ROBOTICS

Product manual

IRB 930

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Product manual

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IRB 930-22/1.05

OmniCore

Document ID: 3HAC086009-001

Revision: D

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Original instructions.

Table of contents

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Overview of this manual

About this manual

This manual contains instructions for:

- mechanical and electrical installation of the IRB 930
- maintenance of the IRB 930
- mechanical and electrical repair of the IRB 930

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

- *Standard*

Product manual scope

The manual covers all variants and designs of the IRB 930. 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.

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References

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

Document name	Document ID
Product manual, spare parts - IRB 930	*3HAC086010-001*
Product specification - IRB 930	*3HAC086011-001*
Circuit diagram - IRB 930	*3HAC081880-003*
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*
Product manual - OmniCore C30	*3HAC060860-001*
Product manual - OmniCore C90XT	*3HAC073706-001*
Product manual - OmniCore E10	*3HAC079399-001*
Operating manual - OmniCore	*3HAC065036-001*
Application manual - Controller software OmniCore	*3HAC066554-001*
Application manual - CalibWare Field	*3HAC030421-001*
Technical reference manual - Event logs for RobotWare 7	*3HAC066553-001*
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*
Technical reference manual - System parameters	*3HAC065041-001*

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

Revisions

Revision	Description
A	First edition.
B	Published in release 23C. The following updates are done in this revision: • Updated article number of robot signal cable from 3HAC067446-00*X* to 3HAC084767-00*X*. • Updated duration for changing oil in *Maintenance schedule on page 82*.
C	Published in release 23D. The following updates are done in this revision: • Added axis positions for most stable transport position. • Supported OmniCore E10. • Added sealing and ring on axis 2.
D	Published in release 24A. The following updates are done in this revision: • Added troubleshooting information.

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.

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- 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.

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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*.

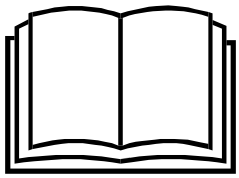
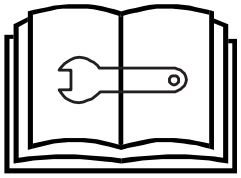
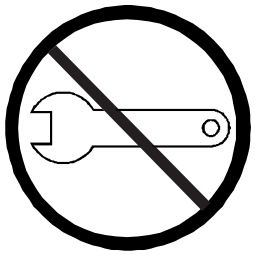
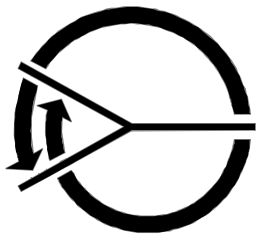
The information labels can contain information in text.

Symbols on safety labels

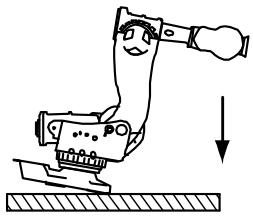
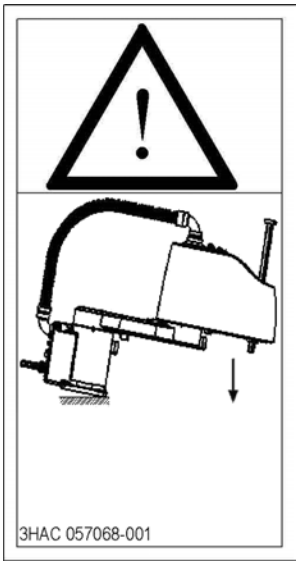
Symbol	Description
 xx0900000812	**Warning!** Warns that an accident *may* occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical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

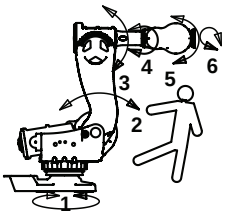
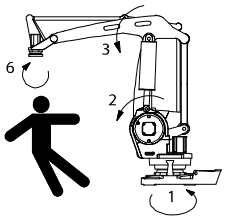
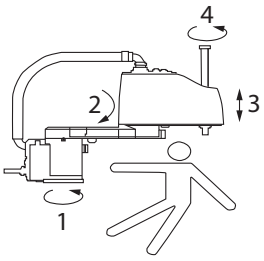
Symbol	Description
 xx0900000813	**See user documentation** Read user documentation for details. Which manual to read is defined by the symbol: • No text: *Product manual*.
 xx0900000816	**Before disassembly, see product manual**
 xx0900000815	**Do not disassemble** Disassembling this part can cause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

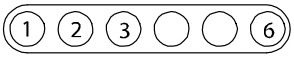
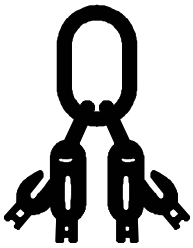
Symbol	Description
 xx0900000810  xx1500002402	**Tip risk when loosening bolts** The robot can tip over if the bolts are not securely fastened.
  xx0900000817	**Crush** Risk of crush injuries.

Continues on next page

1.2.2 Safety symbols on manipulator labels
Continued

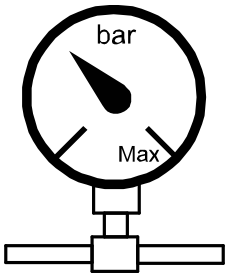
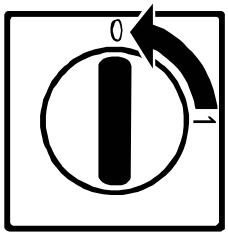
Symbol	Description
 xx0900000818  xx1300001087	**Heat** Risk of heat that can cause burns. (Both signs are used)
 xx0900000819  xx1000001141  xx1500002616	**Moving robot** The robot can move unexpectedly.

Continues on next page

Symbol	Description
 xx0900000820  xx1000001140	**Brake release buttons**
 xx0900000821	**Lifting bolt**
 xx1000001242	**Adjustable chain sling with shortener**
 xx0900000822	**Lifting of robot**
 xx0900000823	**Oil** Can be used in combination with prohibition if oil is not allowed.
 xx0900000824	**Mechanical stop**

Continues on next page

1.2.2 Safety symbols on manipulator labels
Continued

Symbol	Description
 xx1000001144	**No mechanical stop**
 xx0900000825	**Stored energy** Warns that this part contains stored energy. Used in combination with *Do not disassemble* symbol.
 xx0900000826	**Pressure** Warns that this part is pressurized. Usually contains additional text with the pressure level.
 xx0900000827	**Shut off with handle** Use the power switch on the controller.
 xx1400002648	**Do not step** Warns that stepping on these parts can cause damage to the parts.

1.3 Robot stopping functions

Protective stop and emergency stop

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

For more information see:

- *Product manual - OmniCore C30*
- *Product manual - OmniCore C90XT*
- *Product manual - OmniCore E10*

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 606* 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

Pneumatic or hydraulic related hazards

Note

The pressure in the complete pneumatic or hydraulic systems must be released before service and maintenance.

All components in the robot system that remain pressurized after switching off the power to the robot must be marked with clearly visible drain facilities and a warning sign that indicates the hazard of stored energy.

Loss of pressure in the robot system may cause parts or objects to drop.

Dump valves should be used in case of emergency.

Shot bolts should be used to prevent tools, etc., from falling due to gravity.

All pipes, hoses, and connections have to be inspected regularly for leaks and damage. Damage must be repaired immediately.

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 lubricant to spray from the opening.	Open the plug carefully and keep away from the opening. Do not overfill the gearbox when filling.
 **Do not overfill**	Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may: • damage seals and gaskets • completely press out seals and gaskets • prevent the robot from moving freely.	Make sure not to overfill the gearbox when filling it with oil or grease. After filling, verify that the level is correct.
 **Specified amount depends on drained volume**	The specified amount of oil or grease is based on the total volume of the gearbox. When changing the lubricant, the amount refilled may differ from the specified amount, depending on how much has previously been drained from the gearbox.	After filling, verify that the level is correct.

Hazards related to batteries

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

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

Do not short circuit, recharge, puncture, incinerate, crush, immerse, force discharge or expose to temperatures above the declared operating temperature range of the product. Risk of fire or explosion.

Operating temperatures are listed in *Operating conditions, robot on page 41*.

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

Unexpected movement of robot arm

WARNING

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

Continues on next page

1.6.1 Safety during maintenance and repair
Continued

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 Emergency release of the robot axes

Description

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

How to release the brakes is described in the section:

- *Manually releasing the brakes on page 58*.

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

Increased injury

Before releasing the brakes, make sure that the weight of the manipulator does not result in additional hazards, for example, even more severe injuries on a trapped person.

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.

1.6.3 Brake testing

When to test

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

Note

Note that the following axes do not have a brake:

- Axis 1
- Axis 2

How to test

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

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

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

Note

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

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

1.7 Safety during troubleshooting

General

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

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

DANGER

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

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

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 605*.

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.

2 Manipulator description

2.1 About IRB 930

Introduction

The IRB 930 is one of ABB Robotics latest generation of 4-axis robot, with a payload of 12 kg and 22 kg, designed based on industrial robot platform. The robot has an open structure that is especially adapted for flexible use, and can communicate extensively with external systems.

The IRB 930 contains the following variants:

- IRB 930-12/0.85
- IRB 930-12/1.05
- IRB 930-22/1.05

Note

Without any specific statement, IRB 930 represents all variants under this product.

2.2 Technical data

Weight, robot

The table shows the weight of the robot.

Robot model	Nominal weight
IRB 930	IRB 930-12/0.85: 64 kg IRB 930-12/1.05: 66 kg IRB 930-22/1.05: 66 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.

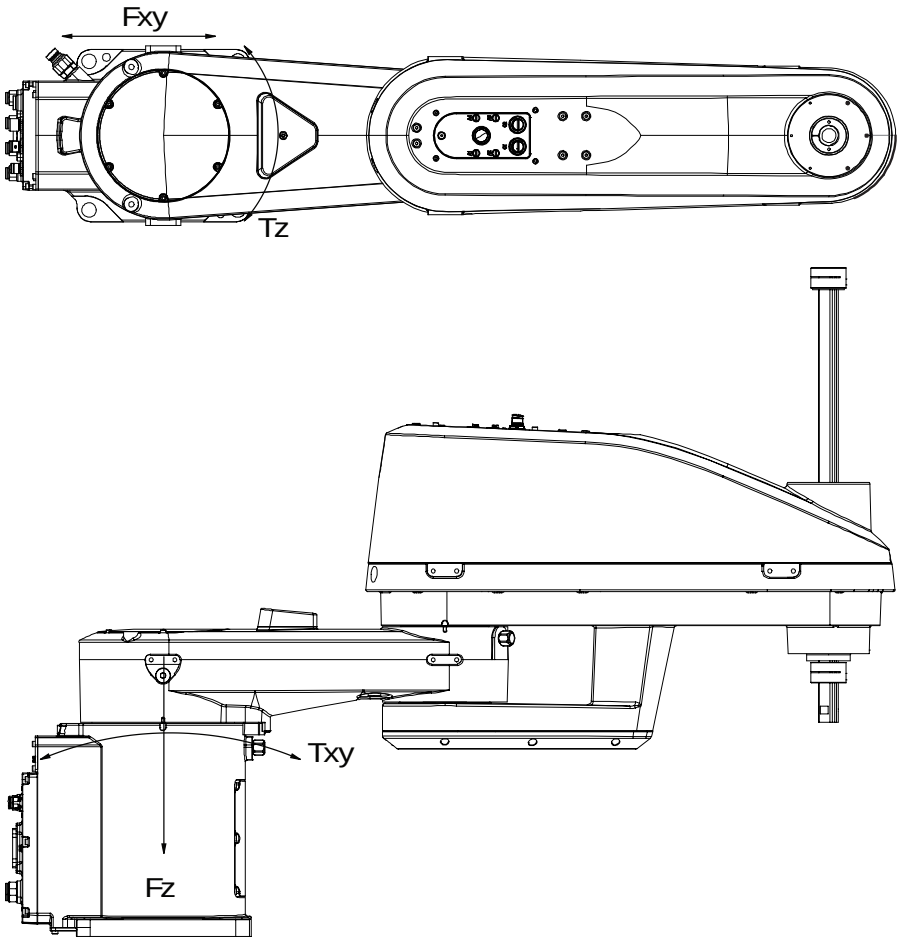
Mounting position	Installation angle
Floor mounted	0°

Note

The actual mounting angle must always be configured in the system parameters, otherwise the performance and lifetime is affected. For details, see *Technical reference manual - System parameters*.

Continues on next page

Loads on foundation, robot



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F_{xy}	Force in any direction in Plane XY
F_z	Force along Axis Z
T_{xy}	Bending moment in any direction in Plane XY
T_z	Torsional moment around Axis Z

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).

Continues on next page

Floor mounted

Force	Endurance load (in operation)	Maximum load (emergency stop)
Force xy	IRB 930-12/0.85: ±1200 N IRB 930-12/1.05: ±1000 N IRB 930-22/1.05: ±1000 N	±2000 N
Force z	IRB 930-12/0.85: ±815 N IRB 930-12/1.05: ±950 N IRB 930-22/1.05: ±950 N	IRB 930-12/0.85: ±1200 N IRB 930-12/1.05: ±1300 N IRB 930-22/1.05: ±1300 N
Torque xy	IRB 930-12/0.85: ±650 Nm IRB 930-12/1.05: ±800 Nm IRB 930-22/1.05: ±800 Nm	IRB 930-12/0.85: ±1310 Nm IRB 930-12/1.05: ±1550 Nm IRB 930-22/1.05: ±1550 Nm
Torque z	IRB 930-12/0.85: ±255 Nm IRB 930-12/1.05: ±250 Nm IRB 930-22/1.05: ±250 Nm	IRB 930-12/0.85: ± 510 Nm IRB 930-12/1.05: ±520 Nm IRB 930-22/1.05: ±520 Nm

Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.1/500 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy.
Minimum resonance frequency	22 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*.
Minimum foundation material yield strength	150 MPa	

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

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

Continues on next page

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

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

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	+5ºC [i]
Maximum ambient temperature	+45ºC
Maximum ambient humidity	5% - 95% non-condensing according to IEC61131-2

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

Protection classes, robot

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

Protection type	Protection class [i]
Manipulator, protection type Standard	IP30 [ii]

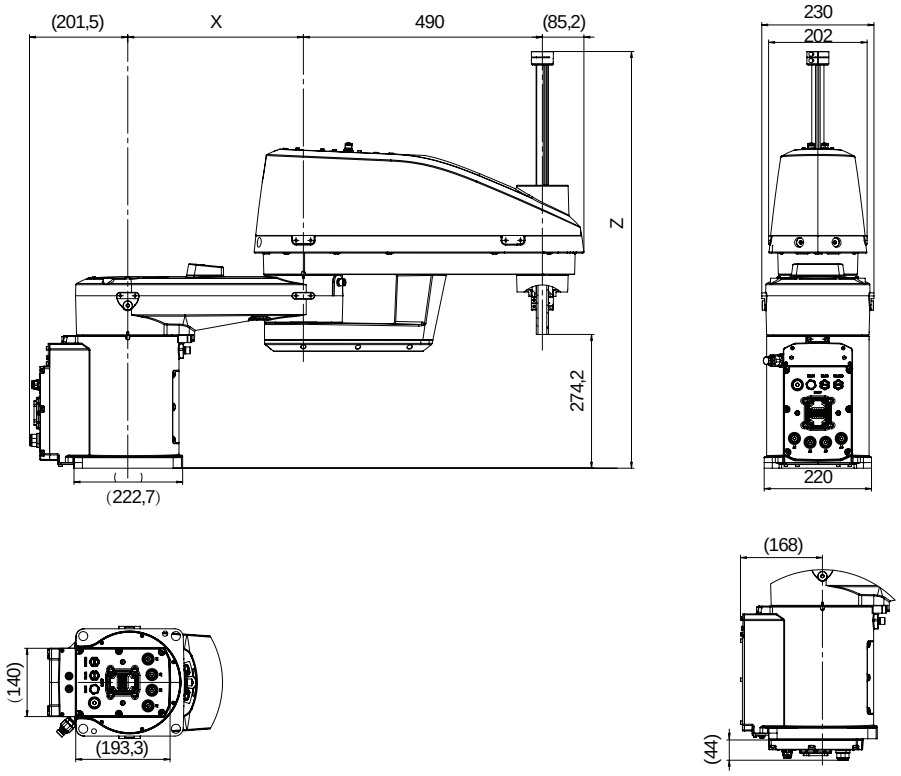
[i] According to IEC 60529.
[ii] The protection class of the ballscrew area is IP20. For more information, please contact ABB.

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*.

2.3 Robot dimensions

Robots with protection class IP30 3350-300



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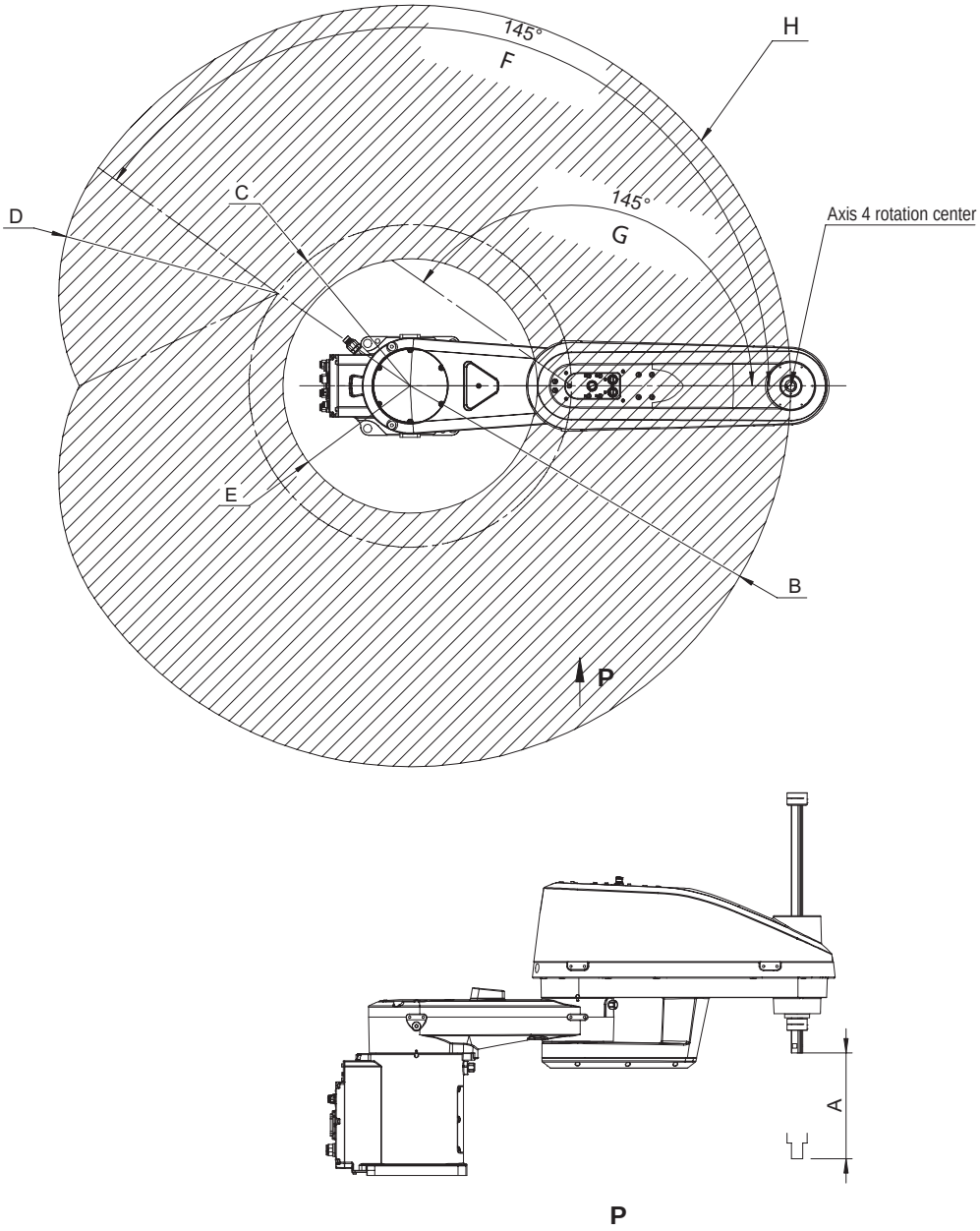
Variants	0.85_0.3	0.85_0.45	1.05_0.3	1.05_0.45
X	360 mm	360 mm	560 mm	560 mm
Y	330 mm	330 mm	530 mm	530 mm
Z	854.2 mm	1,004.2 mm	854.2 mm	1,004.2 mm

2.4 Working range

Illustration, working range

Robots with protection class IP30 3350-300

This illustration shows the unrestricted working range of the robot.



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Variants	0.85_0.3	0.85_0.45	1.05_0.3	1.05_0.45
A (Axis3)	300 mm	450 mm	300 mm	450 mm
B	850 mm		1,050 mm	
C	360 mm		560 mm	

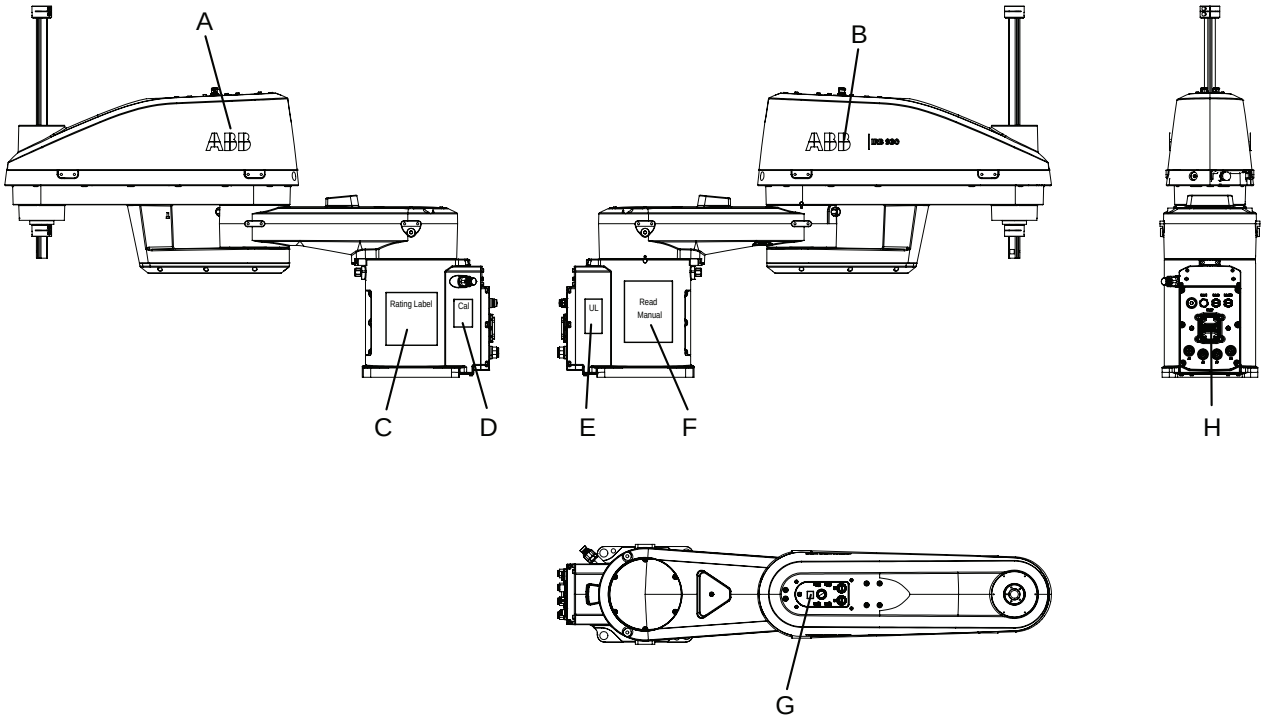
Continues on next page

2.4 Working range
Continued

Variants	0.85_0.3	0.85_0.45	1.05_0.3	1.05_0.45
D	490 mm			
E	284.1 mm		322.7 mm	
F (Axis1)	±145°			
G (Axis2)	±145°			
H (Axis4)	±400°			

2.5 Information labels

Illustration



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A	ABB logo
B	IRB 930 logo
C	Rating label
D	Calibration label
E	UL label
F	Read manual and caution
G	Brake release label
H	Extra O-ring fitting label

2.6 The unit is sensitive to ESD

Description

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

Safe handling

Use one of the following alternatives:

- Use a wrist strap.

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

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

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

3 Installation and commissioning

3.1 Introduction to installation and commissioning

General

This chapter contains assembly instructions and information for installing the IRB 930 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 38*.

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

For more information see:

- *Product manual - OmniCore C30*
- *Product manual - OmniCore C90XT*
- *Product manual - OmniCore E10*

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 38*
6	If the robot is not installed directly, it must be stored as described in: *Storage conditions, robot on page 41*
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: *Operating conditions, robot on page 41*
8	Before taking the robot to its installation site, make sure that the site conforms to: • *Loads on foundation, robot on page 39* • *Protection classes, robot on page 41* • *Requirements, foundation on page 40*
9	Before moving the robot, please observe the stability of the robot: *Risk of tipping/stability on page 49*
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: *On-site installation on page 54*
11	Install required equipment, if any.

3.2.2 Risk of tipping/stability

Risk of tipping

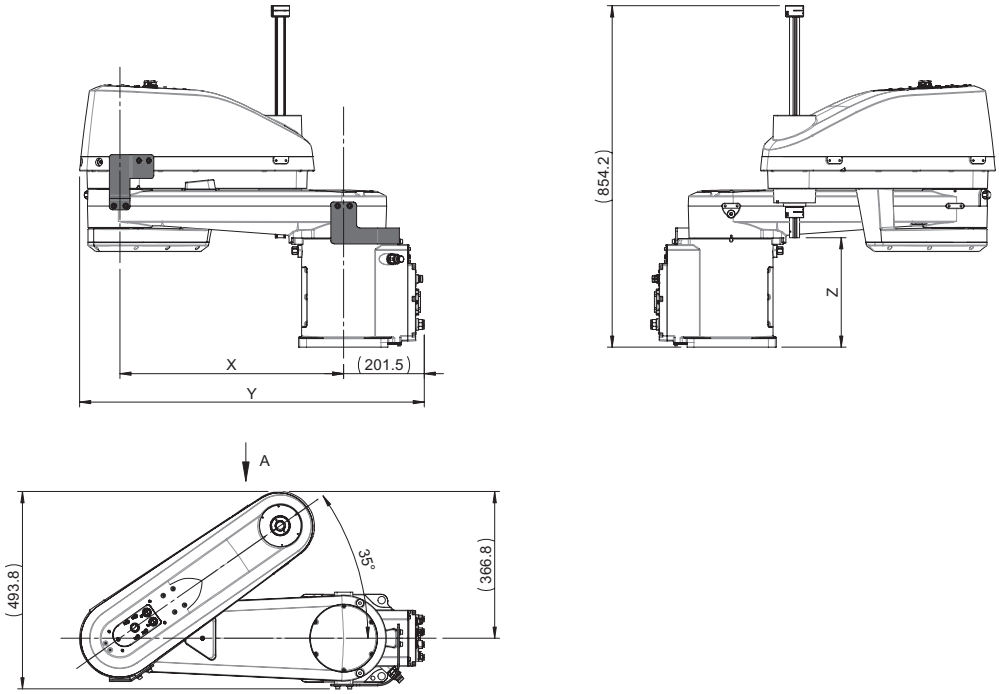
If the robot is not fastened to the foundation while moving the arm, the robot is not stable in the whole working area. Moving the arm will displace the center of gravity, which may cause the robot to tip over.

