks.
Calibration position	Known position of the complete robot that is used for calibration of the robot.
Standard calibration	A generic term for all calibration methods that aim to move the robot to calibration position.
Fine calibration	A calibration routine that generates a new zero position of the robot.
Reference calibration	A calibration routine that in the first step generates a reference to current zero position of the robot. The same calibration routine can later on be used to recalibrate the robot back to the same position as when the reference was stored. This routine is more flexible compared to fine calibration and is used when tools and process equipment are installed. Requires that a reference is created before being used for recalibrating the robot. Requires that the robot is dressed with the same tools and process equipment during calibration as during creation of the reference values.
Update revolution counter	A calibration routine to make a rough calibration of each manipulator axis.
Synchronization mark	Visual marks on the robot axes. When marks are aligned, the robot is in synchronization position.

6.1.2 Calibration methods

Overview

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

Types of calibration

Type of calibration	Description	Calibration method
Standard calibration	The calibrated robot is positioned at calibration position. Standard calibration data is found on the SMB (serial measurement board) or EIB in the robot.	Axis Calibration

Brief description of calibration methods

Axis Calibration method

Axis Calibration is a standard calibration method for calibration of IRB 390. It is the recommended method in order to achieve proper performance.

The following routines are available for the Axis Calibration method:

- Fine calibration
- Update revolution counters
- Reference calibration

The calibration equipment for Axis Calibration is delivered as a toolkit.

An introduction to the calibration method is given in this manual, see *Calibrating with Axis Calibration method on page 330*.

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.

References

Article numbers for the calibration tools are listed in the section *Special tools on page 362*.

6.1.3 When to calibrate

When to calibrate

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

The resolver values are changed

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

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

The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See *Updating revolution counters on page 326*. This will occur when:

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

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

The robot is rebuilt

If the robot is rebuilt, for example, after a crash or when the reachability of a robot is changed, it needs to be re-calibrated for new resolver values.

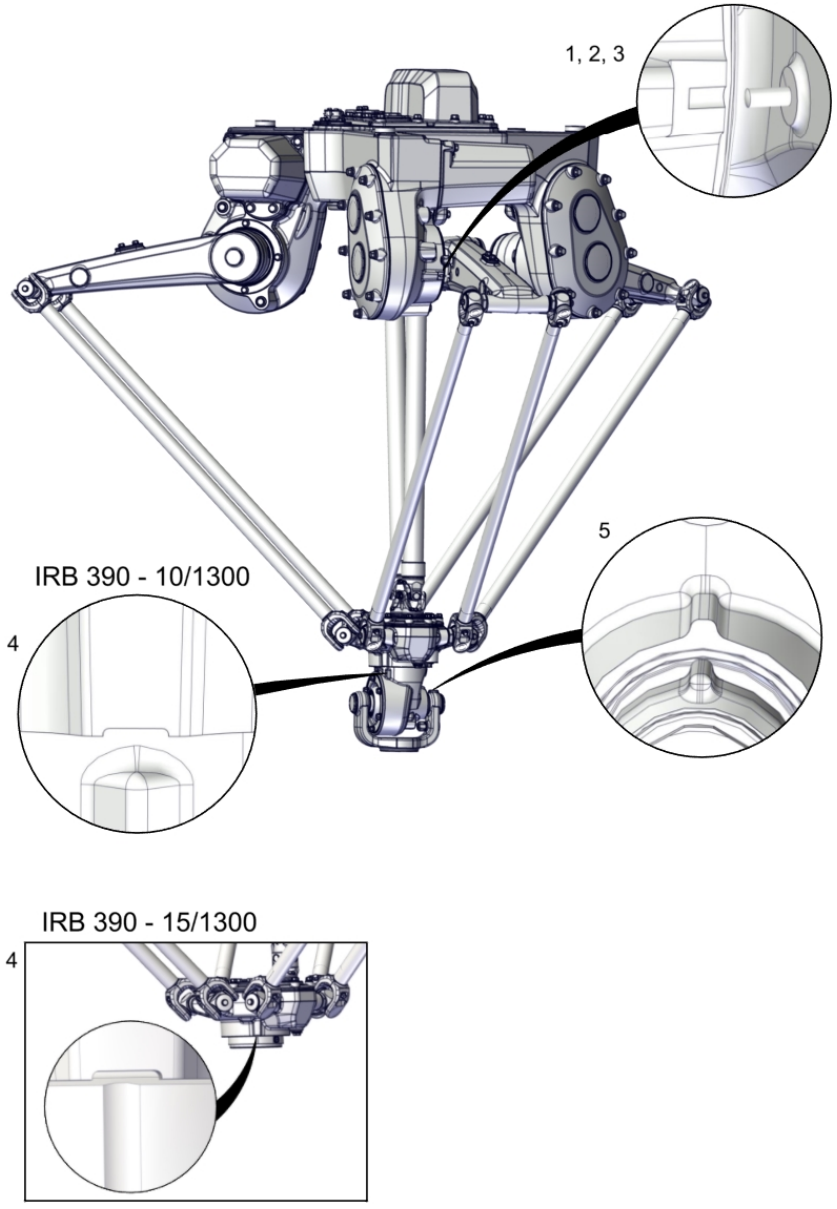
6.2 Synchronization marks and axis movement directions