The transportation position is the most stable position.

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

Transportation position

This figure shows the robot in its transportation position.



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Note

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

Axis number	Angle of axis
Axis 1	0°
Axis 2	-145°
Axis 3	IRB 930-*X*/0.3: 0 mm IRB 930-*X*/0.45: -150 mm
Axis 4	0°

Continues on next page

3.2.2 Risk of tipping/stability
Continued

Transportation bracket

At delivery, the robot is locked in the correct position with a transportation bracket for securing the position during shipping and transport. The bracket must be removed before conducting any service work.

How to use the transportation bracket is described further in *Transportation bracket on page 51*.

WARNING

The robot is likely to be mechanically unstable if not secured to the foundation.

3.2.3 Transportation bracket

Location of the transportation bracket

At delivery, the robot is locked in the correct position with the transportation brackets for securing the position during shipping and transport. The transportation brackets cannot be removed until the robot is secured to the foundation.

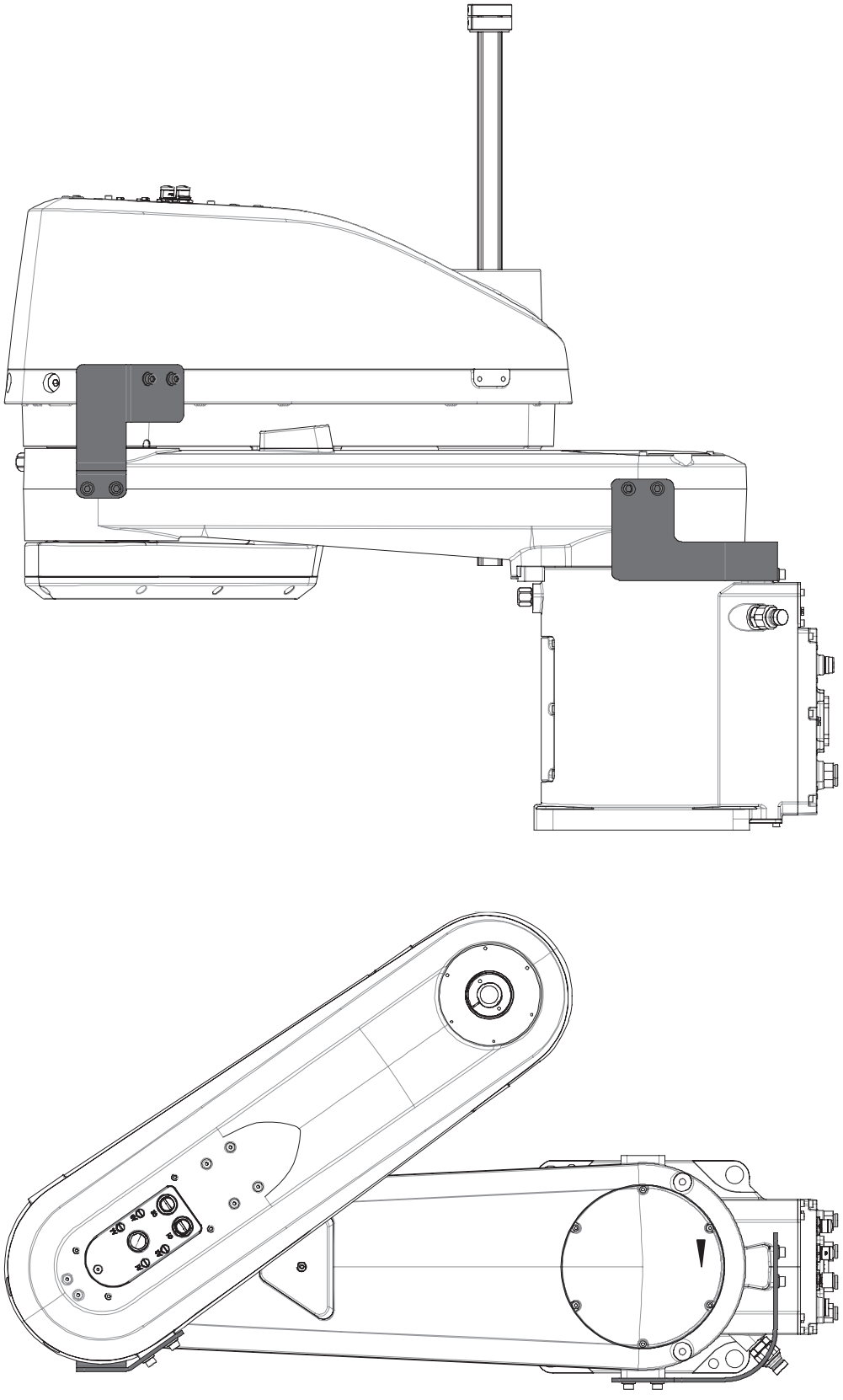
Note

Keep the brackets every time when it's removed from the robot for further use.

Continues on next page

3.2.3 Transportation bracket

Continued



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Removing the transportation bracket

	Action	Note
1	Remove the screws.	
2	Remove the bracket.	

3.3 On-site installation

3.3.1 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 48*.

First installation

Use these procedures to install the IRB 930.

	Action	Note
1	Transport the manipulator to its intended location.	
2	Install the valid platform or prepare the foundation for the manipulator.	
3	Lift and secure the manipulator to the platform/foundation.	See *Lifting the robot on page 56*. See *Orienting and securing the robot on page 60*.
4	Connect the manipulator to the controller.	See • *Product manual - OmniCore C30* • *Product manual - OmniCore C90XT* • *Product manual - OmniCore E10*
5	Configure the safety settings.	See • *Product manual - OmniCore C30* • *Product manual - OmniCore C90XT* • *Product manual - OmniCore E10*
6	How to start and run the robot is described in the product manual for the controller.	See • *Product manual - OmniCore C30* • *Product manual - OmniCore C90XT* • *Product manual - OmniCore E10*
7	Install required equipment, if any.	
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 55*.	

3.3.2 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

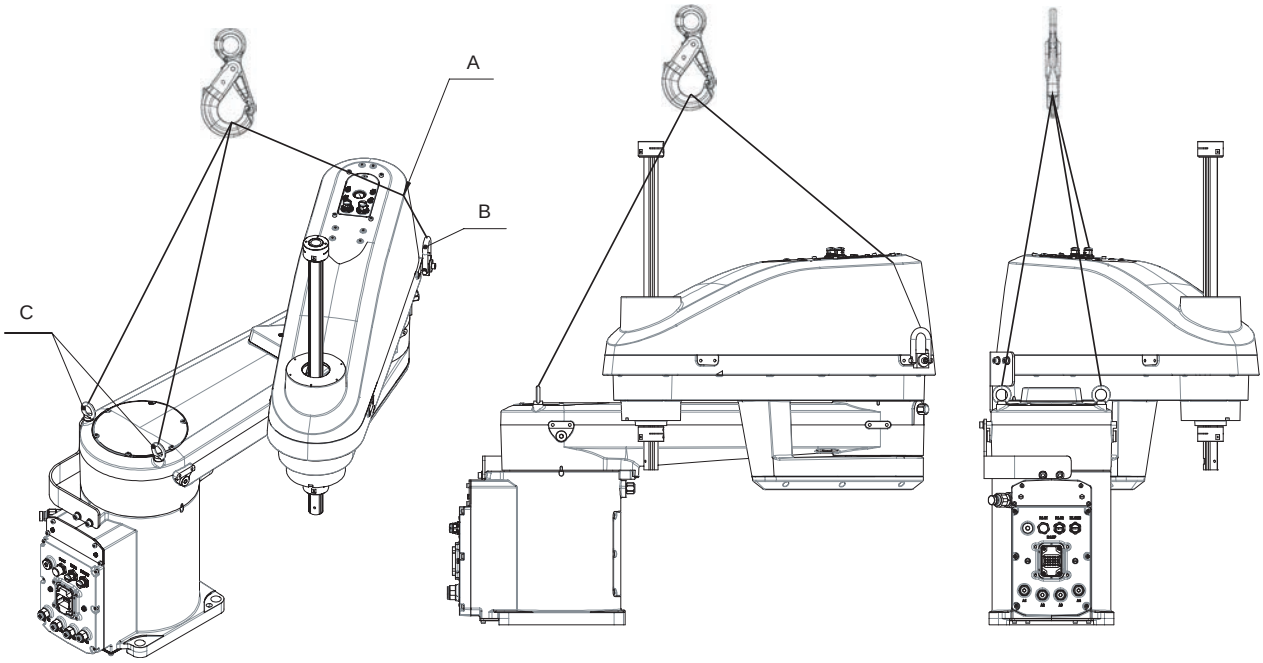
When programming the movements of the robot, always identify potential collision risks before initiating motion.

3.3.3 Lifting the robot

3.3.3.1 Lifting robot with lifting accessories

Illustration - attaching the roundslings

Only 550 mm and 650 mm can be lifted with lifting accessories.



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A: Sling may rub against the manipulator. Be careful to avoid damaging the painting surface. Better to use a buffer.

B: Lifting eye, M6; Rotatable type is recommended.

C: Lifting eye, M8.

DANGER

Attempting to lift a robot in any other position than the recommended lifting position may result in the robot tipping over, causing severe damage or injury.

Required tools and equipment

Equipment	Article number	Note
Overhead crane	-	
Roundsling, 0.6 m	-	Length: 0.6 m. Lifting capacity: >70 kg.
Lifting eye, M6	-	
Lifting eye, M8	-	

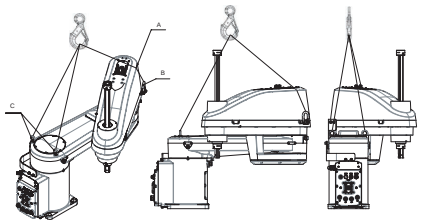
Continues on next page

Lifting the robot

WARNING

The transportation brackets cannot be removed until the robot is secured to the foundation.

Use this procedure to lift the robot.

	Action	Note
1	Move the robot to the appropriate lifting position. **WARNING** The robot is mechanically unstable if not secured to the foundation.	
2	**CAUTION** The weight of the IRB 930 robot is 22 kg All lifting accessories used must be sized accordingly.	
3	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
4	Attach the lifting roundslings to the robot.	Lifting capacity for the lifting chain is specified in *Required tools and equipment on page 56*.  xx2300000164
5	Carefully stretch the roundslings by lifting the crane slowly. This prevents the robot from falling down when it is unfastened. Do not overstretch the roundslings if the robot is fastened because there is a risk of the robot being damaged.	
6	Remove the robot attachment screws (if the robot is fastened).	Screw: M16x50 (4 pcs)
7	Raise the overhead crane to lift the robot.	

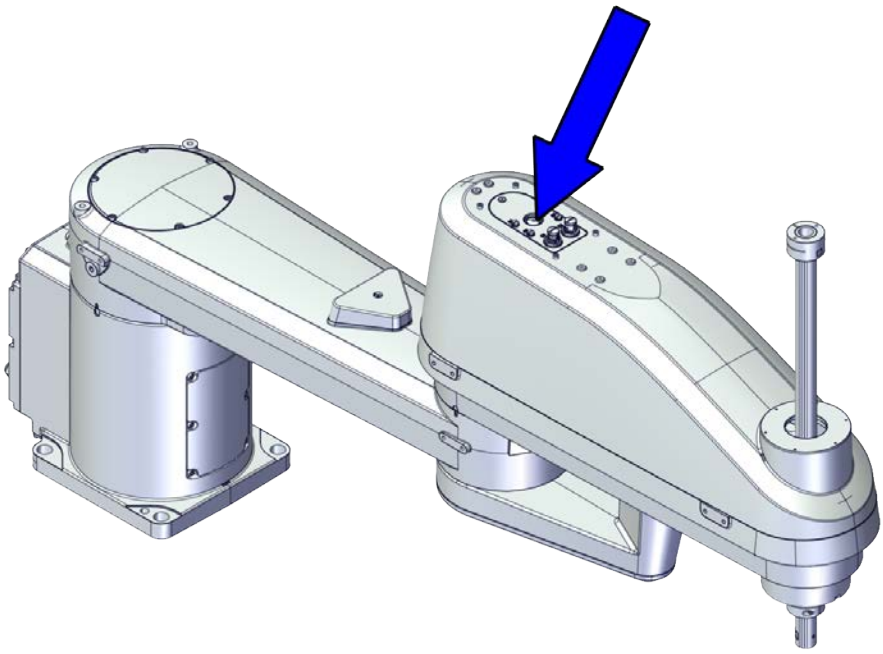
3.3.4 Manually releasing the brakes

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.



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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	**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 59*.	
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.	

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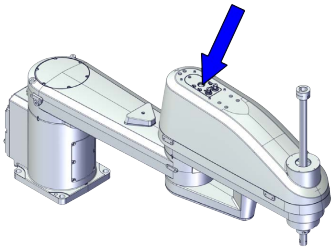
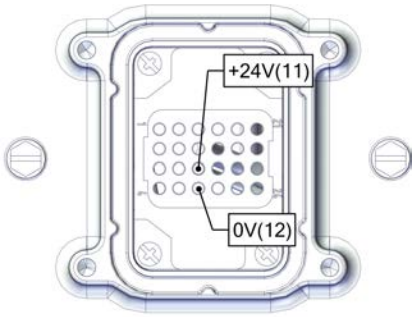
	Action	Note
3	Release the holding brake of all axes by pressing the brake release button. The brake will be enable as soon as the button is released. **WARNING** Pressing the brake release button will release the holding brakes on all axes simultaneously.	 xx2300000168

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.	 xx2300000169
3	Use the brake releasing button as described in *Releasing the brakes on page 58*.	

3.3.5 Orienting and securing the robot

General

This section describes how to orient and secure the robot to the base plate or foundation in order to run the robot safely.

Attachment screws

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

Suitable screws	M16x50
Quantity	4 pcs
Quality	8.8
Suitable washer	30 x 17 x 3 steel hardness class 200HV
Guide pins	2 pcs, D10x30, ISO 2338 - 10m6x30 - A1
Tightening torque	150 Nm±10 Nm
Length of thread engagement	Minimum 22 mm for ground with material yield strength 150 MPa
Level surface requirements	0.1/500 mm [i]

[i] See *Requirements, foundation on page 40*.

Securing a floor mounted robot

Use this procedure to orient and secure the robot floor mounted.

	Action	Note
1	Make sure the installation site for the robot conforms to the specifications in section *Technical data on page 38*.	
2	Prepare the installation site with attachment holes. The foundation surface must be clean and unpainted.	The hole configuration of the base is shown in the figure in *Hole configuration, base on page 61*.
3		
4	**CAUTION** When the robot is put down after being lifted or transported, there is a risk of it tipping, if not properly secured.	
5	Lift the robot.	See *Lifting the robot on page 56*.
6	Fit two pins to the holes in the base.	2 pcs, D10x30, ISO 2338 - 10m6x30 - A1
7	Guide the robot gently, using the attachment screws while lowering it into its mounting position.	Make sure the robot base is correctly fitted onto the pins.
8	Fit the securing screws and washers in the attachment holes of the base.	Screws: M16x50, 4 pcs, quality 8.8 Washers: 30 x 17 x 3 steel hardness class 200HV
9	Tighten the bolts in a crosswise pattern to ensure that the base is not distorted.	Tightening torque: 150 Nm±10 Nm

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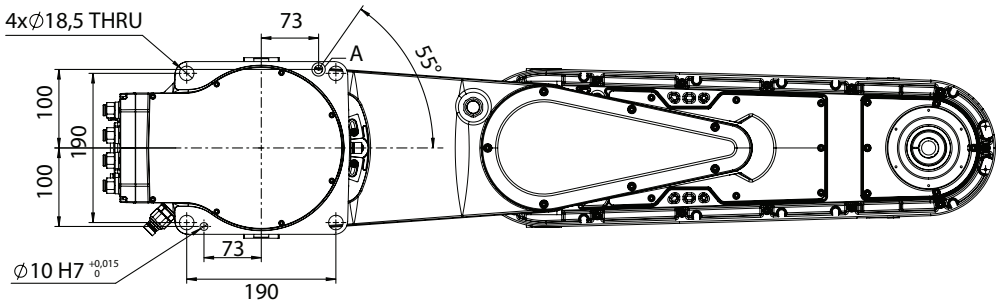
Hole configuration, base

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

Illustration for rear outlet cable version:



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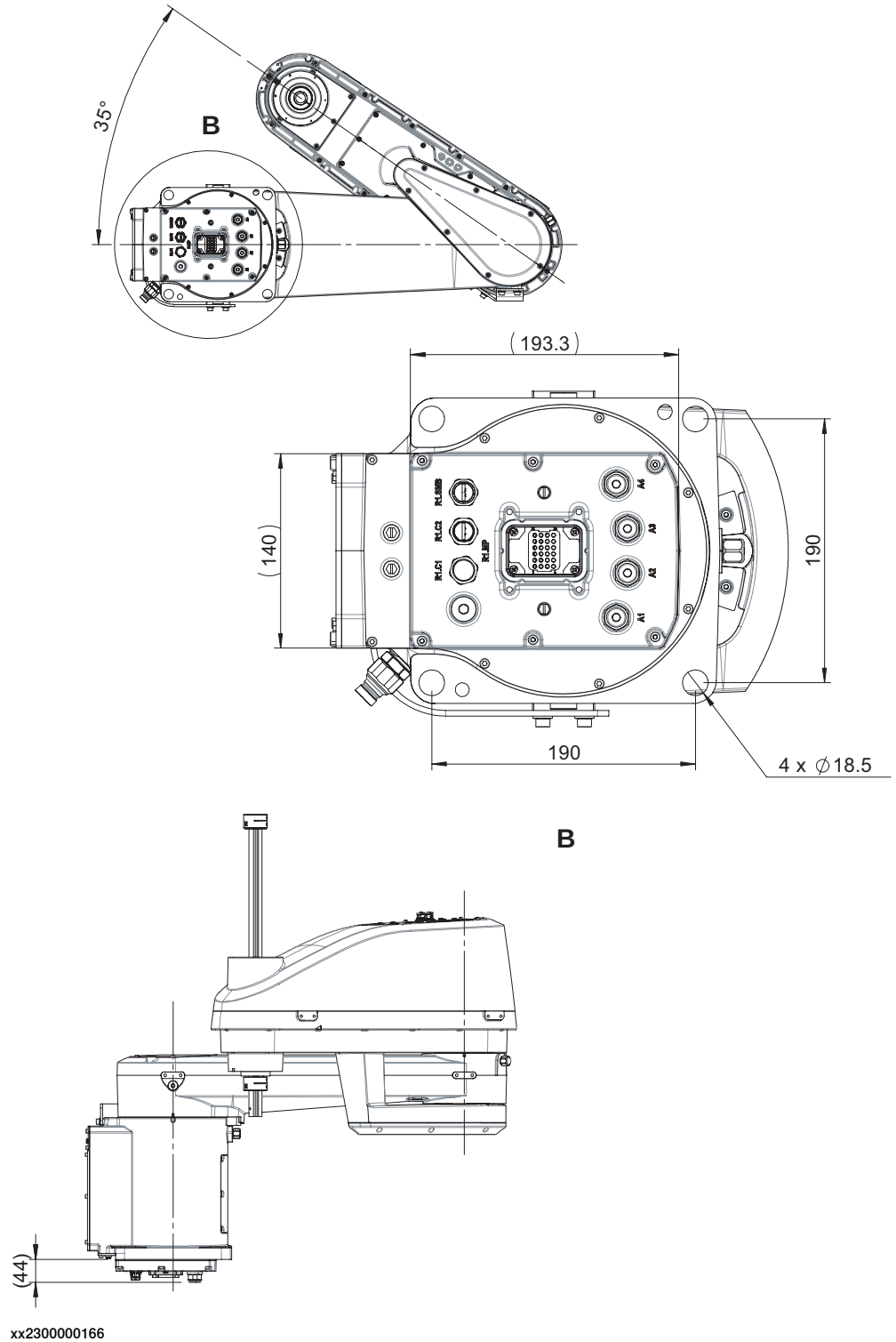
3.3.5 Orienting and securing the robot

Continued

Illustration for underneath outlet cable version:



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3.3.6 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.

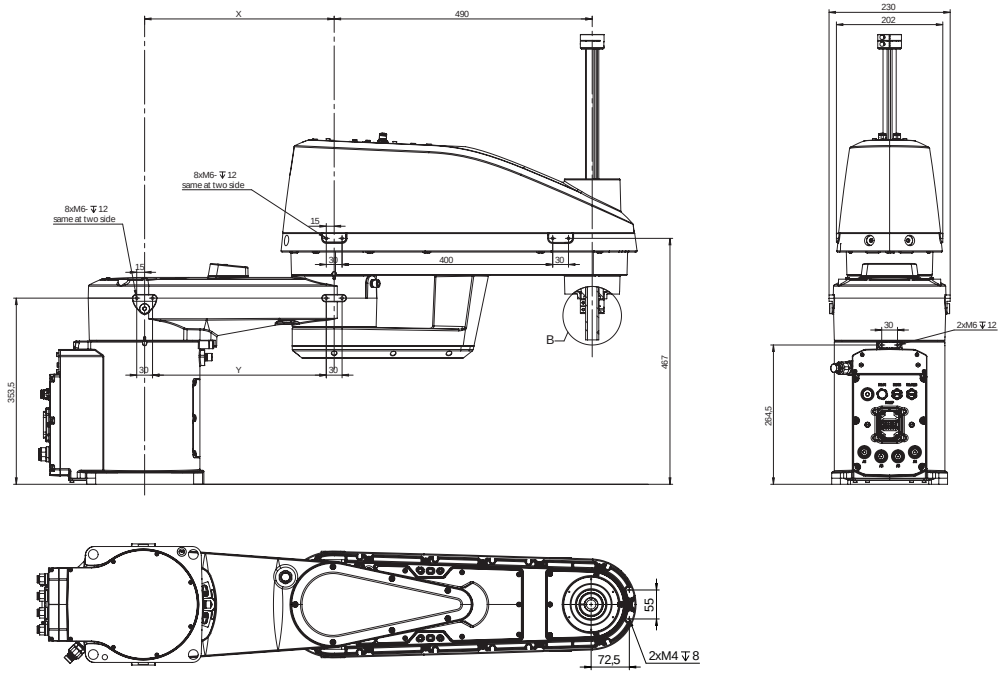
See the product specification for the robot, listed in *References on page 10*.

3.3.7 Fitting equipment on the robot (robot dimensions)

Attachment holes and dimensions

Definitions of dimensions are shown in the following figures. The robot is supplied with holes for fitting extra equipment.

Holes for fitting extra equipment



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	0.85_0.3	0.85_0.45	1.05_0.3	1.05_0.45
X	360 mm	360 mm	560 mm	560 mm
Y	330 mm	330 mm	530 mm	530 mm

Gravity for different arm loads

Arm loads can be mounted on the axis 2. The center of gravity of the extra load shall be within the marked load areas. The robot is supplied with holes for mounting of extra equipment. (See figures in Holes for mounting of extra equipment.)

Note

Maximum load on the frame must not be exceeded.

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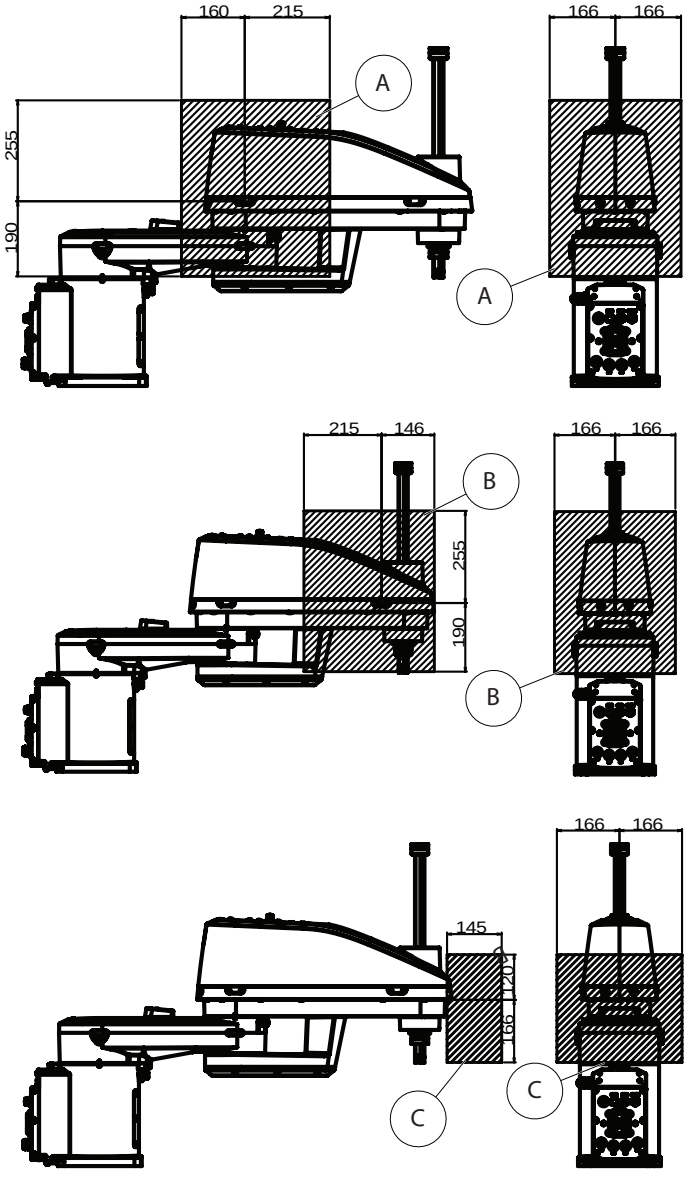

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Load area robot	Max load		
	A	B	C
IRB 930-12/0.85 IRB 930-12/1.05	1 kg	1 kg	1 kg
IRB 930-22/1.05	1.5 kg	1.5 kg	1.5 kg

Fitting of end effector to the ball screw spline shaft

An end effector can be attached to the lower end of the shaft of the ball screw spline unit. The dimensions for fitting the end effector is shown in the following figure.