6.2.1 Synchronization marks and synchronization position for axes

Introduction

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

Synchronization marks, IRB 390



xx2000000004

6.2.2 Calibration movement directions for all axes

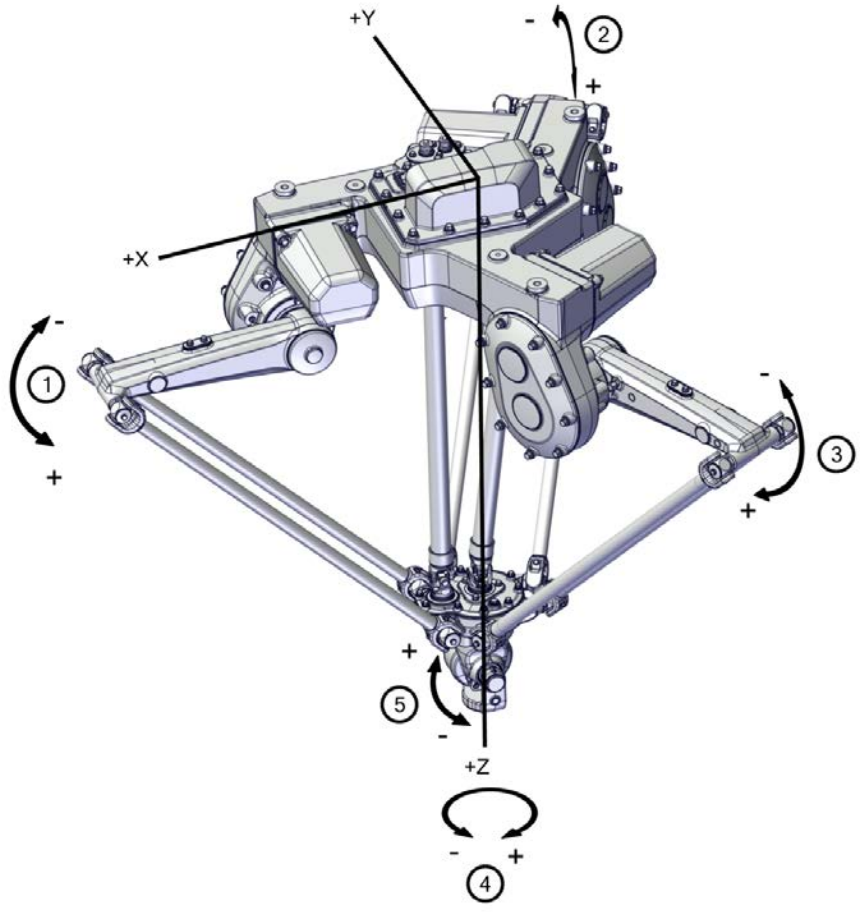
Overview

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

Calibration service routines will handle the calibration movements automatically and these might be different from the positive directions shown below.

Calibration movement and jogging directions

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



xx2000000006

6.3 Updating revolution counters

6.3.1 Updating revolution counters on IRC5 robots

Introduction

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

Step 1 - Manually running the manipulator to the synchronization position

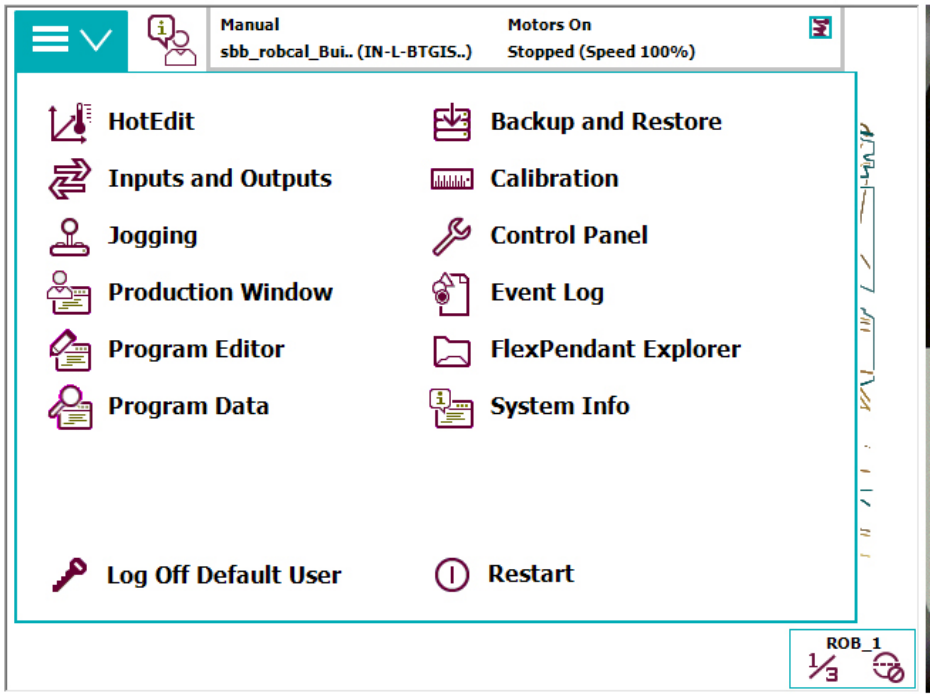
Use this procedure to manually run the manipulator to the synchronization position.

	Action	Note
1	Select axis-by-axis motion mode.	
2	Jog the manipulator to align the synchronization marks.	See *Synchronization marks and synchronization position for axes on page 324*.
3	When all axes are positioned, update the revolution counter.	*Step 2 - Updating the revolution counter with the FlexPendant on page 326*.