Note

Mounting of other equipment on the IRB 930 may damage the gearboxes.

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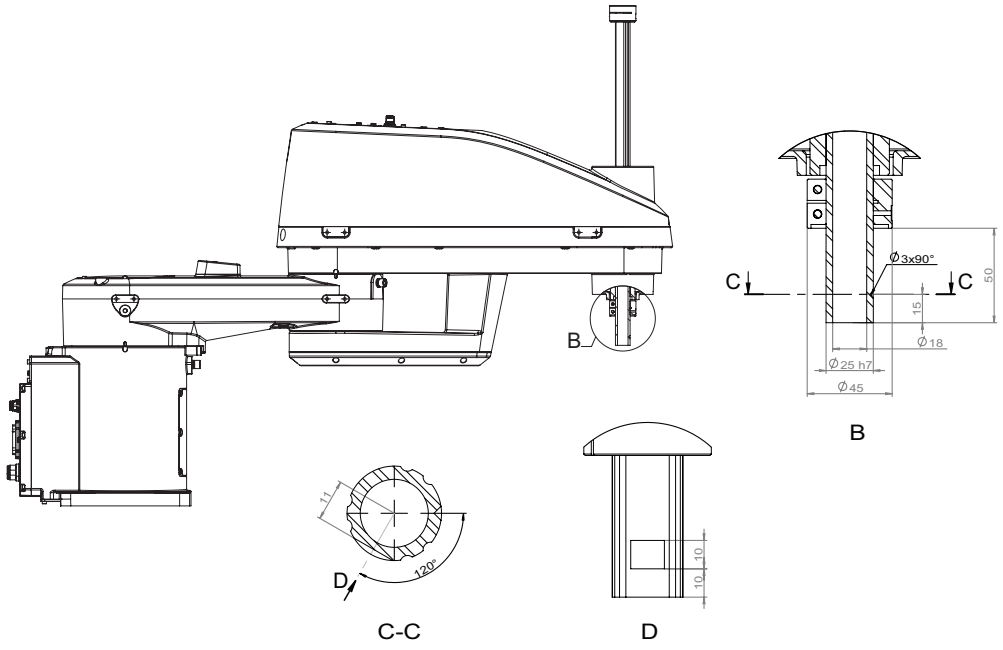
3.3.7 Fitting equipment on the robot (robot dimensions)
Continued

Robots with protection class IP30 3350-300



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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 Restricting the working range

3.4.1 Adjusting the working range

Reasons for adjusting the manipulator working range

The working range of each manipulator axis is configured in the software. If there is a risk that the manipulator may collide with other objects at installation site, its working space should be limited. The manipulator must always be able to move freely within its entire working space.

Working range configurations

The parameter values for the axes working range can be altered within the allowed working range and according to available options for the robot, either to limit or to extend a default working range. Allowed working ranges and available options for each manipulator axis are specified in *Working range on page 43*.

Mechanical stops on the manipulator

Mechanical stops are and can be installed on the manipulator as limiting devices to ensure that the manipulator axis does not exceed the working range values set in the software parameters.

Note

The mechanical stops are only installed as safety precaution to physically stop the robot from exceeding the working range set. A collision with a mechanical stop always requires actions for repair and troubleshooting.

Axis	Fixed mechanical stop[i]	Movable mechanical stop[ii]
Axis 1	yes	no
Axis 2	yes	no
Axis 3	yes	yes
Axis 4	no	no

i Part of the casting or fixed on the casting and can not /should not be removed.

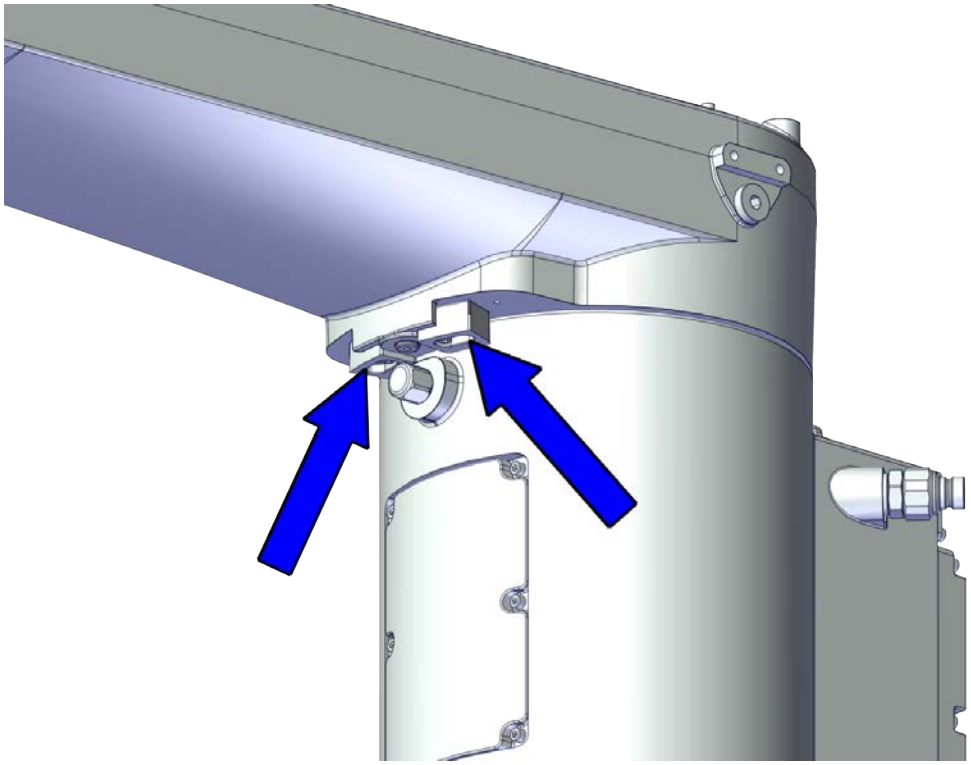
ii Can be installed in one or more than one position, to ensure a reduced working range, or be removed to allow extended working range.

3.4.2 Mechanically restricting the working range

Axis-1 mechanical stops

Location of the axis-1 mechanical stop

The figures shows where the axis-1 mechanical stop is placed on the robot.



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Required spare parts

> **Note**
>
> The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 930 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Rubber stop	3HAC081815-001	With bolt
Hex socket head cap flange screw	3HAB3412-416	Used for axis-1 mechanical stop.

Replacement of the axis-1 mechanical stop

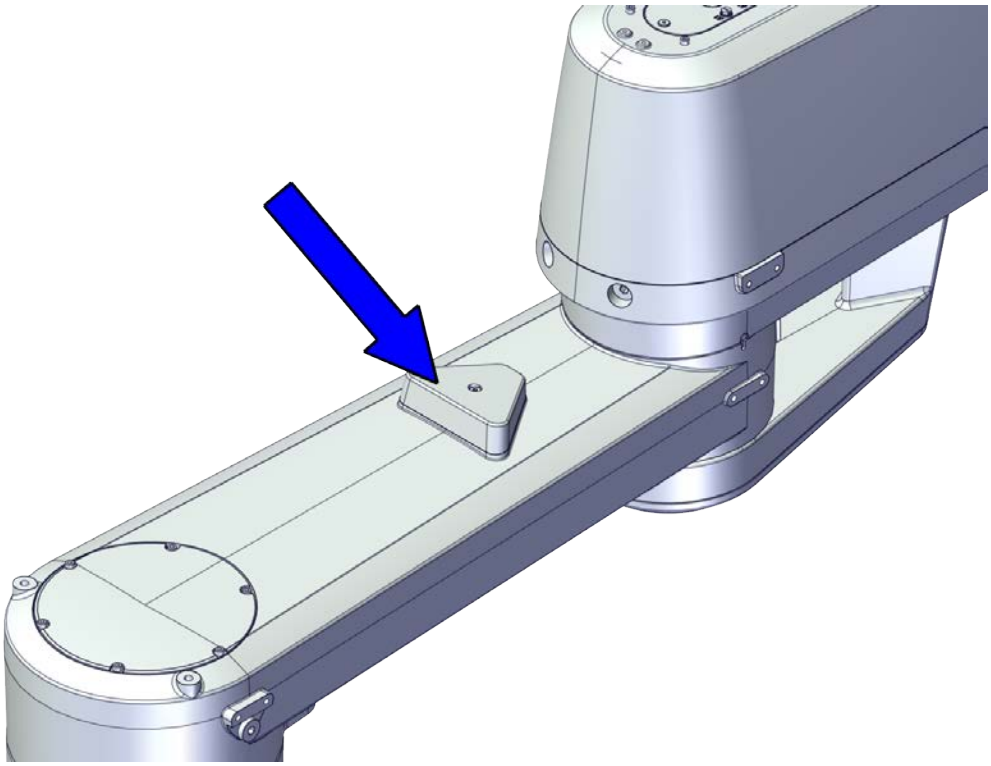
For more details about replacing the axis-1 mechanical stop , see *Replacing the mechanical stopper on page 280*.

Continues on next page

Axis-2 mechanical stops

Location of the axis-2 mechanical stop

The figures shows where the axis-2 mechanical stop is placed on the robot.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 930 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Damper	3HAC084073-001	Replace if damaged.
Hex socket head cap flange	3HAB3412-412	Used for axis-2 mechanical stop.

Replacement of the axis-2 mechanical stop

For more details about replacing the axis-2 mechanical stop , see *Replacing the mechanical stopper on page 280*.

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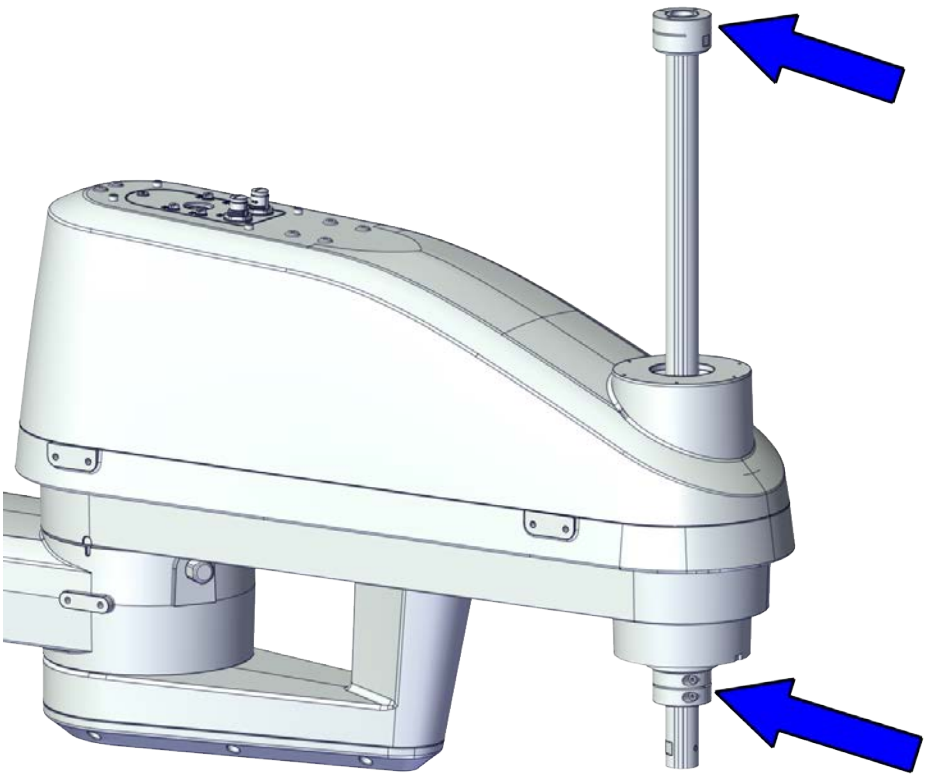
3.4.2 Mechanically restricting the working range
Continued

Axis 3 mechanical stops

Location of the mechanical stops

The figures shows where the axis 3 mechanical stops are placed on the robot.



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Required spare parts

> **Note**
>
> The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 930 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Rubber bumper	3HAC081787-001	
Mechanical stopper	3HAC081786-001	

Replacement of the axis-3 mechanical stop

For more details about replacing the axis-3 mechanical stop , see *Replacing the mechanical stopper on page 280*.

3.5 Electrical connections

3.5.1 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 71*.
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. The customer cables also include the air hose. See the product manual for the controller, see document number in *References on page 10*.
Air hoses	The hose for compressed air is integrated with the manipulator cable harness.

Robot cables

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

Cable sub-category	Description	Connection point, cabinet	Connection point, robot
Robot cables, power	Transfers drive power from the drive units in the control cabinet to the robot motors.	X1	R1.MP
Robot cable, signals	Transfers resolver data from and power supply to the serial measurement board.	X2	R1.SMB

Continues on next page

3.5.1 Robot cabling and connection points
Continued

Robot cable, power

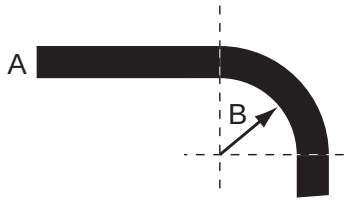
Power cable length	Article number
Power cable, straight connector, 3 m	3HAC077245-001
Power cable, straight connector, 7 m	3HAC077245-002
Power cable, straight connector, 15 m	3HAC077245-003
Power cable, angled connector, 3 m	3HAC077247-001
Power cable, angled connector, 7 m	3HAC077247-002
Power cable, angled connector, 15 m	3HAC077247-003

Robot cable, signals

Signal cable length	Article number
Signal cable, shielded: 3 m	3HAC084767-001
Signal cable, shielded: 7 m	3HAC084767-002
Signal cable, shielded: 15 m	3HAC084767-003

Bending radius for static floor cables

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



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A	Diameter
B	Diameter x10

Customer cables - CP/CS cable

CP/CS cable length	Article number
3 m	3HAC067449-001
7 m	3HAC067449-002
15 m	3HAC067449-003

Customer cables - Ethernet floor cable

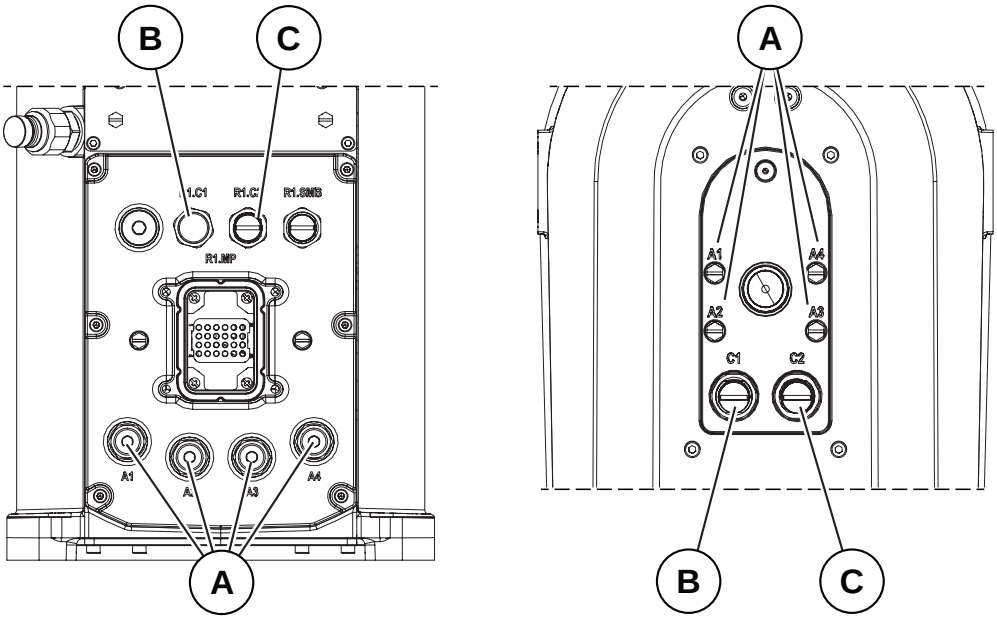
Ethernet floor cable length	Article number
7 m	3HAC067447-002
15 m	3HAC067447-003

3.5.2 Customer connections

Introduction to customer connections

The cables for customer connection are integrated in the robot and the connectors are placed at the outer arm and base. There are two connectors C1/C2 at the outer arm. Corresponding connector R1.C1/R1.C2 are located at the base.

Hose for compressed air is also integrated into the manipulator. There are 4 inlets at the base (R1/8")) and 4 outlets (M5) on the outer arm.



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Position	Connection	Description	Number	Value
A	Air	Max. 6 bar	4	Air hose with outer diameter 6 mm, 4 pcs
B	C1	Customer power/signal	12 wires	30 V, 1.5 A
C	C2	Customer power/signal or ethernet	8 wires	30 V, 1 A or 1 Gbits/s

Connector kits (optional)

Connector kits, base

R1.C1 and R1.C2 connectors on the base are parts of the CP/CS cable and Ethernet floor cable, respectively. For details about the robot cabling, see *Robot cabling and connection points on page 71*.

Continues on next page

3.5.2 Customer connections
Continued

Connector kits, outer arm

The table describes the CP/CS and Ethernet (if any) connector kits for the outer arm.

Position	Description		Art. no.
Connector kits	CP/CS	M12 CPCS Male straight connector kits	3HAC066098-001
		M12 CPCS Male angled connector kits	3HAC066099-001
	Ethernet	M12 Ethernet Cat5e Male straight connector kits	3HAC067413-001
		M12 Ethernet Cat5e Male angled connector kits	3HAC067414-001

Protection covers

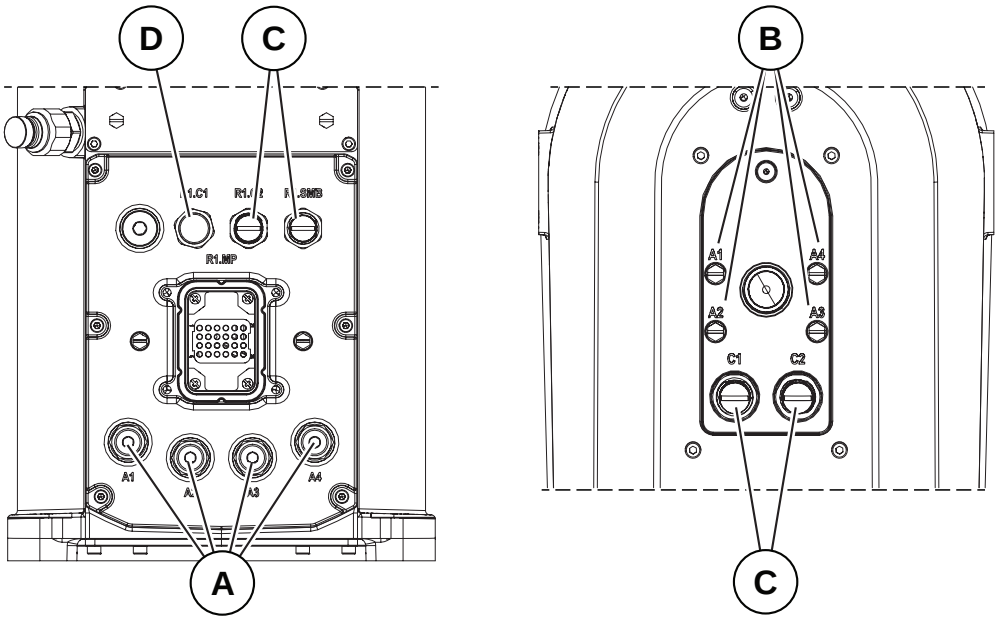
Protection covers for water and dust proofing

Protection covers are delivered together with the robot and must be well fitted to the connectors in any application requiring water and dust proofing.

Always remember to refit the protection covers after removing them.

Note

If the protection covers are not refitted back with the connectors exposed, the protection class will be lost.



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A	Protection covers for air hose connector on the base
B	Protection covers for air hose connector on the process hub
C	Protection covers for C2/SMB connector on the base and C1/C2 connector on the process hub

Continues on next page

D	Protection cover for C1 connector on the base

3.6 Start of robot in cold environments

Introduction

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

Problems with starting the robot

Event message from Motion Supervision

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

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

Robot stopping with other event message

Use this procedure if the robot is not starting.

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

Adjusting the speed and acceleration during warm-up

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

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

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

3.7 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.

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4 Maintenance

4.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 930.

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 930 is connected to power, always make sure that the IRB 930 is connected to protective earth and a residual current device (RCD) before starting any maintenance work.

For more information see:

- *Product manual - OmniCore C30*
- *Product manual - OmniCore C90XT*
- *Product manual - OmniCore E10*
- *Robot cabling and connection points on page 71*.

4.2 Service Information System (SIS)

General

Service Information System (SIS) is a software function within the robot controller, which simplifies maintenance of the robot system. It supervises the operating time and mode of the robot, and alerts the operator when a maintenance activity is scheduled.

Troubleshooting

The SIS function *Gearbox* is available for estimating the service interval (remaining lifetime) of the gearboxes of a robot. Such information of the ball screw spline unit of the IRB 930 is reported as **axis 3** in the SIS system. When a service message is reported for axis 3 of the IRB 930, an inspection on the ball screw spline unit is required.

For more information about the SIS function, see *Operating manual - Service Information System*.

4.3 Maintenance schedule and expected component life

4.3.1 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 930:

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

  The SIS used in OmniCore is further described in the *Operating manual - OmniCore*.

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

4.3.2 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 84*

Maintenance schedule

Maintenance activities	Regularly	Every 12 months	Every 36 months	Every 6,000 hours [i]	Every 15,000 hours [i]	Every 20,000 hours [i]	Reference
Cleaning the robot	x						*Cleaning the IRB 930 on page 98*
Inspecting the robot	x						Check for abnormal wear or contamination.
Inspecting the robot harness	x [ii]						*Inspecting the robot cabling on page 86*
Inspecting the information labels		x					*Inspecting the information labels on page 85*
Inspecting the ball screw spline unit	x						*Inspecting the ball screw spline unit on page 87*
Inspecting the mechanical stop	x						*Inspecting mechanical stops on page 90*
Inspecting the timing belt		x					*Inspecting timing belts on page 94*
Lubricating the ball screw spline unit	x [iii]						*Lubricating the ball screw spline unit on page 96*
Replacing the SMB battery pack			x [iv]				*Replacing the battery pack on page 95*
Changing the oil in axis-1 gearbox				x		x	First change when DTC [i] reads: • 6000 hours Following changes: • 20000 hours *Changing oil, axis-1 gearbox on page 101*

Continues on next page

Maintenance activities	Regularly	Every 12 months	Every 36 months	Every 6,000 hours [i]	Every 15,000 hours [i]	Every 20,000 hours [i]	Reference
Changing the oil in axis-2 gearbox				x		x	First change when DTC [i] reads: • 6000 hours Following changes: • 20000 hours *Changing oil, axis-2 gearbox on page 106*
Running the *Brake Check* routine [v]	x [vi]						Recommended to robots without the SafeMove option. See *Operating manual - OmniCore*.
Running the *Cyclic Brake Check* routine [v]	x [vi]						Recommended to robots with the SafeMove option. See *Application manual - Functional safety and SafeMove*.
Overhaul of complete robot						x	

i Operating hours counted by the DTC = Duty time counter.
ii Replace when damage or cracks is detected or life limit is approaching that specified in section *Expected component life on page 84*.
iii Inspect the grease condition on ball screw spline unit frequently and lubricate the unit if any of grease degradation (including but not limited to discoloration or dry-out) or insufficiency is observed. Alternatively, lubricate the ball screw spline unit regularly depending on the application condition.
iv The battery is to be replaced at given maintenance interval or at battery low alert.
v Not needed separately if already included in the application.
vi Recommended test interval is within the range 8-48 hours.

4.3.3 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
Cable harness, normal usage [i]	20000 hours [ii]	
Cable harness, extreme usage [iii]	20000 hours [ii]	
Gearboxes	20000 hours	

i Examples of "normal usage" in regard to movement: most material handling applications and limited use of bending backwards mode of axis 3.

ii Severe chemical or thermal environments, or similar environments, can result in shortened life expectancy.

iii Examples of "extreme usage" in regard to movement: press tending, very severe palletizing applications, major use of axis 1 movement and major use of bending backwards of axis 3.

4.4 Inspection activities

4.4.1 Inspecting the information labels

Location of labels

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

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 *Spare parts on page 619*.

4.4.2 Inspecting the robot cabling

Required tools and equipment

Visual inspection, no tools are required.

Other tools and procedures may be required if the spare part needs to be replaced. These are specified in the replacement procedure.

Inspection, robot cabling

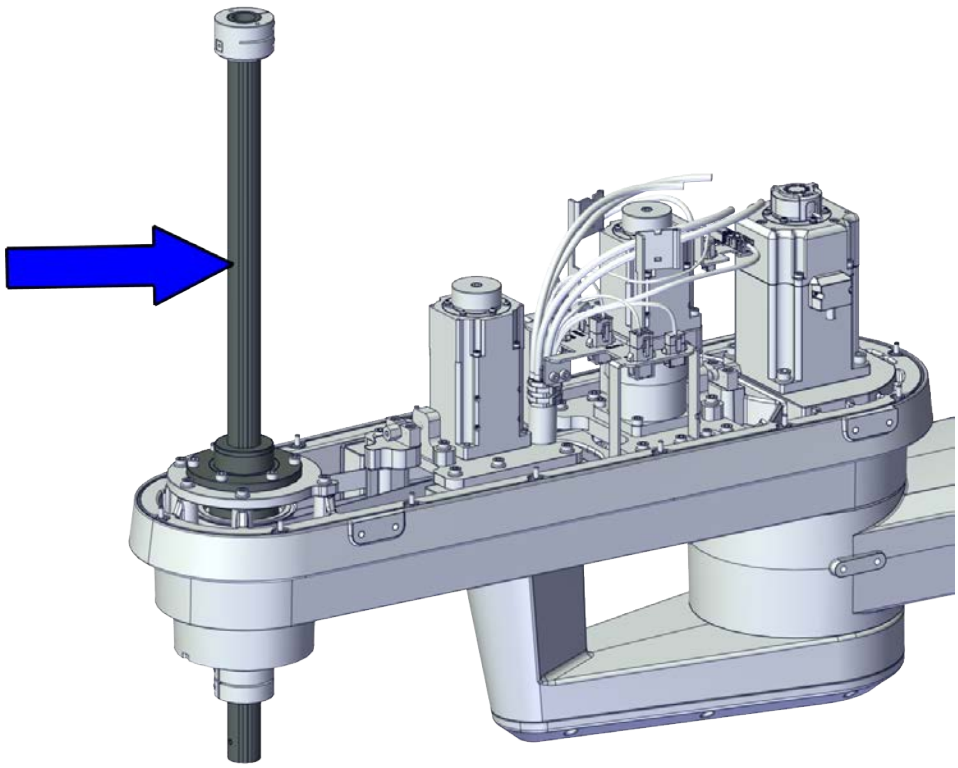
Use this procedure to inspect the robot cabling.

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Visually inspect: • the control cabling between the robot and control cabinet • the cabling to motors 1 and 2. Look for abrasions, cuts or crush damage.	
3	Replace the cabling if wear or damage is detected.	

4.4.3 Inspecting the ball screw spline unit

Location of ball screw spline unit

The ball screw spline unit is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 930 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Ball screw	3HAC081796-001	
Ball screw, long stroke	3HAC081797-001	
Ball screw flange	3HAC081785-001	
Rubber bumper	3HAC081787-001	
Mechanical stopper	3HAC081786-001	
Pulley on the ball screw upper position	3HAC081703-001	

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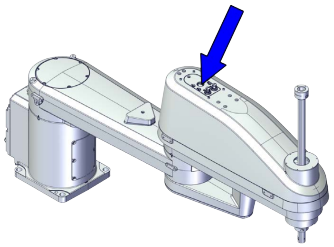
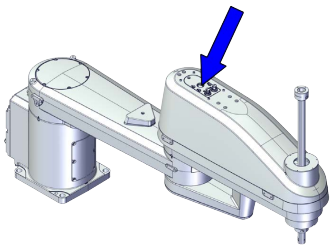
4.4.3 Inspecting the ball screw spline unit

Continued

Required tools and equipment

Spare part	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.
24 VDC power supply	-	Used to release the motor brakes.

Inspecting, ball screw spline unit

	Action	Note
1	Turn on the electric power supply to the robot. 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 59*.	
2	**DANGER** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways! Make sure the payload is disassembled or tooling is properly supported; otherwise, fast downward movements of axis 3 may cause severe hits.	
3	Release the holding brake by pressing the button on the internal brake release unit.	 xx2300000168
4	Move the outer arm to a position where the axis 3 can be moved in full stroke.	
5	Press the brake release button and move the shaft to its upper and lower limits manually.	 xx2300000168

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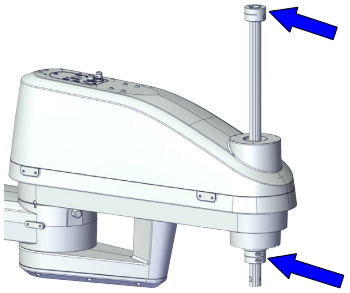
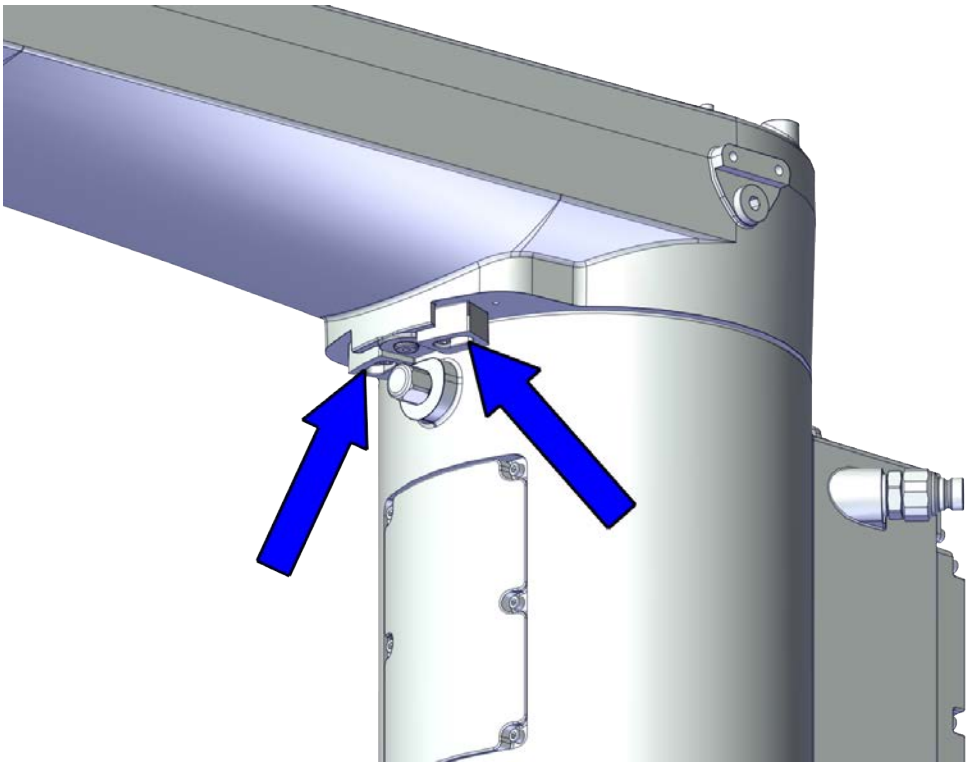
	Action	Note
6	Visually inspect: • the stop blocks on the ball screw spline unit • the shaft of the ball screw spline unit Look for abrasions, cuts or crush damages on the spline, and grease amount on the shaft.	 xx2300000172
7	Apply grease to the shaft if it is not enough.	See *Lubricating the ball screw spline unit on page 96*.
8	Replace the ball screw spline unit if wear or damage is detected.	See *Replacing the ball screw on page 311*.

4.4.4 Inspecting mechanical stops

Location of mechanical stops

The mechanical stops on axis 1, 2 and 3 are located as shown in the figures.



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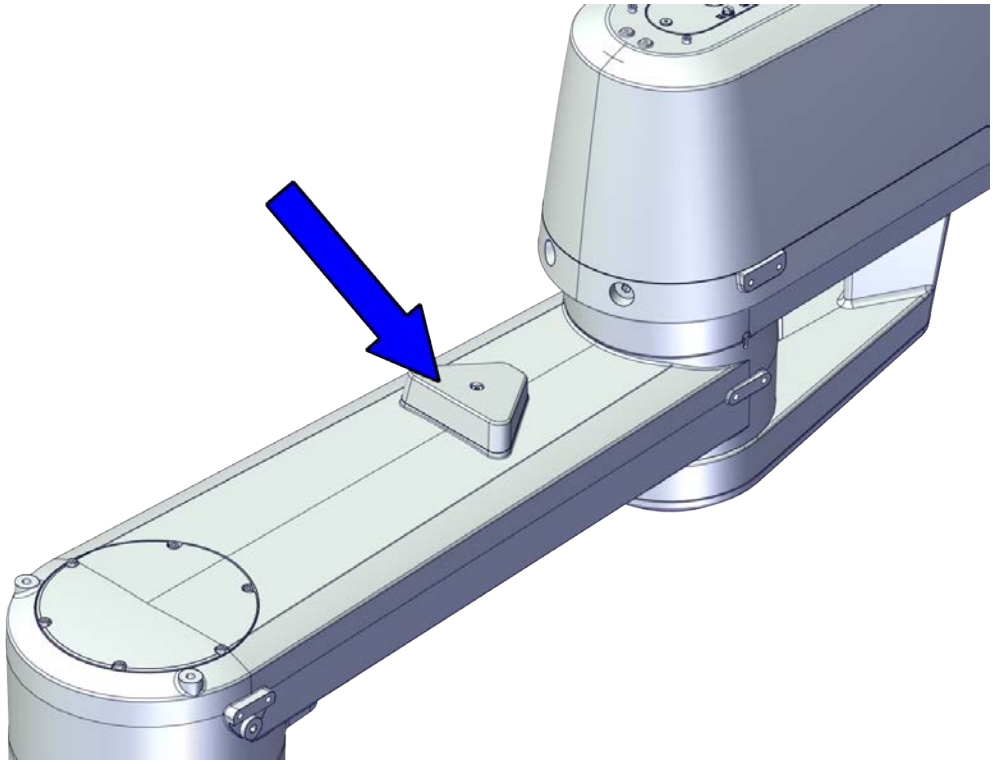

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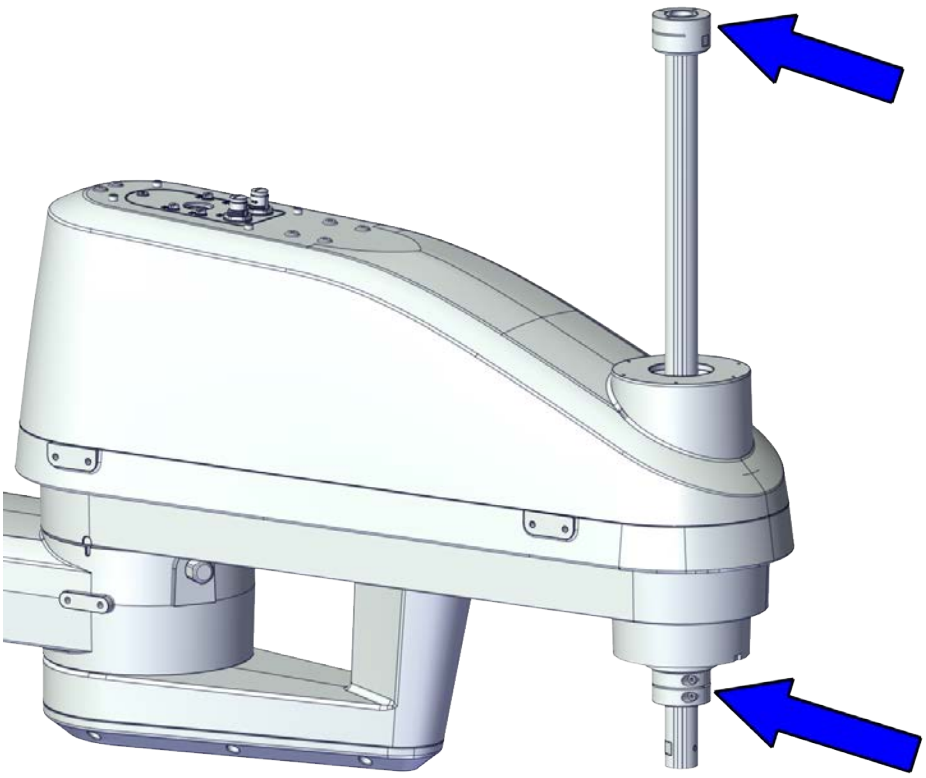

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4.4.4 Inspecting mechanical stops
Continued

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

Spare part	Article number	Note
Rubber bumper	3HAC081787-001	
Mechanical stopper	3HAC081786-001	

Required tools and equipment

Visual inspection, no tools are required.

Other tools and procedures may be required if the spare part needs to be replaced. These are specified in the replacement procedure.

Inspecting, mechanical stops

Use this procedure to inspect mechanical stops on axes 1,2 and 3.

	Action	Information
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	

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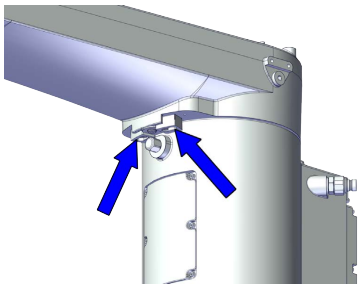
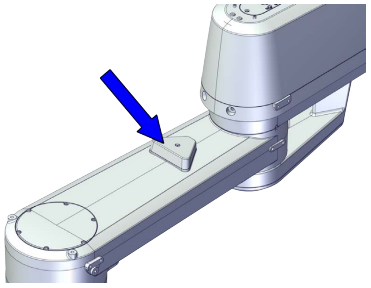
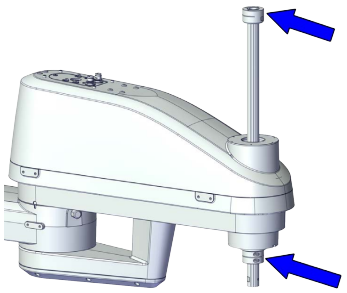
	Action	Information
2	Inspect the mechanical stops.	 xx2300000173  xx2300000174  xx2300000172
3	Replace if any mechanical stop is: • bent • loose • damaged. **Note** The expected life of gearboxes can be reduced as a result of collisions with the mechanical stop.	

4.4.5 Inspecting timing belts

Location of timing belts

The timing belts are located as shown in the figures.

Required tools and equipment

Equipment	Note
Standard toolkit	The content is defined in the section *Standard toolkit on page 616*.
Other tools and procedures may be required if the spare part needs to be replaced. These are specified in the replacement procedure.	

Timing belt tension

The table describes the timing belt tension.

Axis	Force		Frequency	
	Used timing belt	New timing belt	Used timing belt	New timing belt
Axis 3	36.6-41.8 N	40-53 N	139-149 Hz	109-119 Hz
Axis 4	36.3-41.4 N	35-50 N	312-333 Hz	88.4-92.7 Hz

Inspecting timing belts

Use this procedure to inspect timing belts.

	Action	Information
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Gain access to each *timing belt* by removing the cover.	
3	Check the timing belts for damage or wear.	
4	Check the *timing belt pulleys* for damage.	
5	If any damage or wear is detected, the part must be replaced!	
6	Use a sonic tension meter to measure the timing belt tension. Adjust the belt tension if needed!	See *Timing belt tension on page 94*.

4.5 Replacement/changing activities

Replacing the battery pack

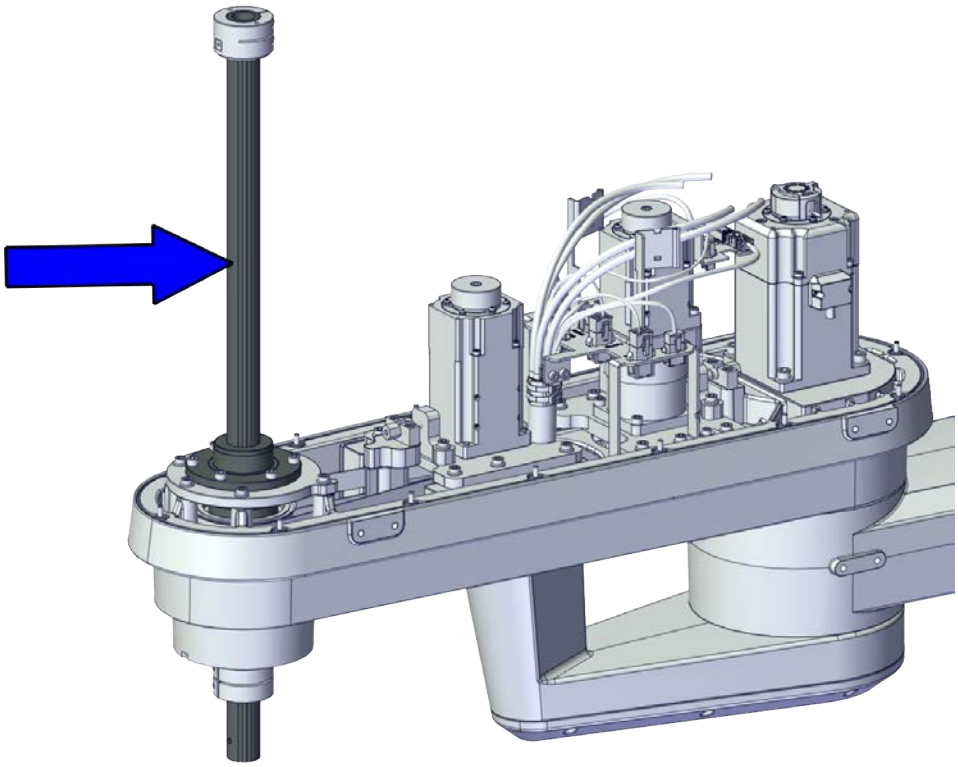
Replacing the battery pack is accessible after removing the SMB from the base, see *Replacing the SMB unit and battery unit on page 130*.

4.6 Lubrication activities

4.6.1 Lubricating the ball screw spline unit

Location of the ball screw spline unit

The ball screw spline unit is located as shown in the figure.



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Required tools and equipment

Equipment	Article number	Note
24 VDC power supply	-	Used to release the motor brakes.

Required consumables

Consumable	Article number	Note
Grease	-	THK AFA
Grease	3HAC077740-001	Gastrol Spheerol EPL 1

Continues on next page

Lubricating the ball screw spline unit

Note

Cover the end effector and peripheral equipment in case the grease drips, before lubricating the ball screw spline unit.

	Action	Note
1	Turn on the electric power supply to the robot. 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 59*.	
2	**DANGER** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways! Make sure the payload is disassembled or tooling is properly supported; otherwise, fast downward movements of axis 3 may cause severe hits.	
3	Release the holding brake by pressing the button on the internal brake release unit.	
4	Move the outer arm to a position where the axis 3 can be moved in full stroke.	
5	Move the shaft manually to its upper limit while pressing the brake release button.	
6	Wipe off old grease from the shaft.	
7	Apply new grease and fill the grooves. Wipe off excessive grease.	
8	Move the shaft manually to its lower limit while pressing the brake release button.	
9	Wipe off old grease from the shaft.	
10	Apply new grease and fill the grooves. Wipe off excessive grease.	
11	Move the shaft up and down several times while pressing the brake release button to smooth out the grease on the shaft. Wipe off excessive grease.	

4.7 Cleaning activities

4.7.1 Cleaning the IRB 930

General

To secure high uptime it is important that the IRB 930 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 930.

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 jet 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. With light cleaning detergent.	Yes. It's highly recommended to inspect the fans for contamination that could hinder the air supply at the regular cleaning, and then clean if necessary.	No

Continues on next page

Cleaning with water

Instructions for rinsing with water

ABB robots with protection types *Standard*, *Foundry Plus*, *Wash*, or *Foundry Prime* can be cleaned by rinsing with water (water cleaner). [1]

The following list defines the prerequisites:

- 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.

1 See *Cleaning methods on page 98* for exceptions.

4.8 Changing activities

4.8.1 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.

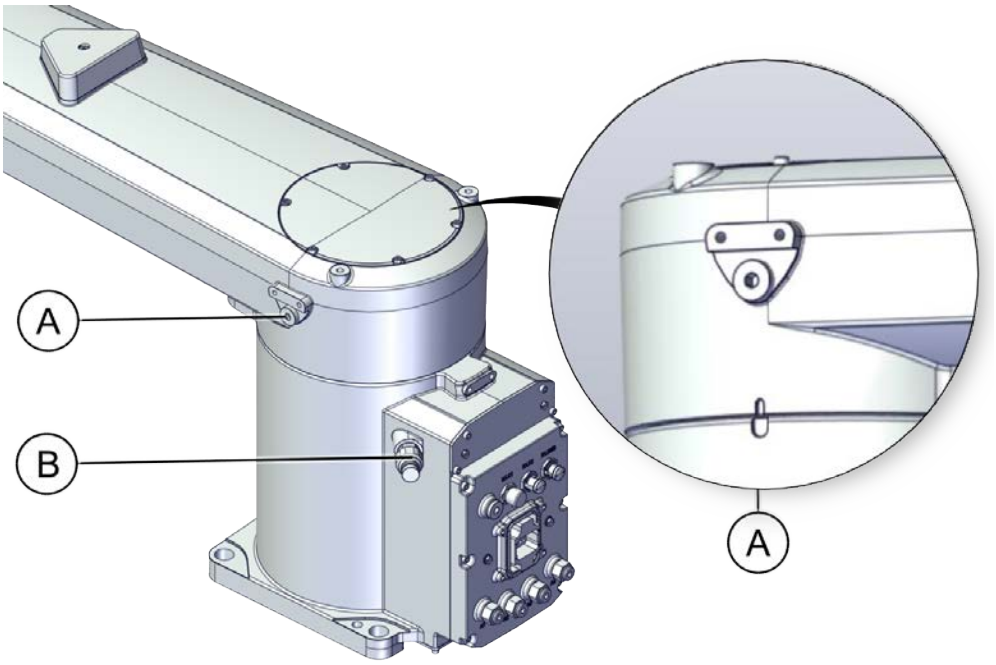
Equipment

Equipment	Note
Oil dispenser	Includes pump with outlet pipe. Use the suggested dispenser or a similar one: • Orion OriCan article number 22590 (pneumatic)
Nipple for quick connect fitting, with o-ring	

4.8.2 Changing oil, axis-1 gearbox

Location of oil plugs

The oil plugs of the gearbox are located as shown in the figure.



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A	Oil plug, filling and venting
B	Quick coupling, draining

Required tools and equipment

Equipment, etc.	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 100*.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Consumable

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 100*.

Continues on next page

4.8.2 Changing oil, axis-1 gearbox
Continued

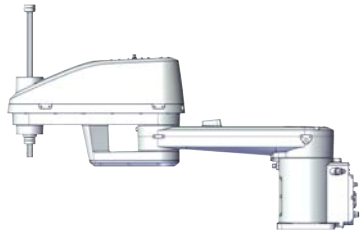
Required documents

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

Draining the axis-1 gearbox

Use this procedure to drain the gearbox.

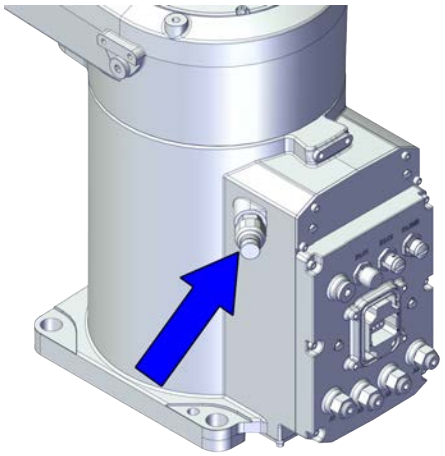
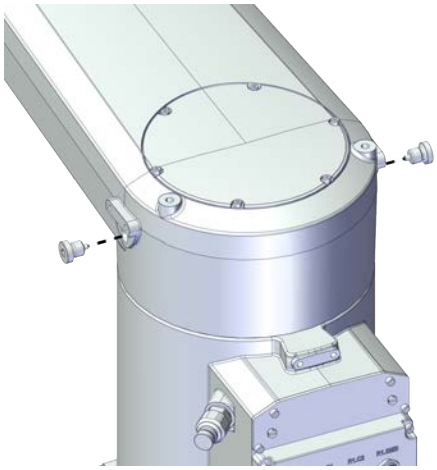
Preparations before draining oil

	Action	Note
1	Jog all axes to zero position.	 xx2300000486
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Draining oil of axis-1 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	
3	Lay down the robot to let the quick coupling facing the ground if needed.	

Continues on next page

	Action	Note
4	Place the oil collecting vessel underneath the quick coupling.	 xx2300000546
5	Remove the oil plugs and keep them opened to speed up the drainage.	 xx2300000547
6	Plug a G3/8 quick coupling connector with pipe to the quick coupling on base.	
7	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 605* for more information.	
8	Drain the gearbox oil.	**Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.

Continues on next page

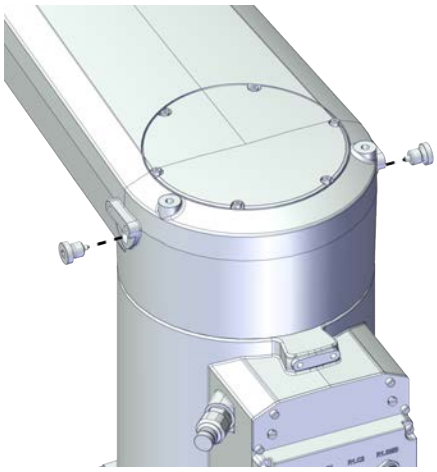
4.8.2 Changing oil, axis-1 gearbox
Continued

	Action	Note
9	Remove the quick coupling connector and clean the pipe after the oil is drained. **Note** There will be some oil left in the gearbox after draining.	
10	Refit oil plugs.	Tightening torque: 10 Nm

Filling oil into the axis-1 gearbox

Use this procedure to refill the gearbox with oil.

Refilling oil to axis-1 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	
3	Open the oil plugs, one for filling and the other for venting.	 xx2300000547

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	Action	Note
4	**WARNING** 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.	
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.
6	Refit the oil plugs.	Tightening torque: 10 Nm

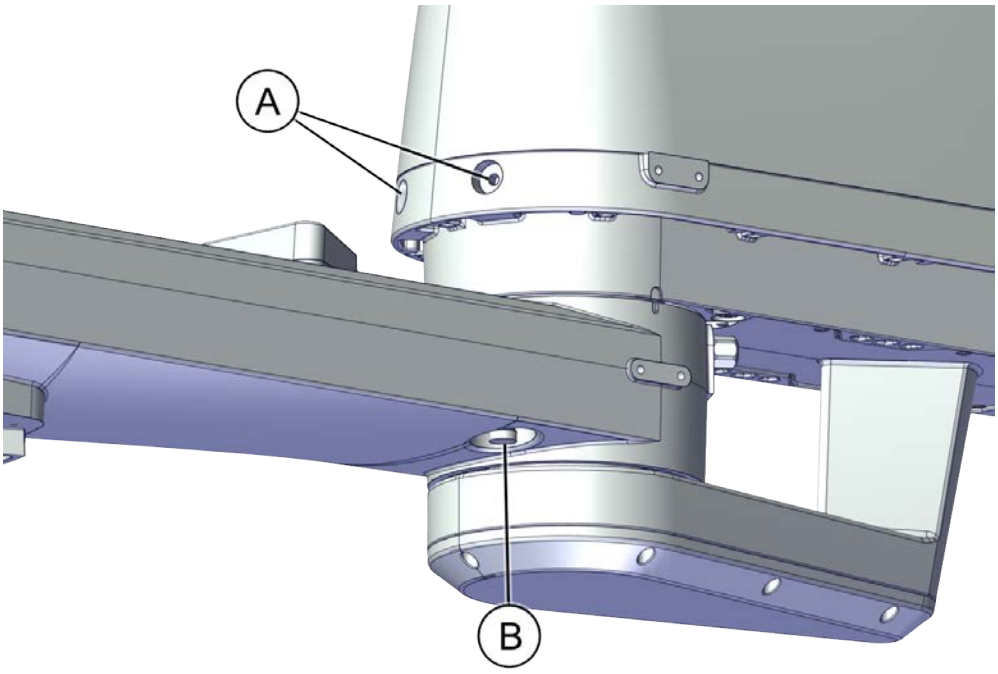
Concluding procedure

	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 55*.	