Step 2 - Updating the revolution counter with the FlexPendant

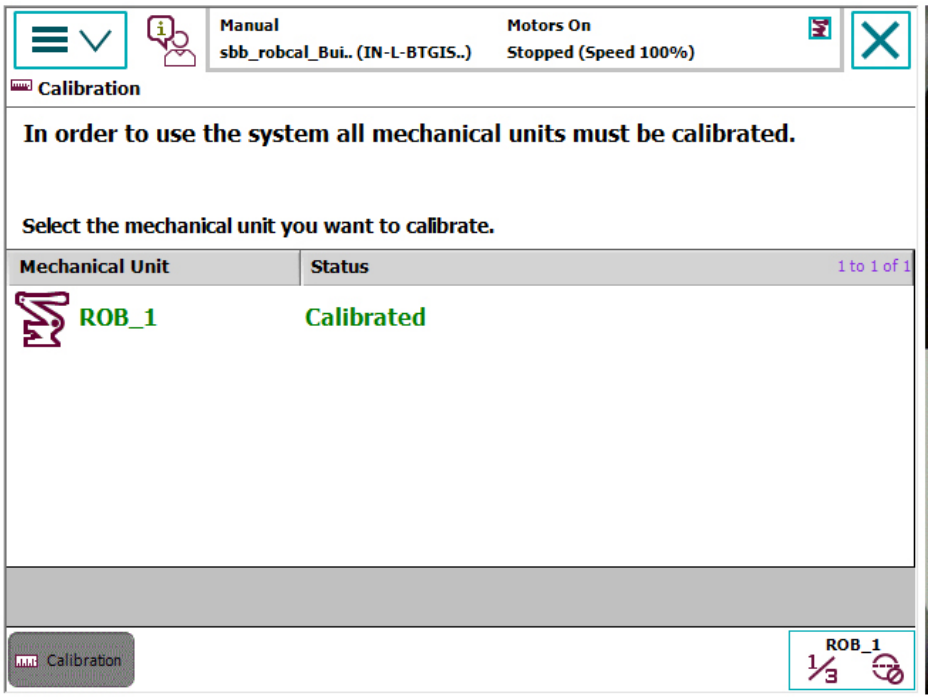
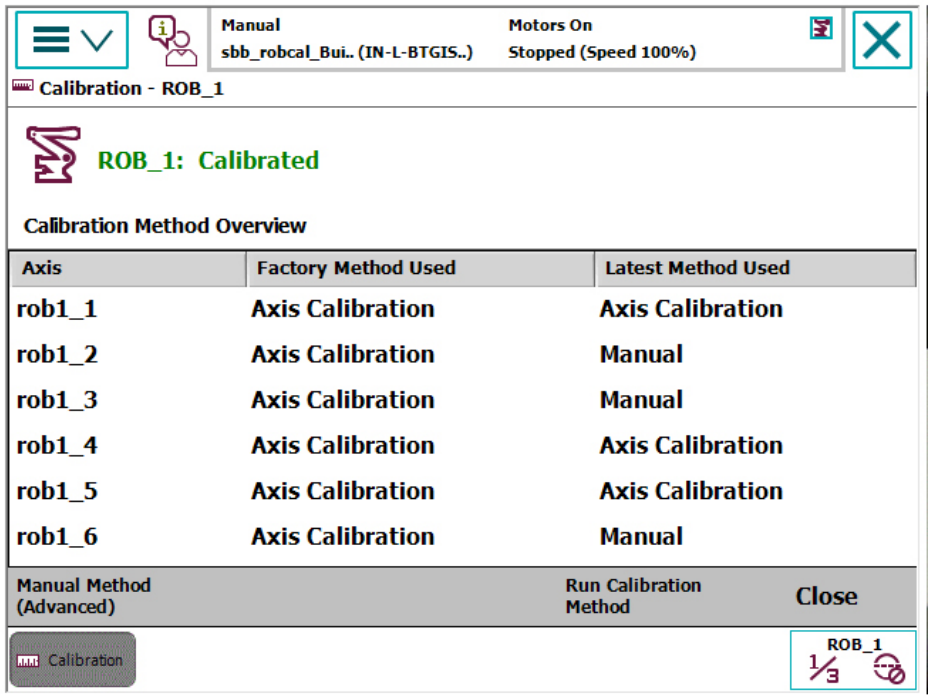
Use this procedure to update the revolution counter with the FlexPendant (IRC5).

	Action
1	On the **ABB** menu, tap **Calibration**.



xx1500000942

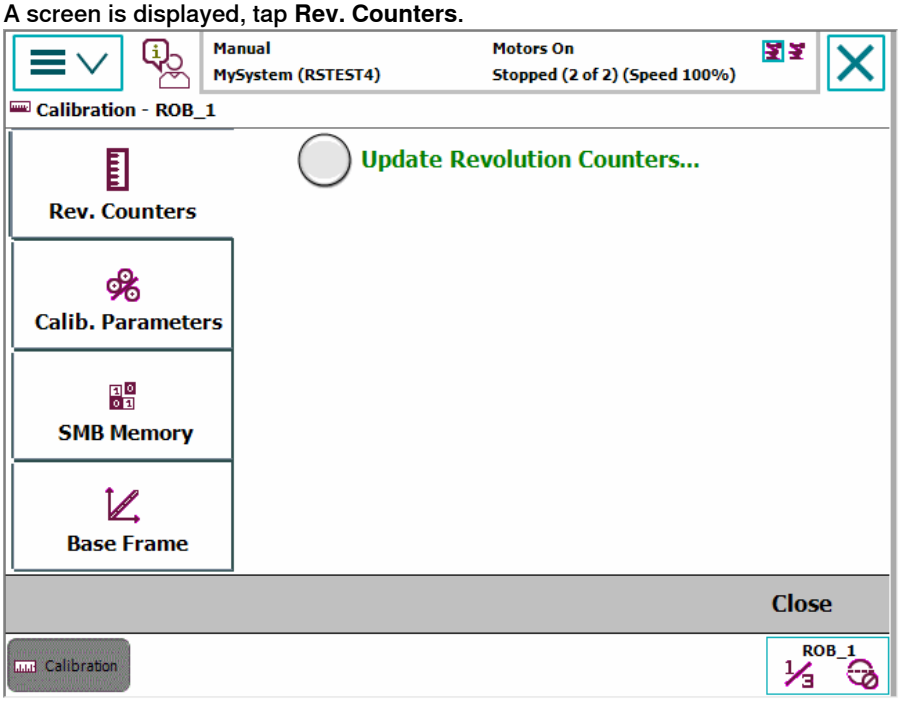
Continues on next page

	Action
2	All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.  xx1500000943
3	**This step is valid for RobotWare 6.02 and later.** Calibration method used at factory for each axis is shown, as well as calibration method used during last field calibration. Tap **Manual Method (Advanced)**.  xx1500000944

Continues on next page

6.3.1 Updating revolution counters on IRC5 robots

Continued

	Action
4	A screen is displayed, tap **Rev. Counters**.  en0400000771
5	Tap **Update Revolution Counters...**. A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions: • Tap **Yes** to update the revolution counters. • Tap **No** to cancel updating the revolution counters. Tapping **Yes** displays the axis selection window.
6	Select the axis to have its revolution counter updated by: • Ticking in the box to the left • Tapping **Select all** to update all axes. Then tap **Update**.
7	A dialog box is displayed, warning that the updating operation cannot be undone: • Tap **Update** to proceed with updating the revolution counters. • Tap **Cancel** to cancel updating the revolution counters. Tapping **Update** updates the selected revolution counters and removes the tick from the list of axes.
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 *Checking the synchronization position on page 344*.