4.8.3 Changing oil, axis-2 gearbox

Location of oil plugs

The oil plugs of the gearbox are located as shown in the figure.



xx2300000466

A	Oil plug, filling and venting
B	Oil plug, filling, draining and venting

Required tools and equipment

Equipment, etc.	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 100*.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Consumable

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 100*.

Continues on next page

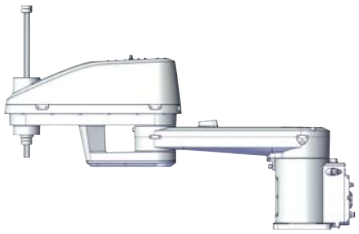
Required documents

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

Draining the axis-2 gearbox

Use this procedure to drain the gearbox.

Preparations before draining oil

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx2300000486
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Draining oil of axis-2 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	

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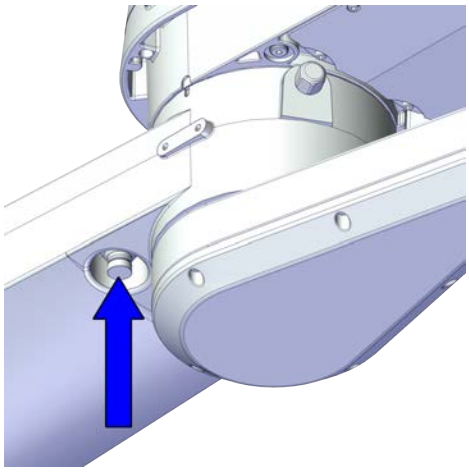
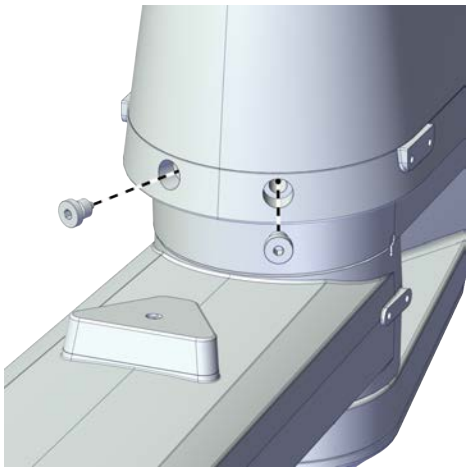
4.8.3 Changing oil, axis-2 gearbox
Continued

	Action	Note
3	Place the oil collecting vessel underneath the oil plug, draining.	 xx2300000548
4	Plug a clean pipe to the oil plug, draining, with the other end to the oil collecting vessel.	
5	Remove the oil plug, draining.	 xx2300000549
6	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 605* for more information.	
7	Drain the gearbox oil.	**Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.

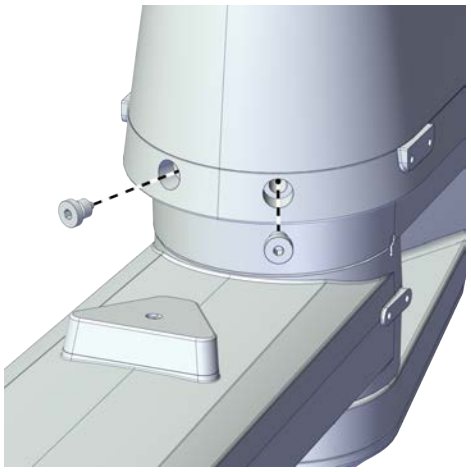
Continues on next page

	Action	Note
8	Remove and clean the pipe after the oil is drained. **Note** There will be some oil left in the gearbox after draining.	
9	Refit oil plugs.	Tightening torque: 10 Nm

Filling oil into the axis-2 gearbox

Use this procedure to refill the gearbox with oil.

Refilling oil to axis-2 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	
3	Open the upper oil plug. **Note** The lower oil plug has to be closed; otherwise, the oil may leak before required oil amount is filled.	 xx2300000549

Continues on next page

4.8.3 Changing oil, axis-2 gearbox
Continued

	Action	Note
4	**WARNING** 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.	
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained. **CAUTION** Oil filling must be slow to make sure air venting is fluent.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.
6	Refit the oil plug.	Tightening torque: 10 Nm
7	**DANGER** Make sure all safety requirements are met when performing the first test run.	

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 55*.	

5 Repair

5.1 Introduction

Structure of this chapter

This chapter describes repair activities for the IRB 930. 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 930, 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

The robot should be secured with the transportation brackets during removing from/refitting to the foundation.

Note

If the IRB 930 is connected to power, always make sure that the IRB 930 is connected to protective earth and a residual current device (RCD) before starting any repair work.

For more information see:

- *Product manual - OmniCore C30*
- *Product manual - OmniCore C90XT*
- *Product manual - OmniCore E10*

5.2 General procedures

5.2.1 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.	

5.2.2 Mounting instructions for bearings

General

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

Equipment

Equipment, etc.	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to grease the bearings, if not specified otherwise.

Assembly of all bearings

Attend to the following instructions while mounting a bearing on the robot.

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

Assembly of tapered bearings

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

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

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

Greasing of bearings

Note

This instruction is not valid for solid oil bearings.

Continues on next page

5.2.2 Mounting instructions for bearings
Continued

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

- The bearings must not be completely filled with grease. However, if space is available beside the bearing fitting, the bearing may be totally filled with grease when mounted, as excessive grease will be pressed out from the bearing when the robot is started.
- During operation, the bearing should be filled to 70-80% of the available volume.
- Ensure that grease is handled and stored properly to avoid contamination.

Grease the different types of bearings as following description:

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

5.2.3 Mounting instructions for sealings

General

This section describes how to mount different types of sealings.

Equipment

Consumable	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2

Rotating sealings

The following procedures describe how to fit rotating sealings.

CAUTION

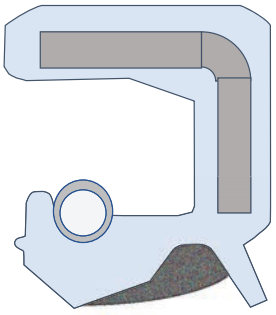
Please observe the following before commencing any assembly of sealings:

- 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.



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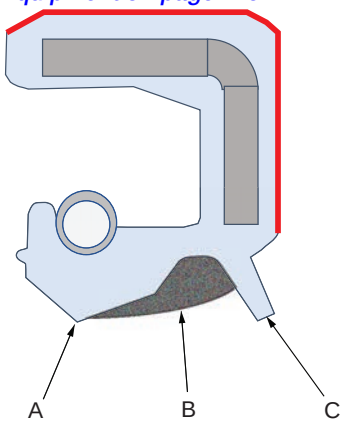
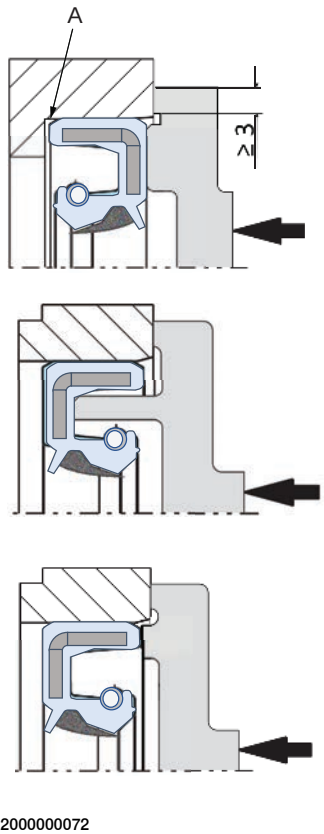
5.2.3 Mounting instructions for sealings

Continued

	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 115*.  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

	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

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.

Continues on next page

5.2.3 Mounting instructions for sealings

Continued

	Action	Note
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.	
5	Tighten the screws evenly while assembling.	
6	Check that the o-ring is not squashed outside the o-ring groove.	

5.2.4 Cut the paint or surface on the robot before replacing parts

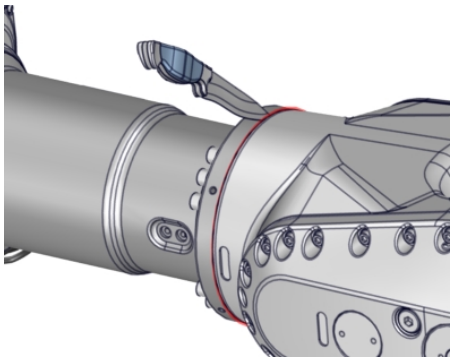
General

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

Required equipment

Equipment	Spare parts	Note
Cleaning agent		Ethanol
Knife		
Lint free cloth		
Touch up paint Standard/Foundry Plus	3HAC067974-001	Graphite White

Removing

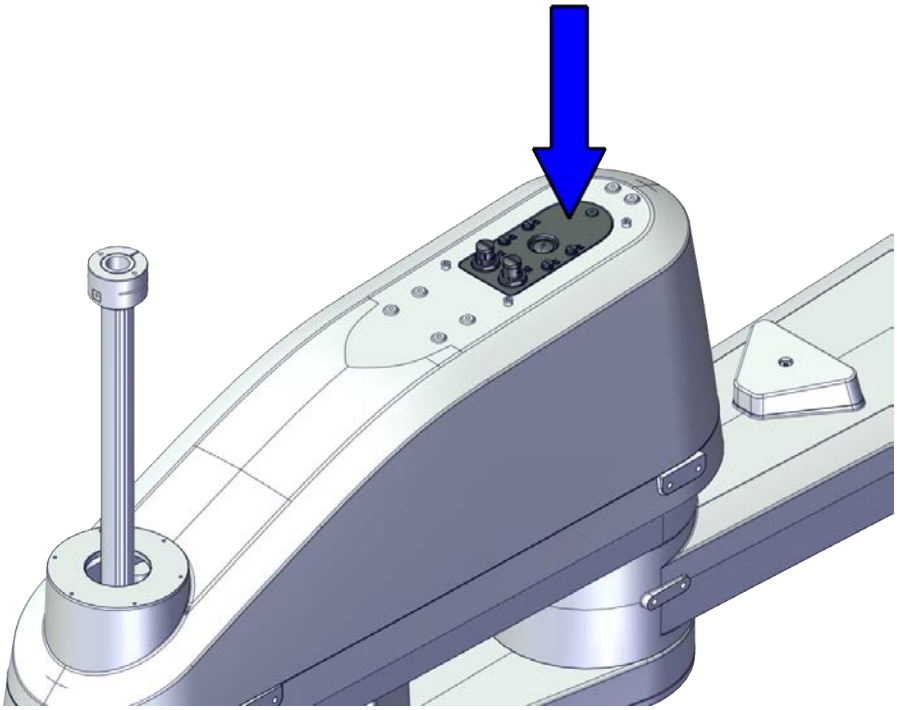
	Action	Description
1	Cut the paint with a knife in the joint between the part that will be removed and the structure, to avoid that the paint cracks.	 xx2300000950
2	Carefully grind the paint edge that is left on the structure to a smooth surface.	

5.3 Cable harness

5.3.1 Replacing the process hub

Location of the process hub

The process hub is located as shown in the figure.



xx2300000467

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

Spare part	Article number	Note
Process hub, Basic	3HAC087326-001	
Process hub, Basic+C1+A	3HAC087327-001	
Process hub, Basic+C1+C2+A	3HAC087328-001	
Outer arm cover	3HAC087313-001	

Continues on next page

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

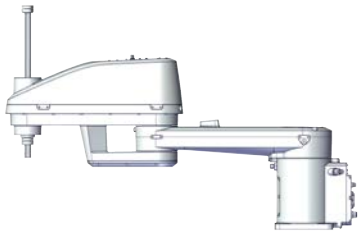
Continues on next page

5.3.1 Replacing the process hub
Continued

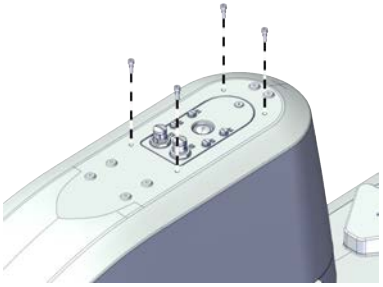
Removing the process hub

Use these procedures to remove the process hub.

Preparations before removing the process hub

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx2300000486
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

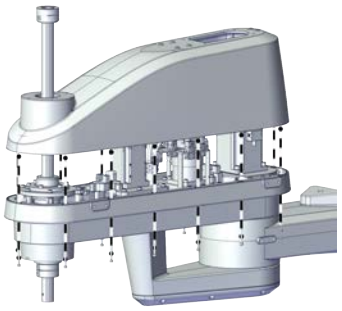
Removing the process hub screws

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487

Continues on next page

	Action	Note
3	Push the process hub to the outer arm.	

Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

Releasing the straps on the bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Cut the straps on the brackets. **Tip** Take photos of the straps before cut them, to have as a reference when reconnecting.	

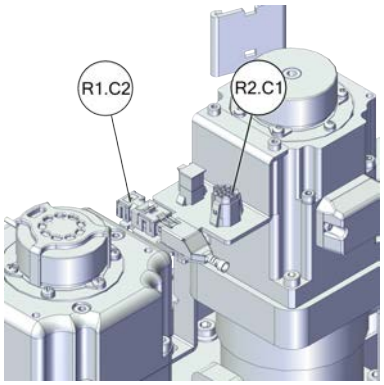
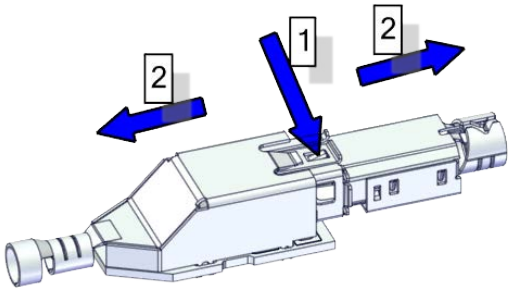
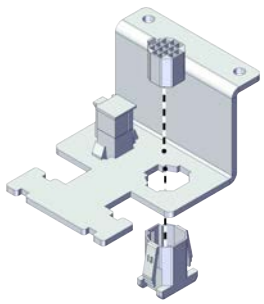
Disconnecting the air hoses, C1 cabling and C2 cabling (if equipped)

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

Continues on next page

5.3.1 Replacing the process hub

Continued

	Action	Note
2	Disconnect the air hoses from the L-shaped connectors.	
3	**For robots with C1 cabling** Disconnect the connector. • R2.C1	 xx2300000542
4	**For robots with C2 cabling** Disconnect the connector. • R1.C2 **Tip** Cut the cable straps for the R1.C2 at the same time. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the R1.C2 (for C2 cabling).  xx1800002943	
5	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544

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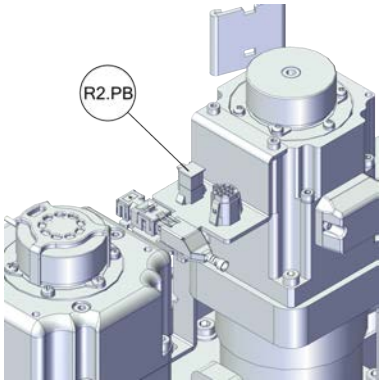
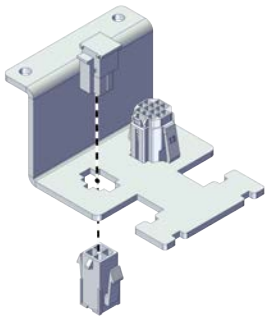
Disconnecting the connector for PB

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connector. • R2.PB	 xx2300000543
3	Snap loose and remove the female head of the connector from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545

Removing the process hub

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Take out the process hub. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	

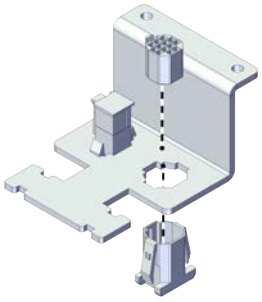
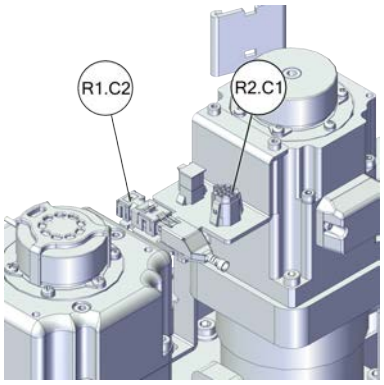
Continues on next page

5.3.1 Replacing the process hub
Continued

Refitting the process hub

Use these procedures to refit the process hub.

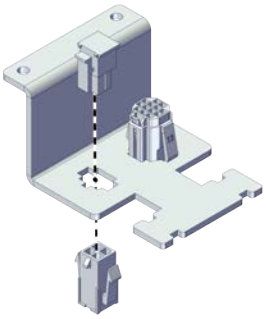
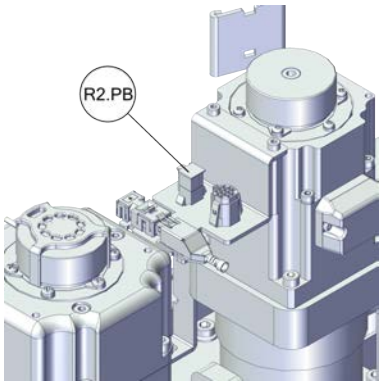
Reconnecting the air hoses, CP/CS cabling and Ethernet cabling (if equipped)

	Action	Note
1	Route the air hoses on the process hub behind the bracket. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
2	Insert the female head of the C1 cabling connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544
3	**For robots with C1 cabling** Reconnect the connector. • R2.C1 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	 xx2300000542
4	**For robots with C2 cabling** Reconnect the connector. • R1.C2 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	
5	Secure the C2 cabling to the C2 bracket with the cable straps.	

Continues on next page

	Action	Note
6	Reconnect the air hoses in a cross pattern with the L-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	
7	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Reconnecting the connector for PB

	Action	Note
1	Insert the female head of the PB connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545
2	Reconnect the connector. • R2.PB **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000543

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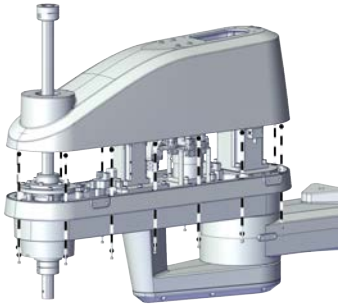
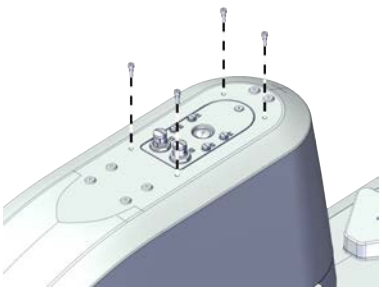
5.3.1 Replacing the process hub
Continued

	Action	Note
3	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed incorrectly the cables can be damaged.	

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487

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	Action	Note
4	Remove the screw.	

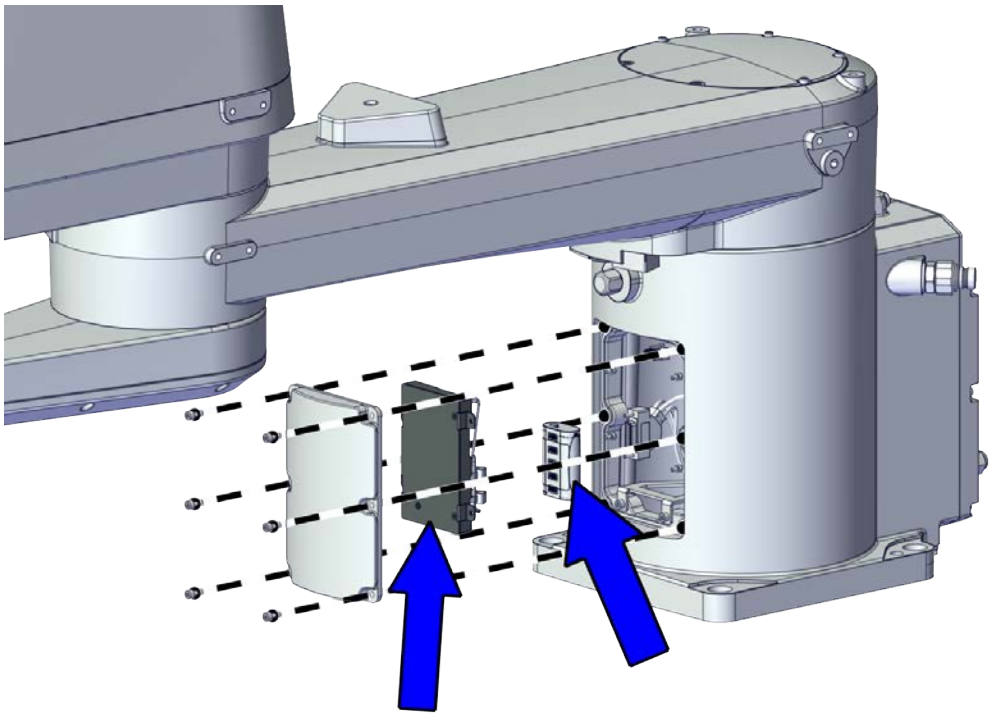
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
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 55*.	

5.3.2 Replacing the SMB unit and battery unit

Location of the SMB unit and battery unit

The SMB unit and battery unit are located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 930 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
SMB unit	3HAC063968-001	
Battery unit	3HAC044075-001	Battery includes protection circuits. Only replace with a specified spare part or an ABB-approved equivalent.
SMB cover	3HAC087302-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Continues on next page

Equipment	Article number	Note
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.

Required consumables

Consumable	Article number	Note
Cable straps	-	

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the SMB unit and battery unit

Use these procedures to remove the SMB unit and battery unit.

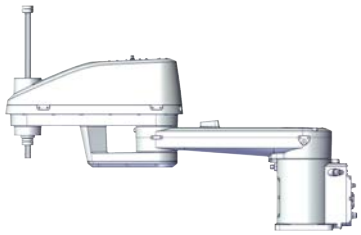
Preparations before removing the SMB unit and battery unit

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	

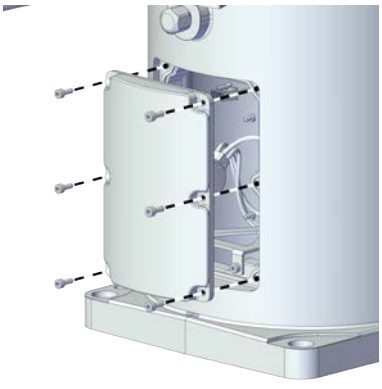
Continues on next page

5.3.2 Replacing the SMB unit and battery unit

Continued

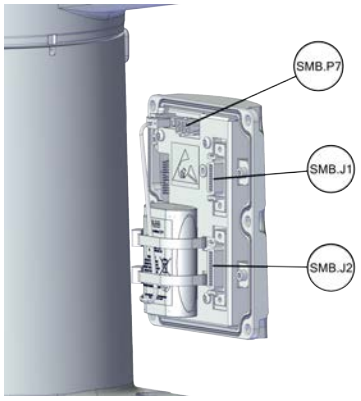
	Action	Note
2	Jog all axes to zero position.	 xx2300000486
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the SMB cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Remove the screws on the SMB cover to the base.	For robots with protection class IP30  xx2300000489
4	Pull the SMB cover with the SMB unit assembly out together.	

Continues on next page

Disconnecting the SMB cabling

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Cut the strips.	
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945

Removing the SMB unit

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	

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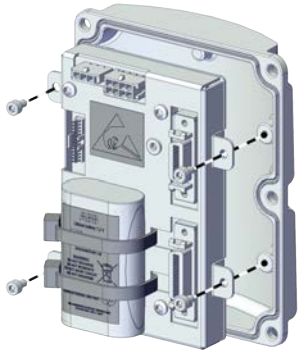
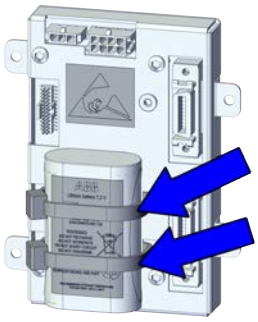
5.3.2 Replacing the SMB unit and battery unit

Continued

	Action	Note
3	Remove the SMB package attachment screws and remove the SMB package from the SMB cover.	 xx2100001036

Separating the battery unit and SMB unit

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Separate the battery unit from the SMB assembly by cutting the cable straps.	 xx2100001035

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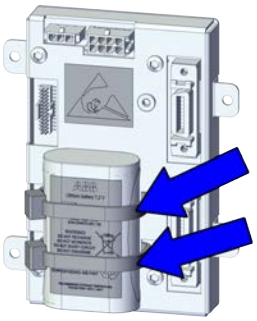
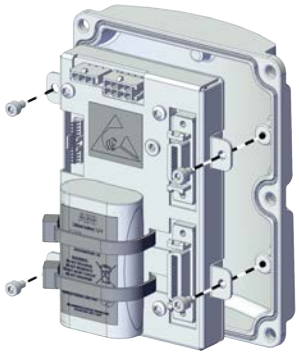
Refitting the SMB unit and battery unit

Use these procedures to refit the SMB unit and battery unit.

Refitting the SMB unit and battery unit

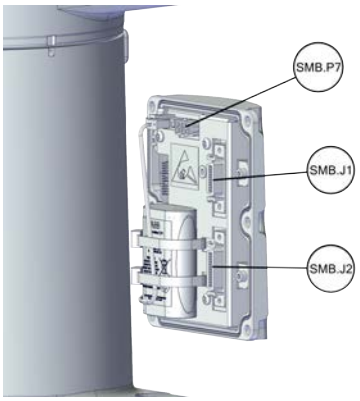
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 46*.	
2	Bind the SMB unit to the battery unit with the cable strap.	 xx2100001035
3	Refit the SMB package to the SMB cover with the screws.	Screws: Hex socket head cap screw M3x5 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.8 Nm  xx2100001036
4	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.3.2 Replacing the SMB unit and battery unit

Continued

Refitting the SMB cover

	Action	Note
1	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945
2	Refit the SMB cover assembly.	For robots with protection class IP30 Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.6 Nm  xx2300000489
3	Secure the SMB cover to the base with the screws.	

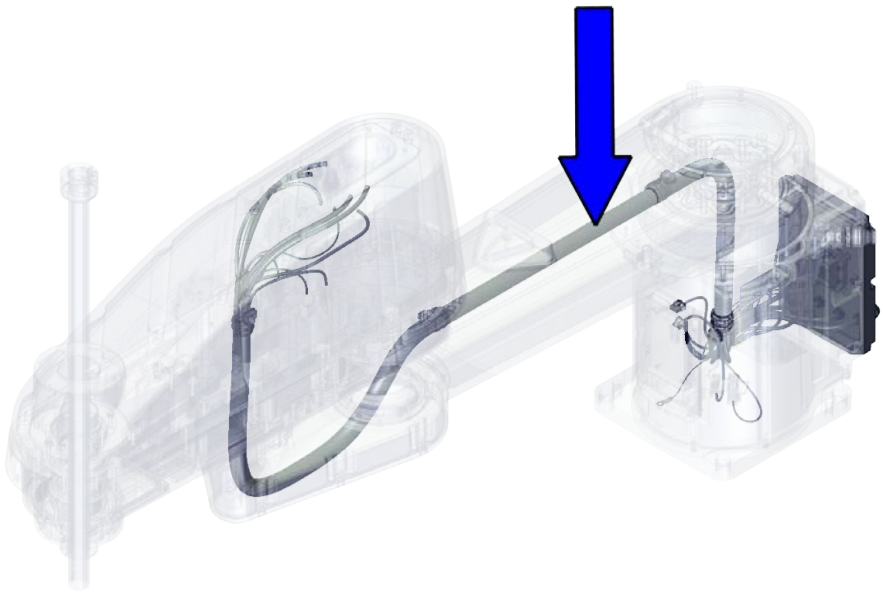
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
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 55*.	

5.3.3 Replacing the main harness

Location of the mian harness

The main harness is located as shown in the figure.



xx2300000469

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

Spare part	Article number	Note
Main harness S, Basic	3HAC087320-001	
Main harness S, Basic+C1+Air	3HAC087321-001	
Main harness S, Basic+C1+C2+Air	3HAC087322-001	
Main harness L, Basic	3HAC087323-001	
Main harness L, Basic+C1+Air	3HAC087324-001	
Main harness L, Basic+C1+C2+Air	3HAC087325-001	
Base plate, rear outlet cable	3HAC0081803-001	Base bottom cover, rear cable
Rear plate, underneath outlet cable	3HAC087318-001	Base rear cover, bottom cable
Base plate, underneath outlet cable	3HAC081817-001	Base bottom cover, bottom cable
Outer arm bracket	3HAC081794-001	

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5.3.3 Replacing the main harness
Continued

Spare part	Article number	Note
Cable arm bracket	3HAC081793-001	
Inner arm bracket	3HAC081792-001	
Base bracket	3HAC081791-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

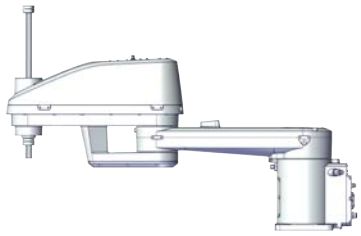
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removing the main harness

Use these procedures to remove the main harness.

Preparations before removing the main arm

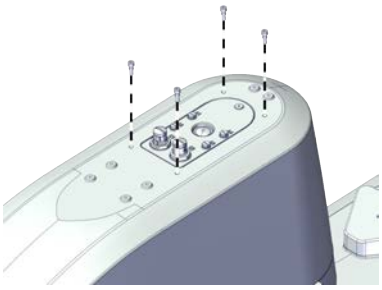
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	Jog all axes to zero position.	 xx2300000486
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the process hub screws

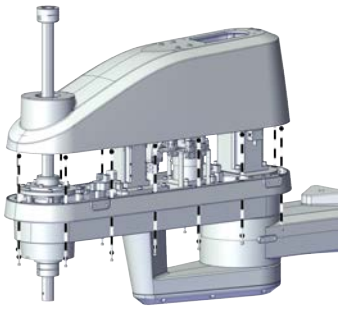
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	

Continues on next page

5.3.3 Replacing the main harness
Continued

	Action	Note
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

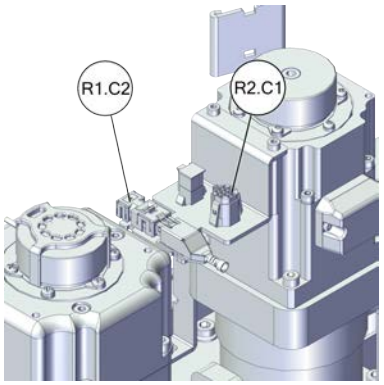
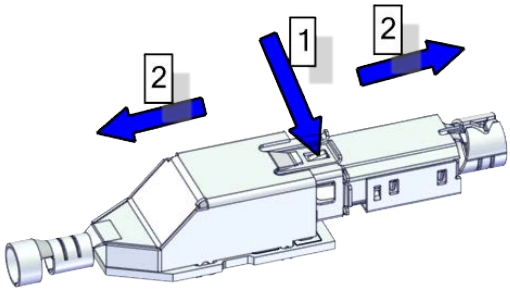
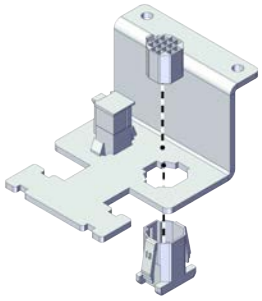
Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

Disconnecting the air hoses, C1 cabling and C2 cabling (if equipped)

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the air hoses from the L-shaped connectors.	

Continues on next page

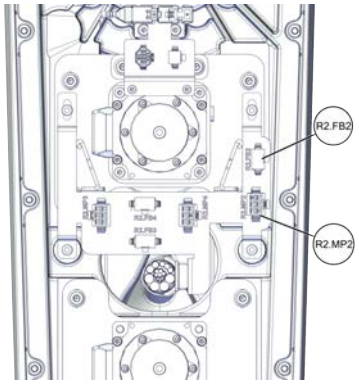
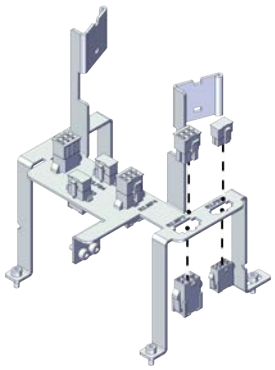
	Action	Note
3	**For robots with C1 cabling** Disconnect the connector. • R2.C1	 xx2300000542
4	**For robots with C2 cabling** Disconnect the connector. • R1.C2 **Tip** Cut the cable straps for the R1.C2 at the same time. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the R1.C2 (for C2 cabling).  xx1800002943	
5	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544

Continues on next page

5.3.3 Replacing the main harness

Continued

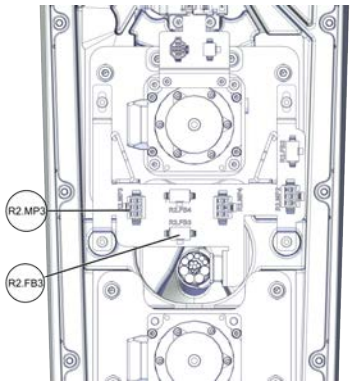
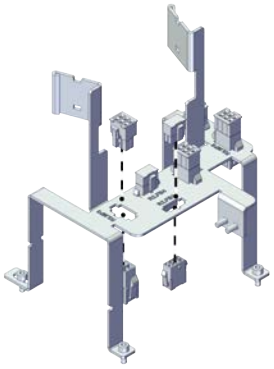
Disconnecting the connectors for axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

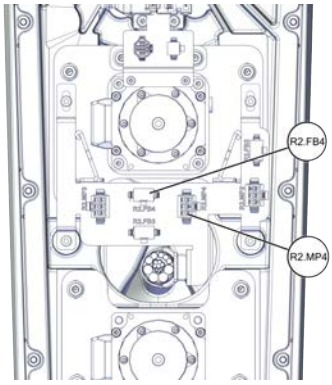
Disconnecting the connectors for axis-3 motor

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

Continues on next page

	Action	Note
2	Disconnect the connectors. • R2.MP3 • R2.FB3	 xx2300000491
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494

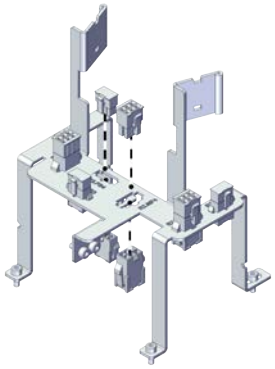
Disconnecting the connectors for axis-4 motor

	Action	Note
1	Disconnect the axis-4 motor connectors. • R2.MP4 • R2.FB4	 xx2300000492

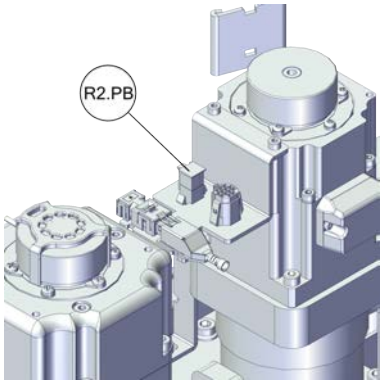
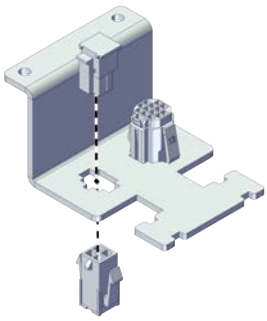
Continues on next page

5.3.3 Replacing the main harness

Continued

	Action	Note
2	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

Disconnecting the connector for PB

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connector. • R2.PB	 xx2300000543
3	Snap loose and remove the female head of the connector from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545

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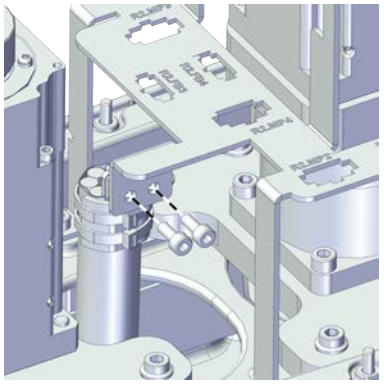
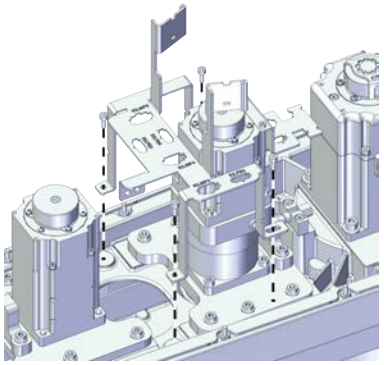
Removing the process hub

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Take out the process hub. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	

Removing the outer arm cable ferrule and bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000496
3	Remove the screws on the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000497

Continues on next page

5.3.3 Replacing the main harness
Continued

Removing the axis-1 cover

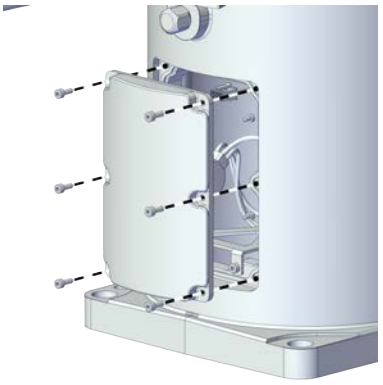
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30 xx2300000498
3	Remove the cover.	

Removing the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30 xx2300000499
3	Remove the cover.	

Continues on next page

Removing the SMB cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Remove the screws on the SMB cover to the base.	For robots with protection class IP30  xx2300000489
4	Pull the SMB cover with the SMB unit assembly out together.	

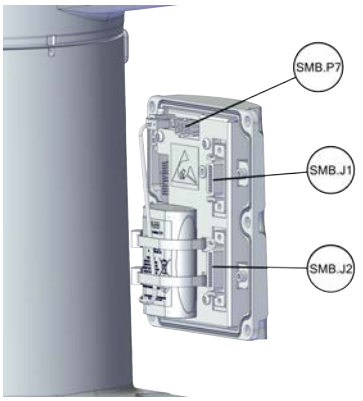
Disconnecting the SMB cabling

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Cut the strips.	

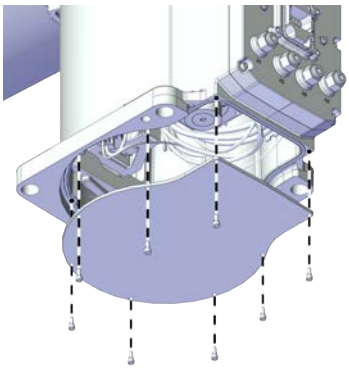
Continues on next page

5.3.3 Replacing the main harness

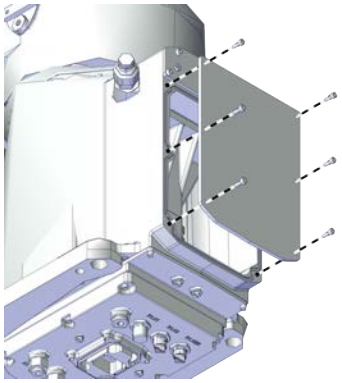
Continued

	Action	Note
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945

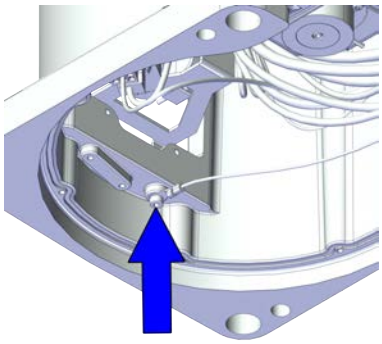
Removing the base plate/ rear plate

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the base to the ground.	
3	Lay down the robot.	
4	For robot with rear outlet cable version, remove the screws on the base plate.	For rear outlet cable version: For robots with protection class IP30  xx2300000500
5	Remove the base plate.	

Continues on next page

	Action	Note
6	For robot with underneath outlet cable version, remove the screws on the rear plate.	For underneath outlet cable version:
7	Remove the rear plate.	For robots with protection class IP30  xx2300000608

Disconnecting the grounding cable connector

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the grounding cable from the base by unscrew the screw.	 xx2300000502

Removing the base bracket

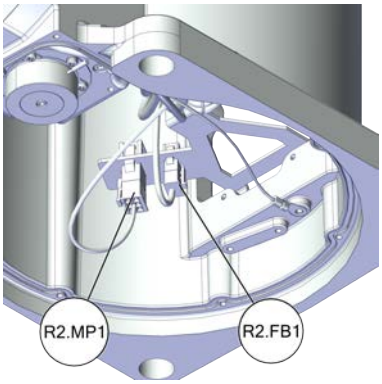
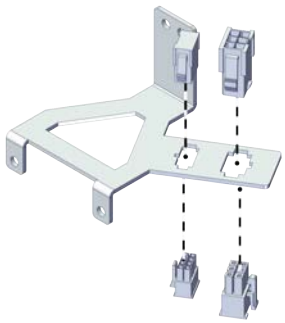
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	

Continues on next page

5.3.3 Replacing the main harness
Continued

	Action	Note
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000503
3	Remove the screws on the base bracket to the base from the SMB side.	

Disconnecting the connectors for axis-1 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP1 • R2.FB1	 xx2300000504
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000505

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Removing the bracket of the cable arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the bracket from the cable arm to release the cable.	 xx2300000506

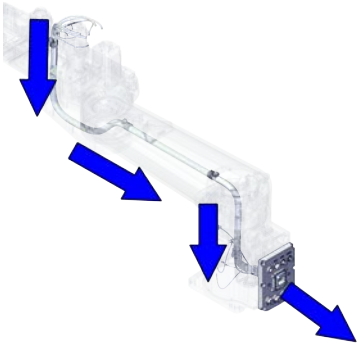
Removing the main harness from the cable arm position

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

Continues on next page

5.3.3 Replacing the main harness

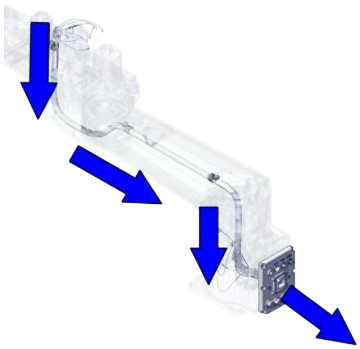
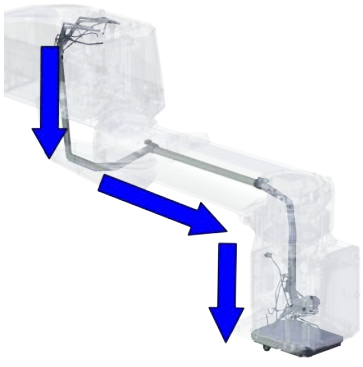
Continued

	Action	Note
2	Pull the main harness out of the outer arm from lower of the cable arm. **Tip** Wrap the connectors with the masking tape. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	For rear outlet cable version:  xx2300000507 For underneath outlet cable version:  xx2300000612
3	Pull the main harness out of the cable arm from the inner arm.	

Removing the main harness from the axis -1 gearbox position

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

Continues on next page

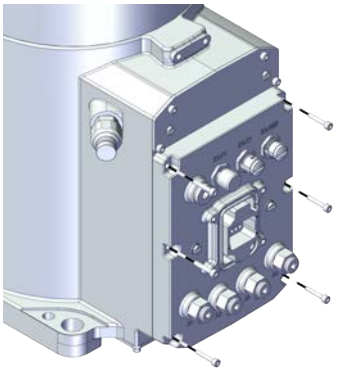
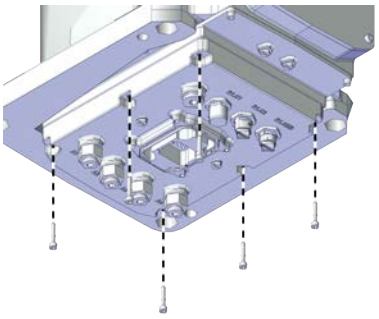
	Action	Note
2	Remove the bracket from the inner arm to release the cable.	 xx2300000508
3	Remove the screws on the cable ferrule to the bracket and take the bracket out.	
4	Pull the main harness out of the inner arm from the sleeve of the axis-1 gearbox. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000507 For underneath outlet cable version:  xx2300000612

Continues on next page

5.3.3 Replacing the main harness

Continued

Removing the main harness

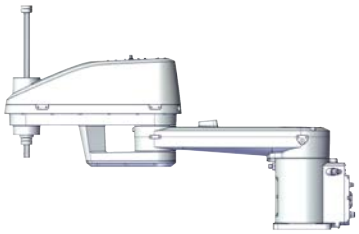
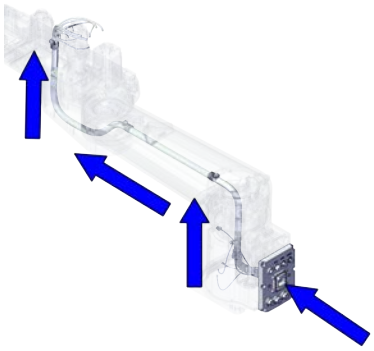
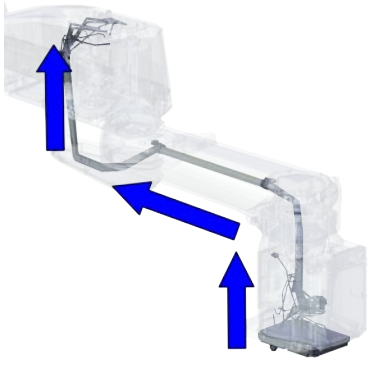
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	For robot with rear outlet cable version, remove the screws on the main harness to the base.	For rear outlet cable version: For robots with protection class IP30  xx2300000509
3	Remove the main harness.	
4	For robot with underneath outlet cable version, remove the screws on the main harness assembly.	For underneath outlet cable version: For robots with protection class IP30  xx2300000609
5	Remove the main harness assembly. **Note** Remove the bottom plate from the main harness if needed.	

Continues on next page

Refitting the main harness

Use these procedures to refit the main harness.

Inserting the main harness through the axis -1 gearbox position

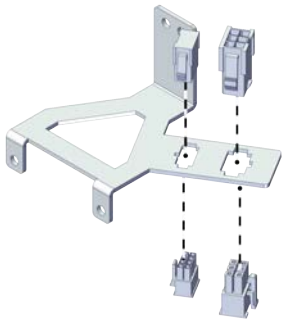
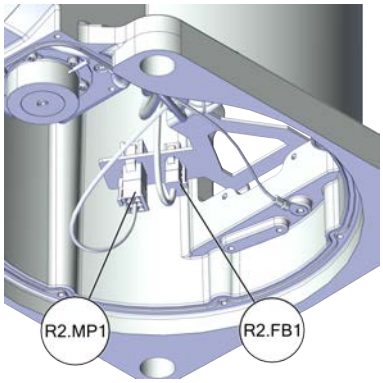
	Action	Note
1	Make sure that the robot is at zero position.	 xx2300000486
2	Insert the main harness into the inner arm through the protection tube of the axis-1 gearbox from the base. **Tip** Wrap the connectors with the masking tape. **Tip** The air hoses should face the axis-1 motor. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610

Continues on next page

5.3.3 Replacing the main harness

Continued

Reconnecting the connectors for axis-1 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000505
2	Reconnect the connectors. • R2.MP1 • R2.FB1 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000504
3	Route the cabling behind the axis-1 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

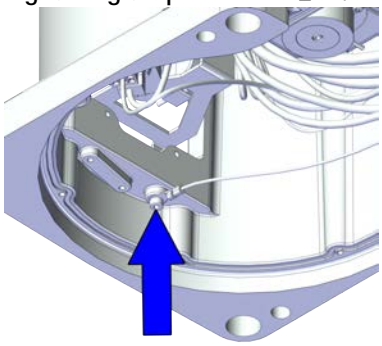
Refitting the base bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Lay the main harness in a natural state without distortion.	

Continues on next page

	Action	Note
	Refit the cable ferrule to the bracket. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000503
3	Refit the base bracket to the base and secure with the screws.	

Reconnecting the grounding cable connector

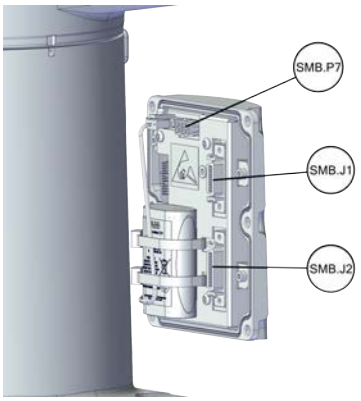
	Action	Note
1	Secure the grounding cable to the bracket with the screw.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (1 pcs) Tightening torque: 1.2 Nm ±10%  xx2300000502
2	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.3.3 Replacing the main harness

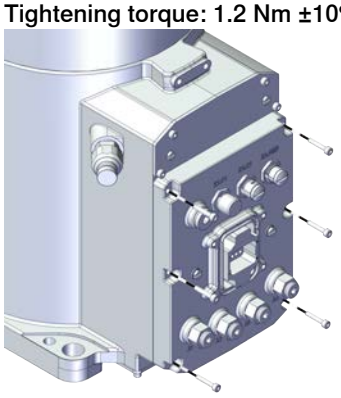
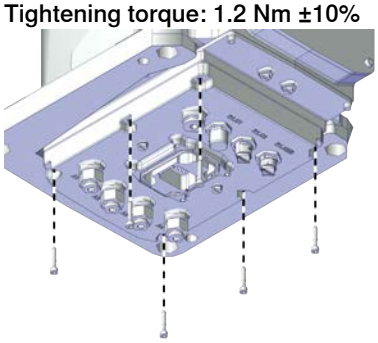
Continued

Refitting the SMB cover

	Action	Note
1	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945
2	Refit the SMB cover assembly.	For robots with protection class IP30 Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.6 Nm  xx2300000489
3	Secure the SMB cover to the base with the screws.	

Continues on next page

Refitting the main harness

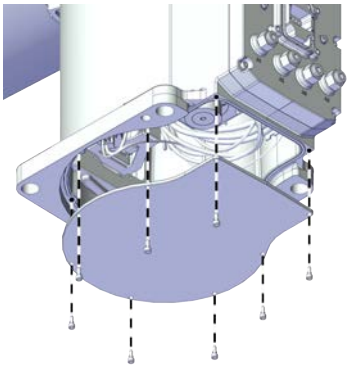
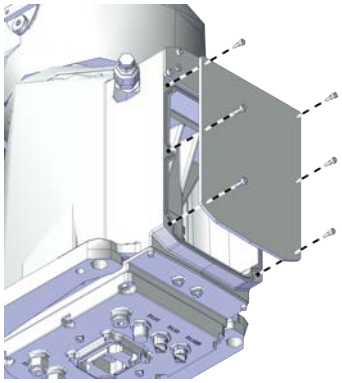
	Action	Note
1	For rear outlet cable version, refit the main harness to the base.	For rear outlet cable version: For robots with protection class IP30 Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm ±10%  xx2300000509
2	Secure with the screws.	
3	For underneath outlet cable version, refit the main harness assembly to the base. **Note** Refit the bottom plate to the main harness if needed.	For underneath outlet cable version: For robots with protection class IP30 Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.2 Nm ±10%  xx2300000609
4	Secure with the screws.	

Refitting the base plate/ rear plate

	Action	Note
1	Apply grease to the internal harness, cover all moving area of the harness.	