6.3.2 Updating revolution counters on OmniCore robots

Introduction

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

Step 1 - Manually running the manipulator to the synchronization position

Use this procedure to manually run the manipulator to the synchronization position.

	Action	Note
1	Select axis-by-axis motion mode.	
2	Jog the manipulator to align the synchronization marks.	See *Synchronization marks and synchronization position for axes on page 324*.
3	When all axes are positioned, update the revolution counter.	*Step 2 - Updating the revolution counter with the FlexPendant on page 329*.

Step 2 - Updating the revolution counter with the FlexPendant

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

	Action
1	On the start screen, tap **Calibrate**. The calibration summary page for the mechanical unit is displayed.
2	In the **Calibration Methods** menu, select **Revolution Counters**.
3	In the **Selection** column select the axes for which revolution counters need to be updated.
4	Tap **Update**. A dialog box is displayed warning that the updating operation cannot be undone.
5	Tap **OK** to update the revolution counter.
6	**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 *Checking the synchronization position on page 344*.

6.4 Calibrating with Axis Calibration method

6.4.1 Description of Axis Calibration

Instructions for Axis Calibration procedure given 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.

This manual contains a brief description of the method, additional information to the information given on the FlexPendant, article number for the tools and images of where to fit the calibration tools on the robot.

Overview of the Axis Calibration procedure

The Axis Calibration procedure applies to all axes, and is performed on one axis at the time. The robot axes are both manually and automatically moved into position, as instructed on the FlexPendant.

A fixed calibration pin/bushing is installed on each robot axis at delivery.

The Axis Calibration procedure described roughly:

1 A removable calibration tool is inserted by the operator into a calibration bushing on the axis chosen for calibration, according to instructions on the FlexPendant.

> **WARNING**
>
> Calibrating the robot with Axis Calibration requires special calibration tools from ABB. Using other pins in the calibration bushings may cause severe damage to the robot and/or personnel.

> **WARNING**
>
> The calibration tool must be fully inserted into the calibration bushing, until the steel spring ring snaps into place.

2 During the calibration procedure, RobotWare moves the robot axis chosen for calibration so that the calibration tools get into contact. RobotWare records values of the axis position and repeats the coming-in-contact procedure several times to get an exact value of the axis position.

> **WARNING**
>
> Risk of pinching! The contact force for large robots can be up to 150 kg. Keep a safe distance to the robot.

3 The axis position is stored in RobotWare with an active choice from the operator.

Continues on next page

Routines in the calibration procedure

The following routines are available in the Axis Calibration procedure, given at the beginning of the procedure on the FlexPendant.

Fine calibration routine

Choose this routine to calibrate the robot when there are no tools, process cabling or equipment fitted to the robot.

Reference calibration routine

Choose this routine to create reference values and to calibrate the robot when the robot is dressed with tools, process cabling or other equipment.

> **Note**
>
> When calibrating the robot with the reference calibration routine, the robot must be dressed with the same tools, process cabling and any other equipment as when the reference values were created.

> **Note**
>
> When using reference calibration with some tools, typically large or flexible tools, oscillations in the robot can cause issues leading to failure of the calibration.

If calibrating the robot with reference calibration there must be reference values created before repair is made to the robot, if values are not already available. Creating new values requires possibility to move the robot. The reference values contain positions of all axes, torque of axes and technical data about the tool installed. A benefit with reference calibration is that the current state of the robot is stored and not the state when the robot left the ABB factory. The reference value will be named according to tool name, date etc.

Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.

When reference calibration is performed, the robot is restored to the status given by the reference values.

Update revolution counters

Choose this routine to make a rough calibration of each manipulator axis by updating the revolution counter for each axis, using the FlexPendant.

Validation

In the mentioned routines, it is also possible to validate the calibration data.

Position of robot axes

The robot axes should be positioned close to 0 degrees before commencing the calibration program. The axis chosen for calibration is then automatically run by the calibration program to its exact calibration position during the calibration procedure.

It is possible to position some of the other axes in positions different from 0 degrees. Information about which axes are allowed to be jogged is given on the FlexPendant.

Continues on next page

6.4.1 Description of Axis Calibration
Continued

These axes are marked with **Unrestricted** in the FlexPendant window. Also the following table shows the dependencies between the axes.

Requirements for axis positioning during calibration

	Axis to calibrate					
Required position of axis	**Axis 1**	**Axis 2**	**Axis 3**	**Axis 4**	**Axis 5**	**Axis 6**
Axis 1	-	X	X	*	*	
Axis 2	X	-	X	*	*	
Axis 3	X	X	-	*	*	
Axis 4	*	*	*	-	0	
Axis 5	*	*	*	*	-	

-	Axis to be calibrated
*	Unrestricted. Axis is allowed to be jogged to other position than 0 degrees.
0	Axis must be put in position 0 degrees.
X	Special requirement

System containing SafeMove

SafeMove will lose its synchronization to the controller if a new calibration is done. New calibration values have to be downloaded to SafeMove, and a new SafeMove calibration has to be done. Make sure that the user rights admit to change the safety settings and to synchronize SafeMove.

For robots with EPS, the same applies as for SafeMove.

6.4.2 Calibration tools for Axis Calibration

Calibration tool set

The calibration tools used for Axis Calibration are designed to meet requirements for calibration performance, durability and safety in case of accidental damage.

The calibration tool will eventually break from fatigue after longer period of use and then needs to be replaced. There is no risk for bad calibrations as long as the calibration tool is in one piece.

WARNING

Calibrating the robot with Axis Calibration requires special calibration tools from ABB. Using other pins in the calibration bushings may cause severe damage to the robot and/or personnel.

Equipment, etc.	Article number	Note
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.

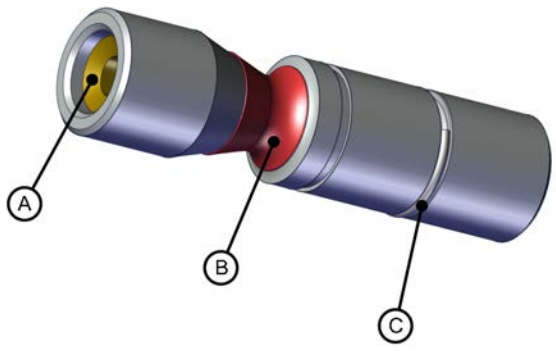
Examining the calibration tool

Check prior to usage

Before using the calibration tool, make sure that the tube insert, the plastic protection and the steel spring ring are present.

WARNING

If any part is missing or damaged, the tool must be replaced immediately.



xx1500001914

A	Tube insert
B	Plastic protection
C	Steel spring ring

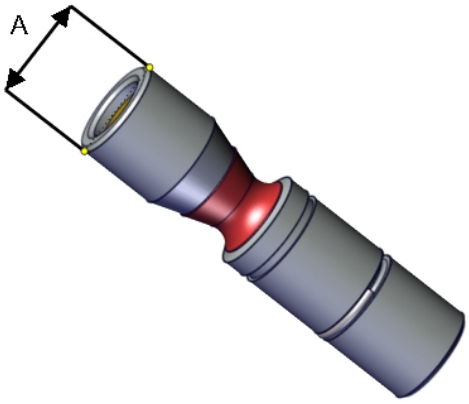
Continues on next page

6.4.2 Calibration tools for Axis Calibration
Continued

Periodic check of the calibration tool

If including the calibration tool in a local periodic check system, the following measures should be checked.

- Outer diameter within Ø12g4 mm, Ø8g4 mm or Ø6g5 mm (depending on calibration tool size).
- Straightness within 0.005 mm.



xx1500000951

A	Outer diameter

Identifying the calibrating tools

It is possible to make the calibration tool identifiable with, for example, an RFID chip. The procedure of how to install an RFID chip is described below.

Note

The tool identifier is NOT delivered from ABB, it is a customized solution.

	Action	Note
1	It is possible to use any RFID solution, with the correct dimensions. ABB has verifed function on some suppliers fulfilling the requirements of NFC compatible devices (13.56 Mhz) according to ISO 14443 or ISO 15693. **Note** The maximum dimensions on the RFID chip must not exceed Ø7.9 mm x 8.0 mm, Ø5.9 mm x 8.0 mm or Ø3.9 mm x 8.0 mm (depending on calibration tool size).	
2	There is a cavity on one end of the calibration tool in which the RFID chip can be installed. Install the RFID chip according to supplier instructions. Install the chip in flush with the tool end.	

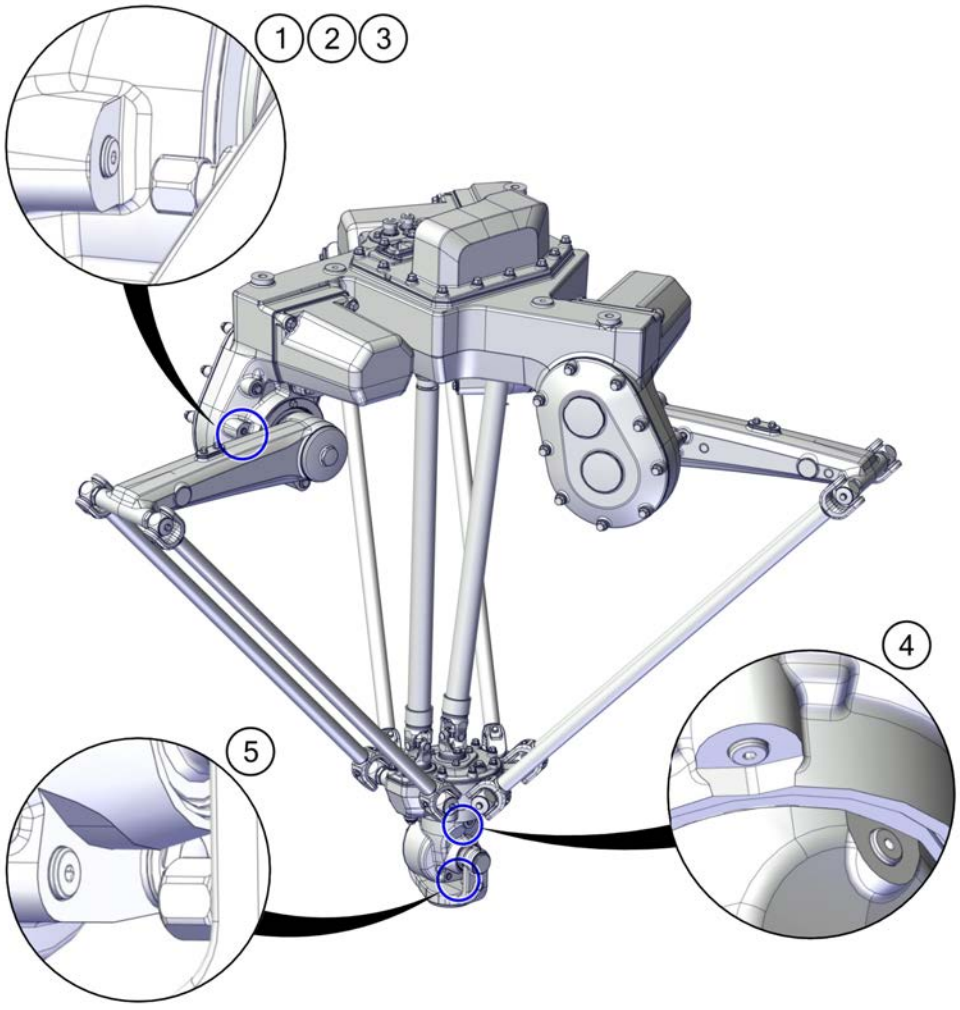
6.4.3 Installation locations for the calibration tools

Location of fixed calibration items

This section shows how the robot is equipped with items for installation of calibration tools for Axis Calibration (fixed calibration pins and/or bushings). Installed calibration tools are not shown.

A fixed calibration pin and a bushing for the movable calibration tool are located on each axis as follows.

If there is not enough space on an axis to install a fixed calibration pin, the axis is equipped with two bushings instead, for installation of two calibration tools when calibration is carried out. This is shown in the figure.



xx2000000025

Continues on next page

6.4.3 Installation locations for the calibration tools
Continued

Spare parts

When calibration is not being performed, a protective cover and an o-ring should always be installed on the fixed calibration pin as well as a protective plug, included a sealing, in the bushing. Replace damaged parts with new.