Continues on next page

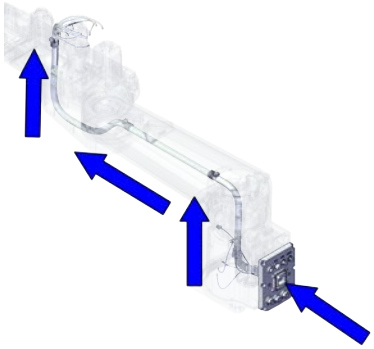
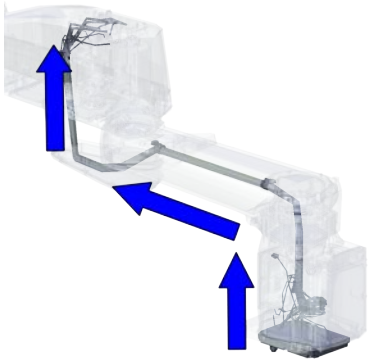
5.3.3 Replacing the main harness
Continued

	Action	Note
2	For rear outlet cable version, refit the base plate to the base. For underneath outlet cable version, refit the rear plate to the base.	Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm ±10%
3	Secure the base plate/ rear plate to the base with the screws.	For rear outlet cable version: For robots with protection class IP30  xx2300000500 For underneath outlet cable version: For robots with protection class IP30  xx2300000608
4	Refit the robot back to the ground.	
5	Secure with the screws.	Screws: Hex socket head cap screw M12x35 12.9 Gleitmo 603+Geomet 500 (4 pcs) Steel Washers: 24 mm x 13 mm x 2.5 mm (4 pcs) Tightening torque: 56 Nm ±10%

Inserting the main harness through the inner arm position

	Action	Note
1	Secure the cable with the cable ferrule to the two brackets in inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) x 2 Tightening torque: 2.4 Nm ±10%

Continues on next page

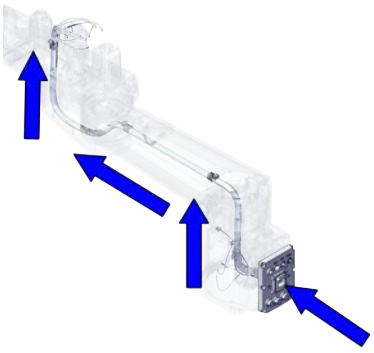
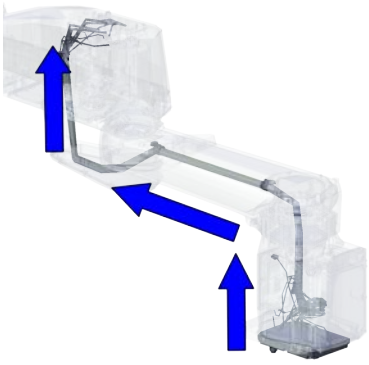
	Action	Note
2	Insert the main harness into the cable arm through the inner arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
3	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000508

Continues on next page

5.3.3 Replacing the main harness

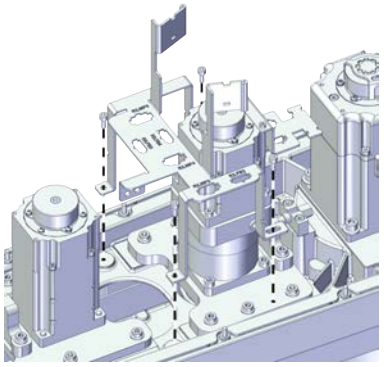
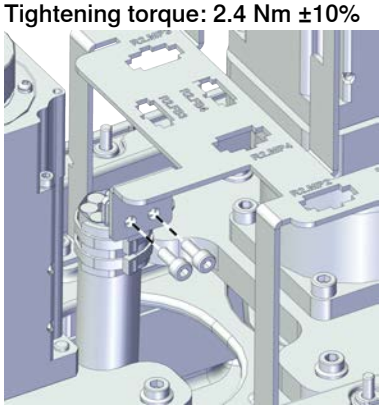
Continued

Inserting the main harness through the cable arm

	Action	Note
1	Insert the main harness into the outer arm through the cable arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
2	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000506

Continues on next page

Refitting the cable ferrule and bracket in the outer arm

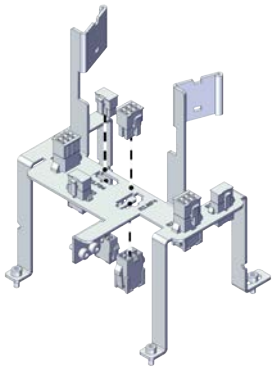
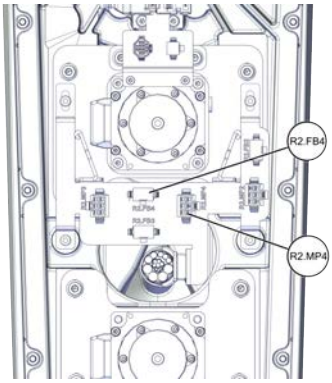
	Action	Note
1	Lay the internal harness in a natural state without distortion.	
2	Refit the bracket. **Tip** Do not secure it with the screws before the cable ferrule installed well. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000497
3	Secure the cable ferrule to the bracket with the screws. **Tip** The air hoses should face the process hub side. **Tip** The position with wrapped tape is the marked position for the cable ferrule. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000496

Continues on next page

5.3.3 Replacing the main harness

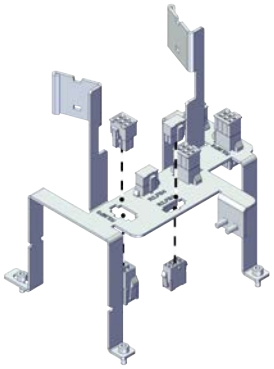
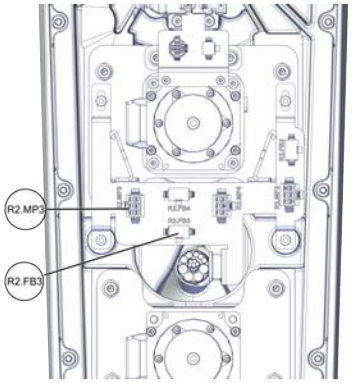
Continued

Reconnecting the connectors for axis-4 motor

	Action	Note
	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495
1	Reconnect the connectors. • R2.MP4 • R2.FB4 **Tip** See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000492
2	Route the cabling on the axis-4 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Reconnecting the connectors for axis-3 motor

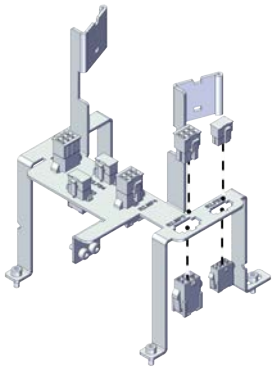
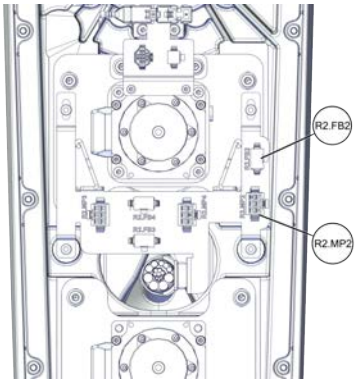
	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494
2	Reconnect the connectors. • R2.MP3 • R2.FB3 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000491
3	Route the cabling on the axis-3 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.3.3 Replacing the main harness

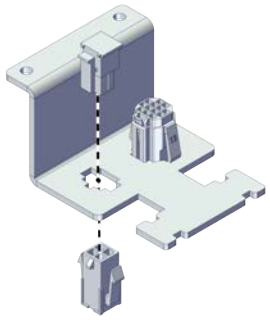
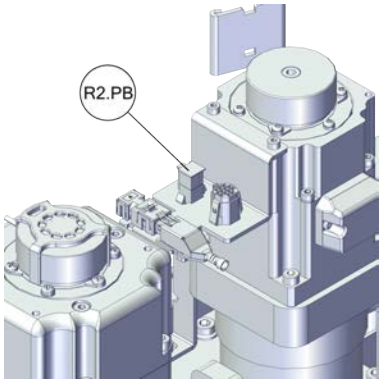
Continued

Reconnecting the connectors for axis-2 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Reconnecting the connector for PB

	Action	Note
1	Insert the female head of the PB connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545
2	Reconnect the connector. • R2.PB **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000543
3	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed incorrectly the cables can be damaged.	

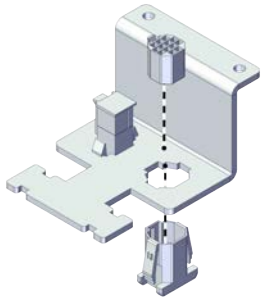
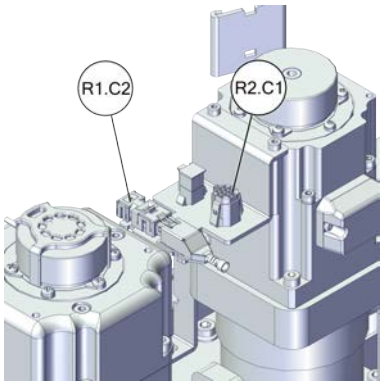
Reconnecting the air hoses, CP/CS cabling and Ethernet cabling (if equipped)

	Action	Note
1	Route the air hoses on the process hub behind the bracket. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.3.3 Replacing the main harness

Continued

	Action	Note
2	Insert the female head of the C1 cabling connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544
3	**For robots with C1 cabling** Reconnect the connector. • R2.C1 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	 xx2300000542
4	**For robots with C2 cabling** Reconnect the connector. • R1.C2 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	
5	Secure the C2 cabling to the C2 bracket with the cable straps.	
6	Reconnect the air hoses in a cross pattern with the L-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	

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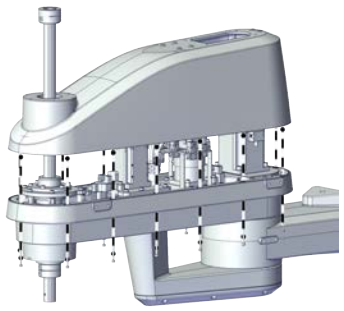
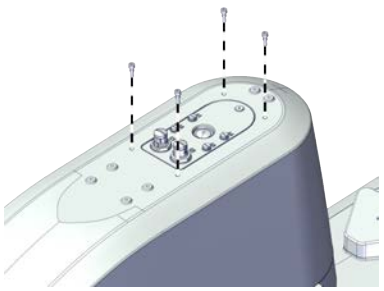
	Action	Note
7	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487

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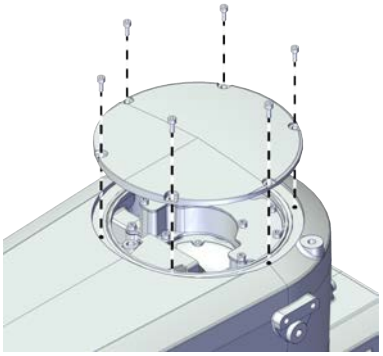
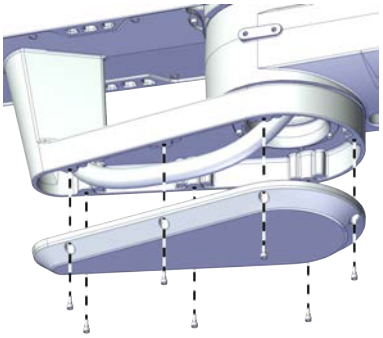
5.3.3 Replacing the main harness
Continued

	Action	Note
4	Remove the screw.	

Refitting the axis-1 cover

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.4 Nm ±3% For robots with protection class IP30  xx2300000498
2	Refit the screws.	

Refitting the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the cover.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (7 pcs) Tightening torque: 6 Nm ±3% For robots with protection class IP30  xx2300000499
3	Refit the screws.	

Continues on next page

Concluding procedure

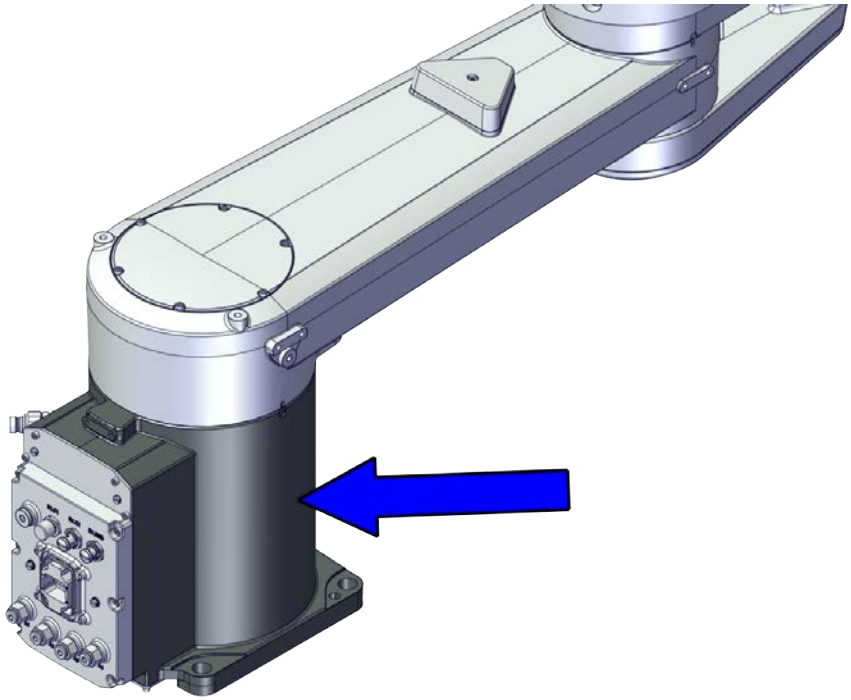
	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 55*.	

5.4 Base

5.4.1 Replacing the base

Location of the base

The base is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 930 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Base	3HAC087301-001	
Airway cover	3HAC087316-001	
Airway cover gasket	3HAC084080-001	
Base plate, rear outlet cable	3HAC0081803-001	Base bottom cover, rear cable
Rear plate, underneath outlet cable	3HAC087318-001	Base rear cover, bottom cable
Base plate, underneath outlet cable	3HAC081817-001	Base bottom cover, bottom cable
Quick coupling	3HAC074630-001	
Base bracket	3HAC081791-001	

Continues on next page

Spare part	Article number	Note
Plug G1/4	3HAC071966-001	
Seal bolt	3HAC032050-001	
Cooling cover	3HAC084066-001	Used in airway.
Air connector	3HAC032049-001	Used in Airway cover.

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.

Continues on next page

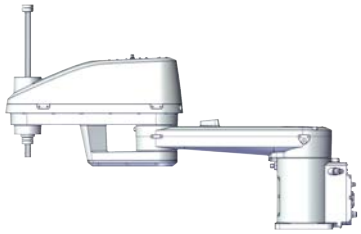
5.4.1 Replacing the base
Continued

	Action	Note
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the base

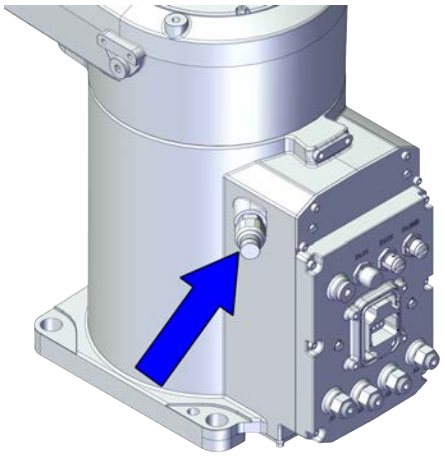
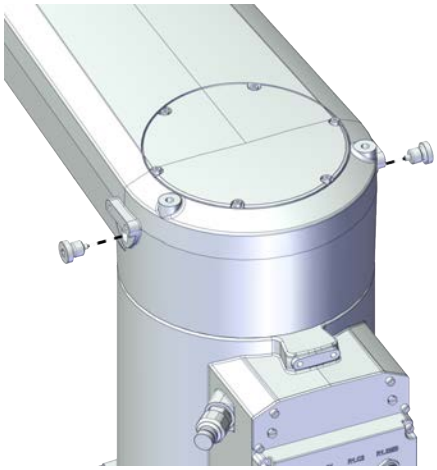
Use these procedures to remove the base.

Preparations before removing the base

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	Jog all axes to zero position.	 xx2300000486
4	**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

Draining oil of axis-1 gearbox

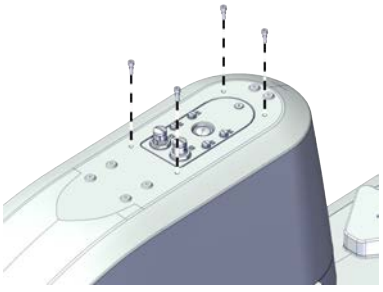
	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**CAUTION** The gearbox can contain an excess of pressure that can be hazardous. Open the oil plug carefully in order to let the excess pressure out.	
3	Lay down the robot to let the quick coupling facing the ground if needed.	
4	Place the oil collecting vessel underneath the quick coupling.	 xx2300000546
5	Remove the oil plugs and keep them opened to speed up the drainage.	 xx2300000547
6	Plug a G3/8 quick coupling connector with pipe to the quick coupling on base.	

Continues on next page

5.4.1 Replacing the base
Continued

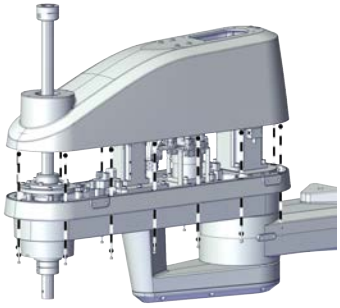
	Action	Note
7	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 605* for more information.	
8	Drain the gearbox oil.	**Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
9	Remove the quick coupling connector and clean the pipe after the oil is drained. **Note** There will be some oil left in the gearbox after draining.	
10	Refit oil plugs.	Tightening torque: 10 Nm

Removing the process hub screws

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

Continues on next page

Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

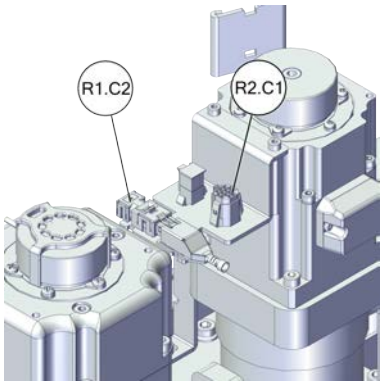
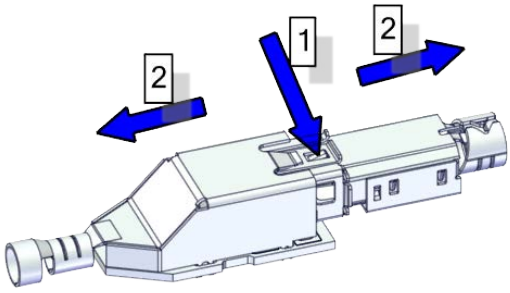
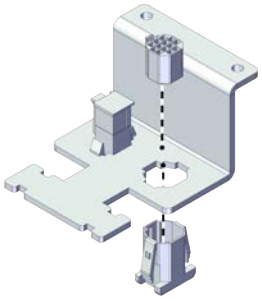
Disconnecting the air hoses, C1 cabling and C2 cabling (if equipped)

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the air hoses from the L-shaped connectors.	

Continues on next page

5.4.1 Replacing the base

Continued

	Action	Note
3	**For robots with C1 cabling** Disconnect the connector. • R2.C1	 xx2300000542
4	**For robots with C2 cabling** Disconnect the connector. • R1.C2 **Tip** Cut the cable straps for the R1.C2 at the same time. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the R1.C2 (for C2 cabling).  xx1800002943	
5	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544

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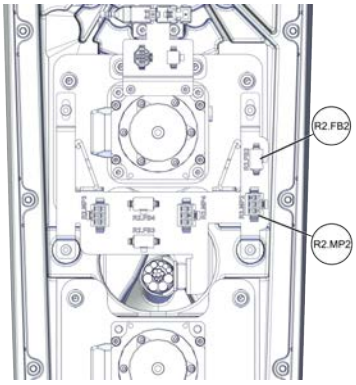
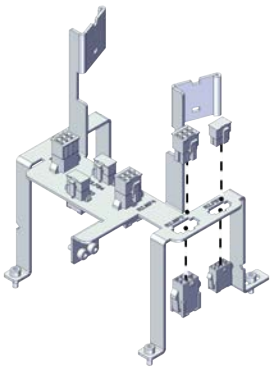
Disconnecting the connectors for axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

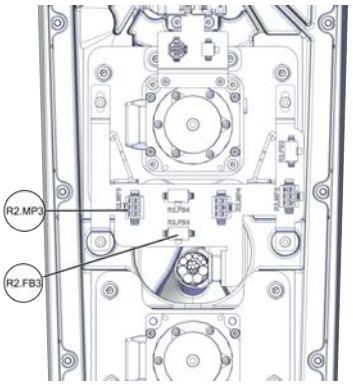
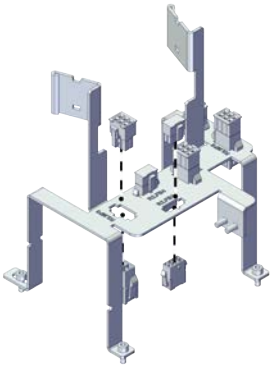
Disconnecting the connectors for axis-3 motor

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

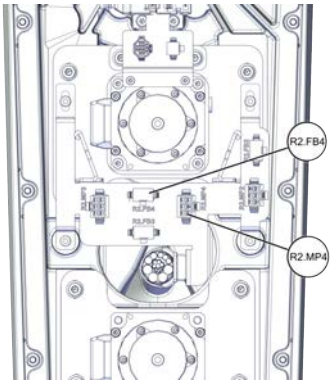
Continues on next page

5.4.1 Replacing the base

Continued

	Action	Note
2	Disconnect the connectors. • R2.MP3 • R2.FB3	 xx2300000491
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494

Disconnecting the connectors for axis-4 motor

	Action	Note
1	Disconnect the axis-4 motor connectors. • R2.MP4 • R2.FB4	 xx2300000492

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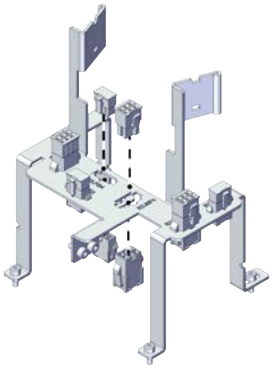
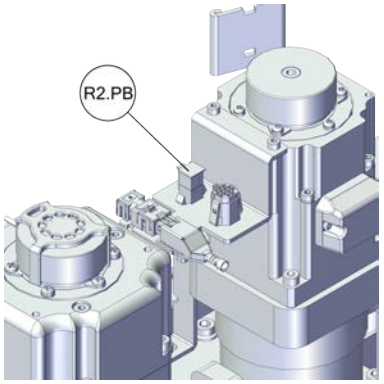
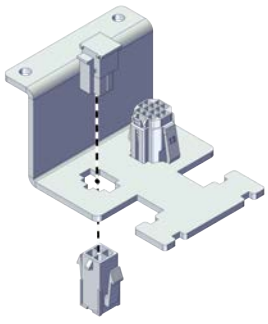
	Action	Note
2	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

Disconnecting the connector for PB

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connector. • R2.PB	 xx2300000543
3	Snap loose and remove the female head of the connector from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545

Continues on next page

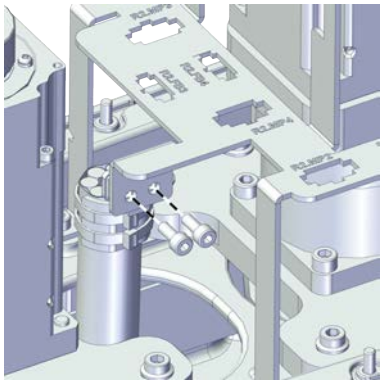
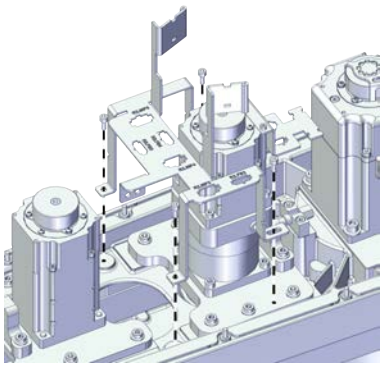
5.4.1 Replacing the base

Continued

Removing the process hub

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Take out the process hub. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	

Removing the outer arm cable ferrule and bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000496
3	Remove the screws on the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000497

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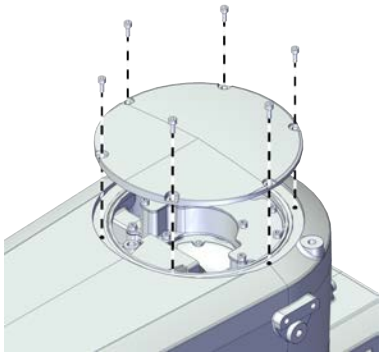
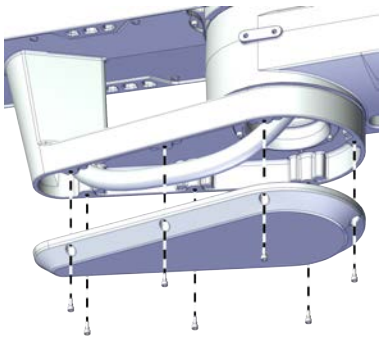
Removing the axis-1 cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000498
3	Remove the cover.	

Removing the cable arm cover

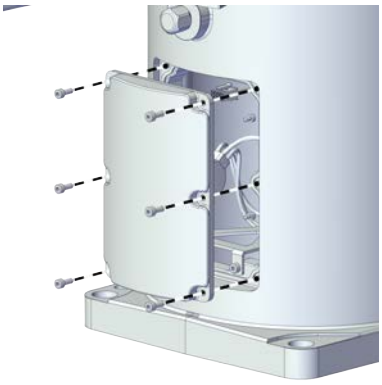
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000499
3	Remove the cover.	

Continues on next page

5.4.1 Replacing the base

Continued

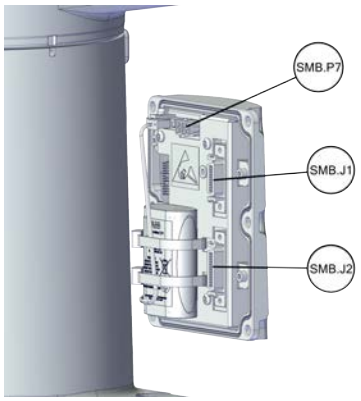
Removing the SMB cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Remove the screws on the SMB cover to the base.	For robots with protection class IP30  xx2300000489
4	Pull the SMB cover with the SMB unit assembly out together.	

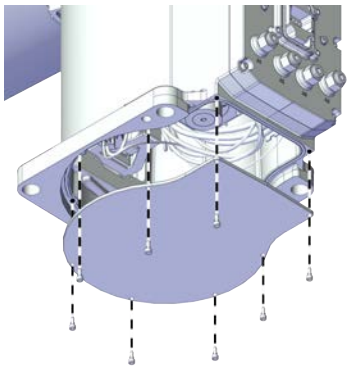
Disconnecting the SMB cabling

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Cut the strips.	