Spare part	Article number	Note
Protection cover and plug set	3HAC056806-001	Contains replacement calibration pin covers and protective plugs for the bushing.

6.4.4 Axis Calibration - Running the calibration procedure

Required tools

The calibration tools used for Axis Calibration are designed to meet requirements for calibration performance, durability and safety in case of accidental damage.

WARNING

Calibrating the robot with Axis Calibration requires special calibration tools from ABB. Using other pins in the calibration holes may cause severe damage to the robot and/or personnel.

Equipment, etc.	Article number	Note
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools.

Required consumables

Consumable	Article number	Note
Clean cloth	-	

Spare parts

Spare part	Article number	Note
Protection cover and plug set	3HAC056806-001	Contains replacement calibration pin covers and protective plugs for the bushing.

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.

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

1. Choose calibration routine. The routines are described in *Routines in the calibration procedure on page 331*.
2. Choose which axis/axes to calibrate.
3. The robot moves to synchronization position.
4. Validate the synchronization marks.
5. The robot moves to preparation position.
6. Remove the protective cover from the fixed pin and the protection plug from the bushing, if any, and install the calibration tool.
7. The robot performs a measurement sequence by rotating the axis back and forth.

Continues on next page

6.4.4 Axis Calibration - Running the calibration procedure
Continued

8 Remove the calibration tool and reinstall the protective cover on the fixed pin and the protection plug in the bushing, if any.
9 The robot moves to verify that the calibration tool is removed.
10 Choose whether to save the calibration data or not.

Calibration of the robot is not finished until the calibration data is saved, as last step of the calibration procedure.

Preparation prior to calibration

The calibration procedure is described in the FlexPendant while conducting it.

	Action	Note
1	**DANGER** While conducting the calibration, the robot needs to be connected to power. Make sure that the robot's working area is empty, as the robot can make unpredictable movements.	
2	Wipe the calibration tool clean. **Note** The calibration method is exact. Dust, dirt or color flakes will affect the calibration value.	Use a clean cloth.

Starting the calibration procedure

Use this procedure to start the Axis Calibration routine on the FlexPendant.

	Action	Note
1	Tap the calibration icon and enter the calibration main page.	
2	All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question. **Note** For RobotWare 7, the mechanical unit page is displayed only if there is more than one mechanical unit available.	
3	The calibration method used at ABB factory for each axis is shown, as well as calibration method used for the robot during last field calibration.	The FlexPendant will give all information needed to proceed with Axis Calibration.
4	**Valid for RobotWare 6** Tap **Call Calibration Method**. The software will automatically call for the procedure for the valid calibration method. If not, tap **Call Routine** and then tap **Axis calibration**.	

Continues on next page

	Action	Note
5	**Valid for RobotWare 7** Tap **Calibration Methods** on the right pane and then tap **Calibration**. The software will automatically call for the procedure for the valid calibration method.	
6	Follow the instructions given on the FlexPendant.	A brief overview of the sequence that will be run on the FlexPendant is given in *Overview of the calibration procedure on the FlexPendant on page 337*.

Restarting an interrupted calibration procedure

If the Axis Calibration procedure is interrupted before the calibration is finished, the RobotWare program needs to be started again. Use this procedure to take required action.

Situation	Action
The three-position enabling device on the FlexPendant has been released during robot movement.	Press and hold the three-position enabling device and press **Play**.
The RobotWare program is terminated with **PP to Main**.	Remove the calibration tool, if it is installed, and restart the calibration procedure from the beginning. See *Starting the calibration procedure*. If the calibration tool is in contact the robot axis needs to be jogged in order to release the calibration tool. Jogging the axis in wrong direction will cause the calibration tool to break. Directions of axis movement is shown in *Calibration movement directions for all axes on page 325*

Axis Calibration with SafeMove option

To be able to run Axis Calibration, SafeMove needs to be unsynchronized. The Axis Calibration routine recognizes if the robot is equipped with SafeMove and will force SafeMove to unsynchronize automatically.

However, SafeMove may generate other warning messages anytime during the Axis Calibration routine. When a warning message is displayed, tap **Acknowledge** to confirm the unsynchronized state and continue Axis Calibration procedure.

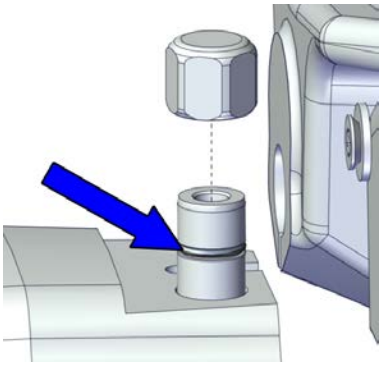
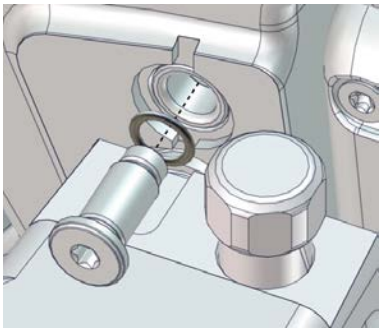
CAUTION

SafeMove must be synchronized after the calibration is completed.

Continues on next page

6.4.4 Axis Calibration - Running the calibration procedure
Continued

After calibration

	Action	Note
1	Check the o-ring on the fixed calibration pin. Replace if damaged or missing.	 xx1600002102 Protection cover and plug set: 3HAC056806-001.
2	Reinstall the protective cover on the fixed calibration pin on each axis, directly after the axis has been calibrated. Replace the cover with new spare part, if missing or damaged.	
3	Reinstall the protective plug and sealing in the bushing on each axis, directly after the axis has been calibrated. Ensure that the sealing is not damaged. Replace the plug and the sealing with new spare part, if missing or damaged.	 xx1500000952 Protection cover and plug set: 3HAC056806-001.

6.4.5 Reference calibration

Brief introduction to Reference Calibration

Reference calibration is a faster method compared to Fine calibration, as it refers to a previously made calibration.

1. Create a backup of the current robot system.
2. Check that the active calibration offset values corresponds to the values on the calibration label (located on the lower arm or the base).
3. Jog the manipulator so that all axes are in zero position (ex use `MoveAbsJ` instruction). Check that all axis scales are aligned with calibration marks.
4. If the scales differ from calibration marks it might depend on wrong turns of the revolution counters. Make a marker line on the corresponding axis to be able to validate the result of the calibration. If more than one motor revolutions are wrong, the calibration will fail.
5. Use a verification position. This is especially recommended if all axes were not aligned with the synchronization marks (step 3). Reuse an existing position that is suitable and accurate so it can be used to validate the repair. Use a position where a deviation in axis calibration gives a big deviation in positioning. Note! Check the position after each repair in one axis.
6. Use Reference calibration to save reference values for all axes that is to be replaced. Make sure that the values are saved in RobotStudio or FTP program. The files are located in "Active system folder name/HOME/RefCalibFiles".
7. Perform the repair.
8. Make sure that the tooling and process equipment are the same as when creating the reference. Use Reference calibration to update the system with new calibration offset value for the repaired axis.
9. Check the position against the verification position (step 5).
10. Proceed with the repair of the next axis, if necessary, and repeat (step 8-9) for every axis.
11. (For system containing SafeMove or EPS) Download new calibration values to SafeMove. Use Visual SafeMove in RobotStudio.(For system containing SafeMove) Download new calibration values to SafeMove. Use Visual SafeMove in RobotStudio.
12. (For system containing SafeMove or EPS) Synchronize SafeMove to activate SafeMove.(For system containing SafeMove) Synchronize SafeMove to activate SafeMove.
13. Perform test run.
14. Update the calibration label with new resolver values (calibration values).

Manual tuning of calibration offset

Manual tuning of calibration offset is normally not needed, but can be useful in some situations. The requirement to do manual tuning is that there is a known accurate position, that worked accurately before the repair (step 5, see *Brief introduction to Reference Calibration on page 341*).

Continues on next page

6.4.5 Reference calibration
Continued

Example "Adjust axis 4":

1. Create a backup.
2. Run the manipulator to the verification position. (The manipulator position is now deviating from the verification position.)
3. Read and note current axis 4 value in degrees (example: 96.3 degrees).
4. Manually jog, only axis 4, so that the manipulator is correctly positioned to the verification position.
5. Read and note current axis 4 value in degrees (example: 94.2 degrees).
6. Move the manipulator to its calibration position.
7. Calculate the angle difference (ie 96.3-94.2=2.1 degrees).
8. Manually jog axis 4 the calculated angle difference (-2.1). NOTE! The direction +/- shall be the same direction as the direction used when axis 4 was manually jogged to coincide with the verification process. In the example -2.1 degrees.
9. Make a new manual fine calibration of axis 4 with axis in -2.1 degrees position.
10. Check again against the verification position.
11. Repeat the manual tuning if needed.
12. Create a new reference if the intention is to use the reference in the future.

6.5 Verifying the calibration

Introduction

Always verify the results after calibrating *any* robot axis to verify that all calibration positions are correct.

Verifying the calibration

Use this procedure to verify the calibration result.

	Action	Note
1	Run the calibration home position program twice. Do not change the position of the robot axes after running the program!	See *Checking the synchronization position on page 344*.
2	Adjust the *synchronization marks* when the calibration is done, if necessary.	This is detailed in section *Synchronization marks and synchronization position for axes on page 324*.
3	Write down the values on a new label and stick it on top of the calibration label. The label is located on the xx.	

6.6 Checking the synchronization position

Introduction

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

- Using a `MoveAbsJ` instruction with argument zero on all axes.
- Using the **Jogging** window on the FlexPendant.Using the **Jog** window on the FlexPendant.

Continues on next page

6.6.1 Checking the synchronization position on IRC5 robots

Using a MoveAbsJ instruction

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

	Action	Note
1	On ABB menu tap **Program editor**.	
2	Create a new program.	
3	Use **MoveAbsJ** in the **Motion&Proc** menu.	

4	Create the following program:
	`MoveAbsJ [[0,0,0,0,0,0],`
	`[9E9,9E9,9E9,9E9,9E9,9E9]]`
	`\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 *Synchronization marks and synchronization position for axes on page 324* and *Updating revolution counters on page 326*.

Using the jogging window

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

	Action	Note
1	On the **ABB** menu, tap **Jogging**.	
2	Tap **Motion mode** to select group of axes to jog.	
3	Tap to select the axis to jog, axis 1, 2, or 3.	
4	Manually run the robots axes to a position where the axis position value read on the FlexPendant, is equal to zero.	
5	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See *Synchronization marks and synchronization position for axes on page 324* and *Updating revolution counters on page 326*.

6.6.2 Checking the synchronization position on OmniCore robots

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 [[0,0,0,0,0,0],`
	`[9E9,9E9,9E9,9E9,9E9,9E9]]`
	`\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 *Synchronization marks and synchronization position for axes on page 324* and *Updating revolution counters on page 326*.

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 zero.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See *Synchronization marks and synchronization position for axes on page 324* and *Updating revolution counters on page 326*.

7 Troubleshooting

7.1 Introduction to troubleshooting

Introduction

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

For IRC5, all event logs from the software can be seen on the FlexPendant, or in *Operating manual - Troubleshooting IRC5*.

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.

Note

During troubleshooting with power on, the internal fan might cause dust to enter the cabinet.

CAUTION

During troubleshooting with power on, make sure not to place your head too close to the internal fan located on the door.

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.

Continues on next page

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.
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

7.2 Oil and grease stains on motors and gearboxes

Description

The area surrounding the motor or gearbox shows signs of oil leaks. This can be at the base, closest to the mating surface, or at the furthest end of the motor at the resolver.

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 390 on page 139*. Monitor the robot over time to see if new oil or grease occurs.	If the oil spill is small, this step is sufficient.
3	Check the gearbox oil level.	
4	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.
5	Inspect all sealings and gaskets between motor and gearbox. Replace broken parts.	

7.3 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.	

7.4 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.

Recommended actions

The following actions are recommended:

	Action	Information
1	Determine which motor(s) causes the robot to collapse.	
2	Check the brake power supply to the collapsing motor during the Motors OFF state.	See the circuit diagram.
3	Remove the resolver or resolver cover of the motor to see if there are any signs of oil leaks.	If found faulty, the motor must be replaced as a complete unit.
4	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.

This page is intentionally left blank

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.

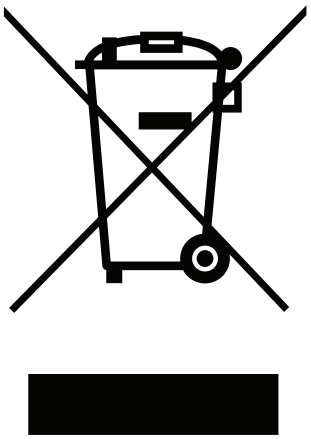
8.2 Environmental information

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 unit, upper arm, covers, tilt arm, gear housing, motors
Batteries, Lithium	Serial measurement board
Carbon fiber	Lower arms
Copper	Cables, motors
Neodymium	Motors
Nickel	Coating
Oil, grease	Gearboxes, telescopic shaft
Plastic/rubber	Sealings, cable harness
Stainless steel	Flange bolts, covers, washers, cassette sealings
Steel	Gears, pinions, bearings, shafts, brackets, motors, screws, washers

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
UL 1740 (option)	Standards For Safety - Robots and Robotic Equipment Valid for USA and Canada.

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 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.	

9.5 Standard toolkit

General

All service (repairs, maintenance, and installation) procedures contains lists of tools required to perform the specified activity.

All special tools required are listed directly in the procedures while all the tools that are considered standard are gathered in the standard toolkit and defined in the following table.

This way, the tools required are the sum of the standard toolkit and any tools listed in the instruction.

Contents, standard toolkit

Qty	Tool	Rem.
1	Torque wrench 32 mm 45 Nm	To be used on upper arm covers.
1	Torque wrench, 4-190 Nm	
1	Interchangeable head torque wrench	
1	Open-end wrench 47 mm	To be used as an anvil during fitting of universal joint to axis-4 and axis-5 motor shaft.
1	Torx bit, size T30	
1	Ratchet head for torque wrench 1/2	
1	Hex socket wrench insert, size 10 mm	
1	Hex socket wrench insert, size 13 mm	
1	Hexagon bit socket head cap, size 6 mm	
1	Screw M8 x minimum 25 mm	To be used to press out the cassette sealing holder from the upper arm.
1	Magnetic retrieval tool	Useful for retrieving dropped screws or washers during spare part replacements inside the base.
1	Striker	Used for knocking out the cassette sealing.
1	Long nose pilers (non-serrated jaw, no teeth marks)	Used for inspection & cleaning the cups

9.6 Special tools

General

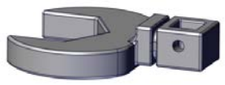
All service instructions contain lists of tools required to perform the specified activity. The required tools are a sum of standard tools, defined in the section *Standard toolkit on page 361*, and of special tools, listed directly in the instructions and also gathered in this section.

Special tools

Note

If the replacing procedure is not listed in the table below, only standard tools are needed for the procedure.

Continues on next page

Tools and equipment with spare part number: (These tools can be ordered from ABB)			Assembly of robot (installation)	Axis-1-2-3 motor	Axis-4-5 motor	Axis-4-5 gear unit	Base unit	Brake release unit	Cable harness	Cassette sealing	Delta unit	Lower arm	SMB	SMB battery	Telescopic shaft	Tilt arm	Universal joint	Upper arm
Guide pins																		
Guide pin, M8x150	3HAC15520-2			2														
Guide pin, M6x150	3HAC080345-001				2													
Removal and refitting tools																		
Torque wrench head, closed end	3HAC063379-001	 xx2000000282 Included in robot delivery.	1			1	1		1		1				1		1	
Torque wrench head, open-end insert	3HAC073854-001	 xx1900002148 Included in robot delivery.	1	1			1			1	1	1						1
Lifting tools																		
Lifting eye	3HAC16131-1	 xx2000000261	3				3											
Roundsling, 2 m	-		3				3											
Press tools																		
Press tool, cassette sealing	3HAC069723-010									1								
Other tools																		
24 VDC power supply	-		1	1	1													
Calibration toolbox, Axis Calibration	3HAC074119-001			1	1	1	1			1	1					1		1

Continues on next page

9.6 Special tools

Tools and equipment with spare part number: (These tools can be ordered from ABB)			Assembly of robot (installation)	Axis-1-2-3 motor	Axis-4-5 motor	Axis-4-5 gear unit	Base unit	Brake release unit	Cable harness	Cassette sealing	Delta unit	Lower arm	SMB	SMB battery	Telescopic shaft	Tilt arm	Universal joint	Upper arm
Blind hole bearing puller	-															1		
Lashing strap	-	 xx2000001117		1						1	1/2	1						1
Leak-down tester	-			1														
Oil collecting vessel	-			1														
Oil dispenser	-			1														
Overhead crane	-		1				1											
Rotation tool	3HAB7887-1		1	1	1													

Continues on next page

9.7 Lifting accessories and lifting instructions

General

Many repair and maintenance activities require different pieces of lifting accessories, which are specified in each procedure.

The use of each piece of lifting accessories is *not* detailed in the activity procedure, but in the instruction delivered with each piece of lifting accessories.

The instructions delivered with the lifting accessories should be stored for later reference.

This page is intentionally left blank

Index

ABB AB
Robotics & Discrete Automation
S-721 68 VÄSTERÅS, Sweden
Telephone +46 10-732 50 00

ABB AS
Robotics & Discrete Automation
Nordlysvegen 7, N-4340 BRYNE, Norway
Box 265, N-4349 BRYNE, Norway
Telephone: +47 22 87 2000

ABB Engineering (Shanghai) Ltd.
Robotics & Discrete Automation
No. 4528 Kangxin Highway
PuDong New District
SHANGHAI 201319, China
Telephone: +86 21 6105 6666

ABB Inc.
Robotics & Discrete Automation
1250 Brown Road
Auburn Hills, MI 48326
USA
Telephone: +1 248 391 9000

abb.com/robotics

3HAC066566-001, Rev M, en