Continues on next page

	Action	Note
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945

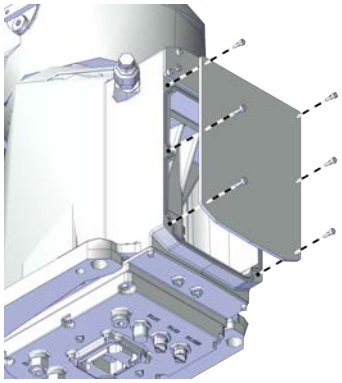
Removing the base plate/ rear plate

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the base to the ground.	
3	Lay down the robot.	
4	For robot with rear outlet cable version, remove the screws on the base plate.	For rear outlet cable version: For robots with protection class IP30  xx2300000500
5	Remove the base plate.	

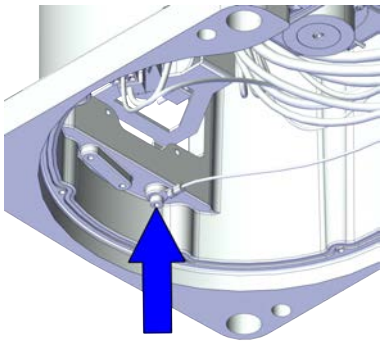
Continues on next page

5.4.1 Replacing the base

Continued

	Action	Note
6	For robot with underneath outlet cable version, remove the screws on the rear plate.	For underneath outlet cable version:
7	Remove the rear plate.	For robots with protection class IP30  xx2300000608

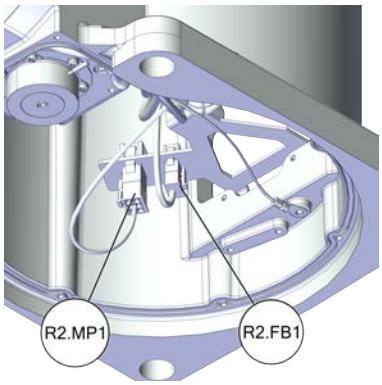
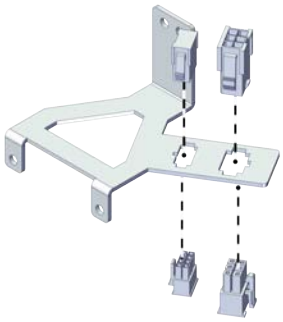
Disconnecting the grounding cable connector

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the grounding cable from the base by unscrew the screw.	 xx2300000502

Disconnecting the connectors for axis-1 motor

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

Continues on next page

	Action	Note
2	Disconnect the connectors. • R2.MP1 • R2.FB1	 xx2300000504
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000505

Removing the base bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000503
3	Remove the screws on the base bracket to the base from the SMB side.	

Continues on next page

5.4.1 Replacing the base

Continued

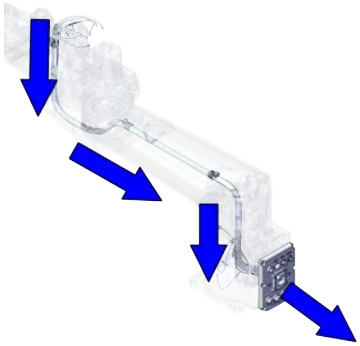
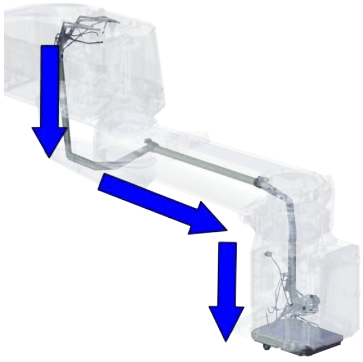
Removing the bracket of the cable arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the bracket from the cable arm to release the cable.	 xx2300000506

Removing the main harness from the cable arm position

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

Continues on next page

	Action	Note
2	Pull the main harness out of the outer arm from lower of the cable arm. **Tip** Wrap the connectors with the masking tape. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	For rear outlet cable version:  xx2300000507 For underneath outlet cable version:  xx2300000612
3	Pull the main harness out of the cable arm from the inner arm.	

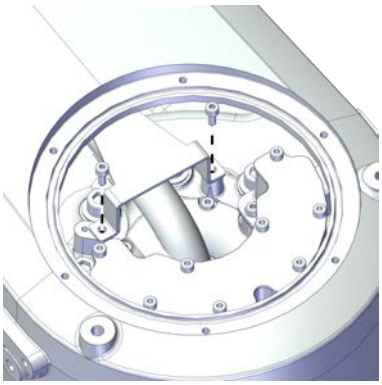
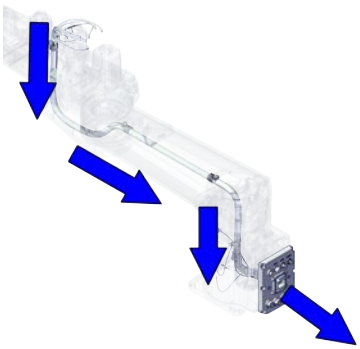
Removing the main harness from the axis -1 gearbox position

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

Continues on next page

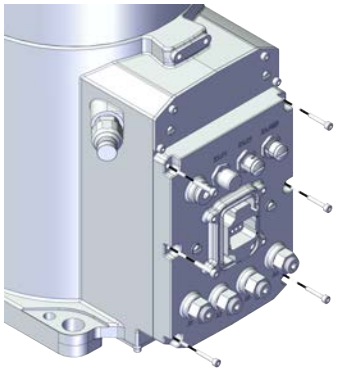
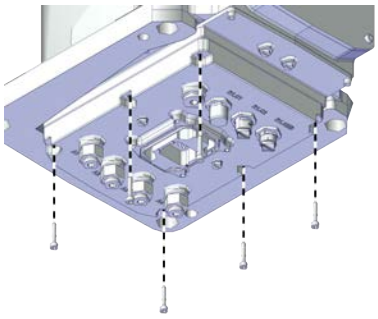
5.4.1 Replacing the base

Continued

	Action	Note
2	Remove the bracket from the inner arm to release the cable.	 xx2300000508
3	Remove the screws on the cable ferrule to the bracket and take the bracket out.	
4	Pull the main harness out of the inner arm from the sleeve of the axis-1 gearbox. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000507 For underneath outlet cable version:  xx2300000612

Continues on next page

Removing the main harness

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	For robot with rear outlet cable version, remove the screws on the main harness to the base.	For rear outlet cable version: For robots with protection class IP30  xx2300000509
3	Remove the main harness.	
4	For robot with underneath outlet cable version, remove the screws on the main harness assembly.	For underneath outlet cable version: For robots with protection class IP30  xx2300000609
5	Remove the main harness assembly. **Note** Remove the bottom plate from the main harness if needed.	

Removing the oil tank

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

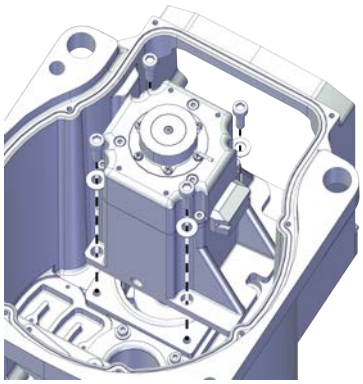
Continues on next page

5.4.1 Replacing the base

Continued

	Action	Note
2	Remove the screws on the oil tank to the inner arm.	 xx2300000511
3	Remove the oil tank.	

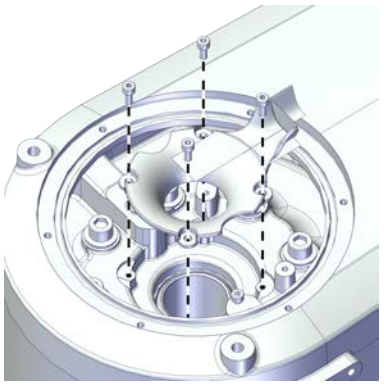
Removing the axis-1 motor sub-assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and washers.	 xx2300000512
3	Remove the motor.	

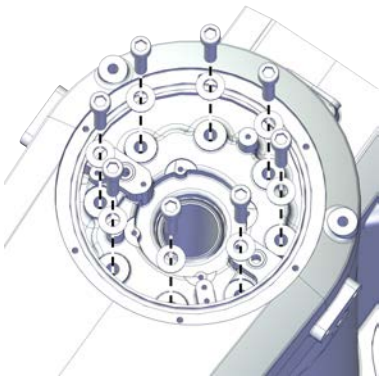
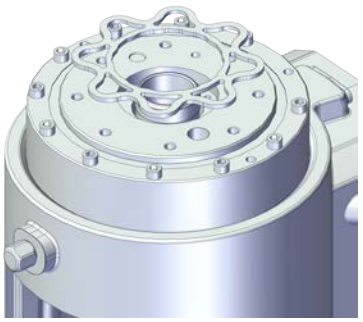
Removing the protection tube

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

Continues on next page

	Action	Note
2	Remove the screws on the protection tube to the inner arm.	 xx2300000513
3	Remove the protection tube.	

Removing the base from inner arm

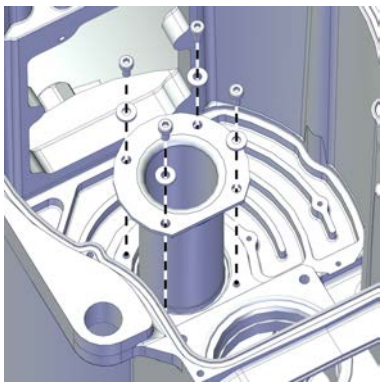
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and washers on the inner to the axis-1 gear unit.	 xx2300000514
3	Disconnect the axis-1 gear to the inner arm.	
4	Remove the BassSwing gasket on the axis-1 gear unit.	 xx2300000602

Continues on next page

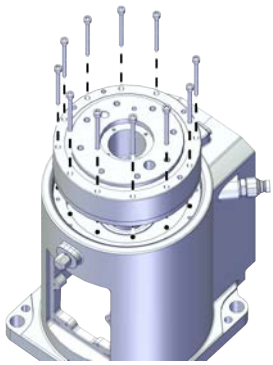
5.4.1 Replacing the base

Continued

Removing the center pipe

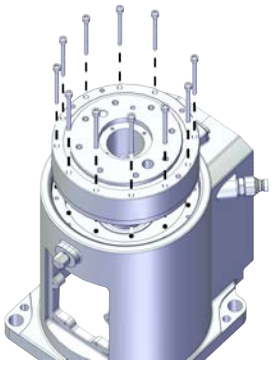
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and washers on the center pipe to the base.	 xx2300000514

Removing the base from the axis-1 gear unit sub-assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and washers on the base to the axis-1 gear unit.	 xx2300000515
3	Remove the base.	

Continues on next page

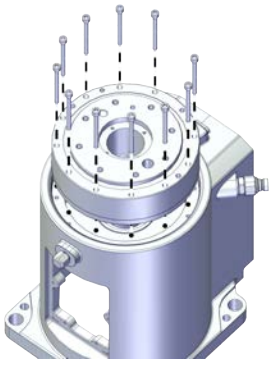
Removing the parts on the base

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and washers on the base to the axis-1 gear unit.	 xx2300000515
3	Remove the base.	

Refitting the base

Use these procedures to refit the base.

Refitting the base to the axis-1 gear unit sub-assembly

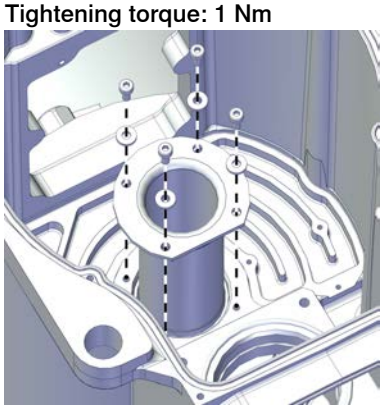
	Action	Note
1	Refit the base to the axis-1 gearbox as the illustration.	Screws: Hex socket head cap screw M6x65 12.9 Gleitmo 603+Geomet 500 (11 pcs) Tightening torque: 10 Nm ±10%  xx2300000515
2	Refit the screws.	

Continues on next page

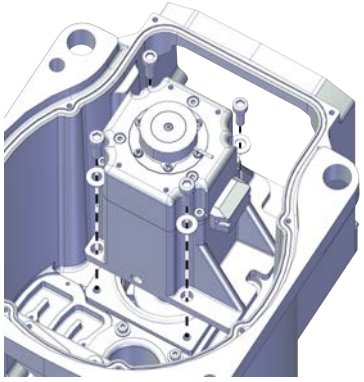
5.4.1 Replacing the base

Continued

Refitting the center pipe

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the center pipe.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Washers: Washer 4.3x10x2 steel (4 pcs) Tightening torque: 1 Nm  xx2300000514
3	Secure the screws on the center pipe to the base.	

Refitting the axis-1 motor sub-assembly

	Action	Note
1	Replace the o-ring if needed.	
2	Put the timing belt into the pulley on the gear.	
3	Refit the motor and refit the timing belt to the motor. Ensure that the belt runs correctly in the grooves.	Screws: Hex socket head cap screw M6x20 12.9 Gleitmo 603+Geomet 500 (4 pcs) Washers: Spring washer, conical 11x5.3x1.2 Steel (4 pcs) Tightening torque: 10 Nm ±10%  xx2300000512
4	Refit the screws and washers without fully tightened.	

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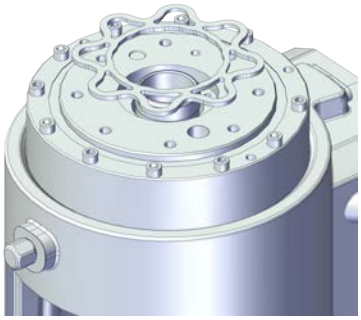
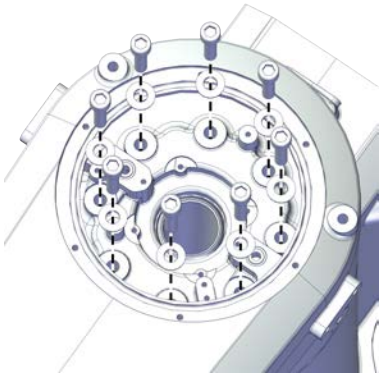
Refitting the base to the inner arm

	Action	Note
1	Refit the BassSwing gasket to the axis-1 gearbox.	 xx2300000602
2	Refit the inner arm to the axis-1 gearbox as the illustration.	Screws: Hex socket head cap screw M8x40 12.9 Gleitmo 603+Geomet 500 (8 pcs) Washers: Spring washer, conical 9ADA334-7 18x4x2 Steel (8 pcs) Tightening torque: 25 Nm ±3%  xx2300000514
3	Refit the screws.	

Refitting the protection tube

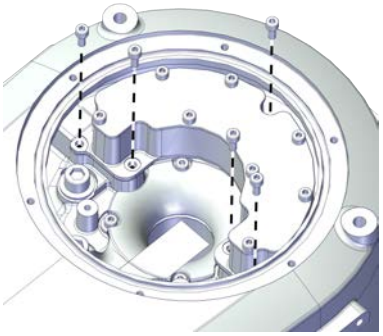
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	

Continues on next page

5.4.1 Replacing the base
Continued

	Action	Note
2	Refit the protection tube.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1 Nm  xx2300000513
3	Secure the screws on the protection tube to the inner arm.	

Refitting the oil tank

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the oil tank.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (5 pcs) Tightening torque: 2.4 Nm ±3%  xx2300000511
3	Secure the screws on the oil tank to the inner arm.	

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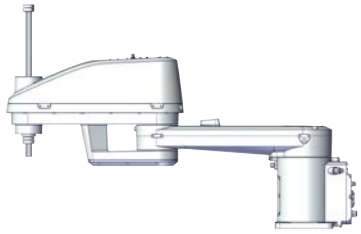
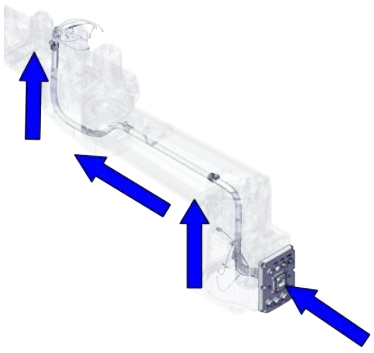
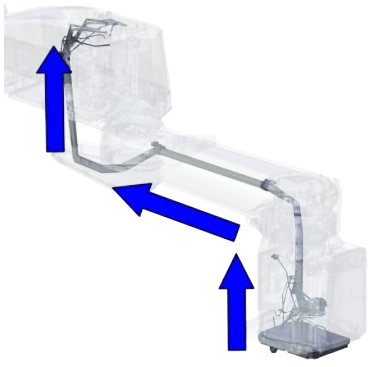
Inserting the main harness through the axis -1 gearbox position

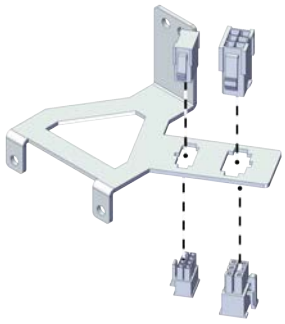
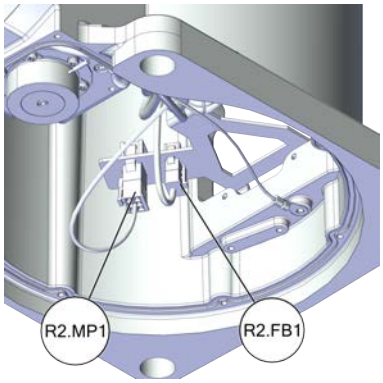
	Action	Note
1	Make sure that the robot is at zero position.	 xx2300000486
2	Insert the main harness into the inner arm through the protection tube of the axis-1 gearbox from the base. **Tip** Wrap the connectors with the masking tape. **Tip** The air hoses should face the axis-1 motor. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610

Continues on next page

5.4.1 Replacing the base

Continued

Reconnecting the connectors for axis-1 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000505
2	Reconnect the connectors. • R2.MP1 • R2.FB1 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000504
3	Route the cabling behind the axis-1 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

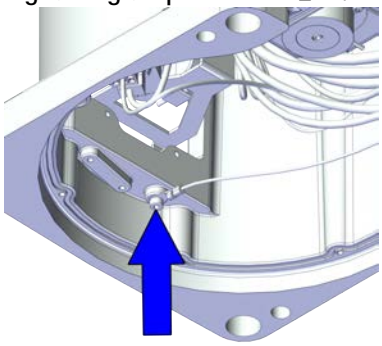
Refitting the base bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Lay the main harness in a natural state without distortion.	

Continues on next page

	Action	Note
	Refit the cable ferrule to the bracket. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000503
3	Refit the base bracket to the base and secure with the screws.	

Reconnecting the grounding cable connector

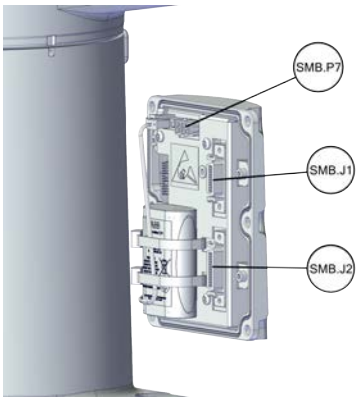
	Action	Note
1	Secure the grounding cable to the bracket with the screw.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (1 pcs) Tightening torque: 1.2 Nm ±10%  xx2300000502
2	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.4.1 Replacing the base

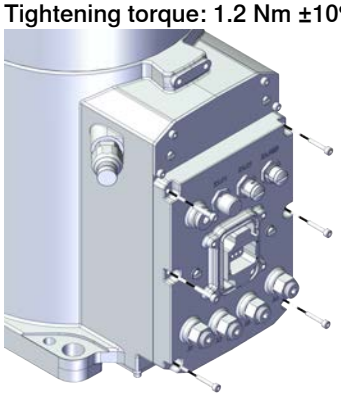
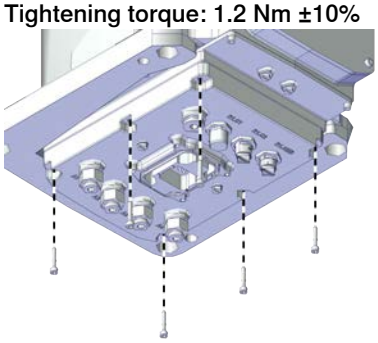
Continued

Refitting the SMB cover

	Action	Note
1	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945
2	Refit the SMB cover assembly.	For robots with protection class IP30 Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.6 Nm  xx2300000489
3	Secure the SMB cover to the base with the screws.	

Continues on next page

Refitting the main harness

	Action	Note
1	For rear outlet cable version, refit the main harness to the base.	For rear outlet cable version: For robots with protection class IP30 Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm ±10%  xx2300000509
2	Secure with the screws.	
3	For underneath outlet cable version, refit the main harness assembly to the base. **Note** Refit the bottom plate to the main harness if needed.	For underneath outlet cable version: For robots with protection class IP30 Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.2 Nm ±10%  xx2300000609
4	Secure with the screws.	

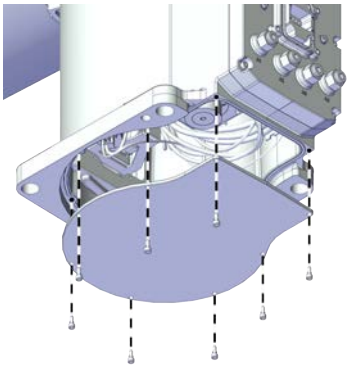
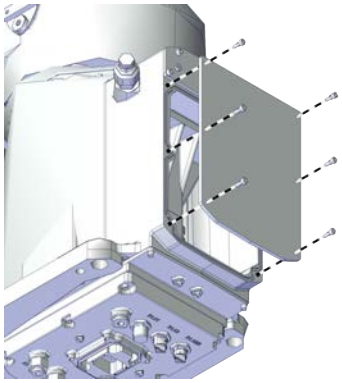
Refitting the base plate/ rear plate

	Action	Note
1	Apply grease to the internal harness, cover all moving area of the harness.	

Continues on next page

5.4.1 Replacing the base

Continued

	Action	Note
2	For rear outlet cable version, refit the base plate to the base. For underneath outlet cable version, refit the rear plate to the base.	Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm ±10%
3	Secure the base plate/ rear plate to the base with the screws.	For rear outlet cable version: For robots with protection class IP30  xx2300000500 For underneath outlet cable version: For robots with protection class IP30  xx2300000608
4	Refit the robot back to the ground.	
5	Secure with the screws.	Screws: Hex socket head cap screw M12x35 12.9 Gleitmo 603+Geomet 500 (4 pcs) Steel Washers: 24 mm x 13 mm x 2.5 mm (4 pcs) Tightening torque: 56 Nm ±10%

Inserting the main harness through the inner arm position

	Action	Note
1	Secure the cable with the cable ferrule to the two brackets in inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) x 2 Tightening torque: 2.4 Nm ±10%

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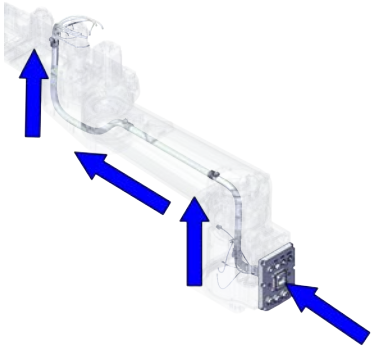
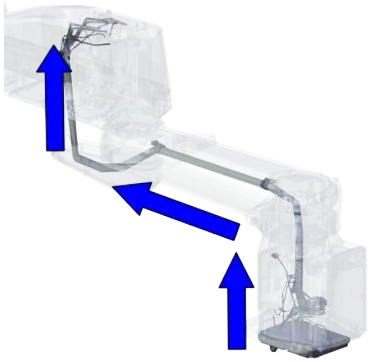
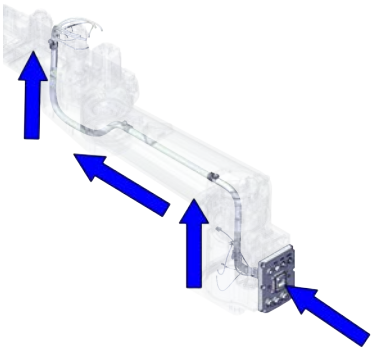
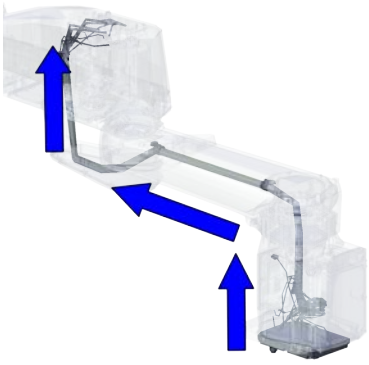
	Action	Note
2	Insert the main harness into the cable arm through the inner arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
3	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000508

Continues on next page

5.4.1 Replacing the base

Continued

Inserting the main harness through the cable arm

	Action	Note
1	Insert the main harness into the outer arm through the cable arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
2	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000506

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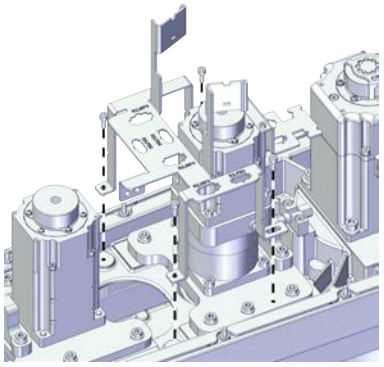
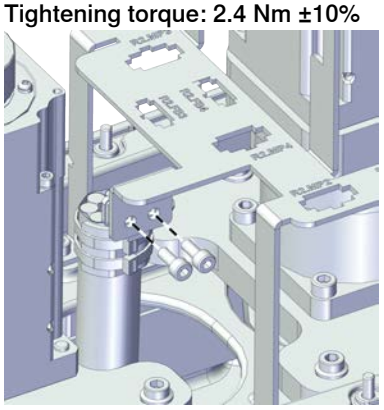
Refitting the cable ferrule and bracket in the outer arm

	Action	Note
1	Lay the internal harness in a natural state without distortion.	
2	Refit the bracket. **Tip** Do not secure it with the screws before the cable ferrule installed well. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000497
3	Secure the cable ferrule to the bracket with the screws. **Tip** The air hoses should face the process hub side. **Tip** The position with wrapped tape is the marked position for the cable ferrule. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000496

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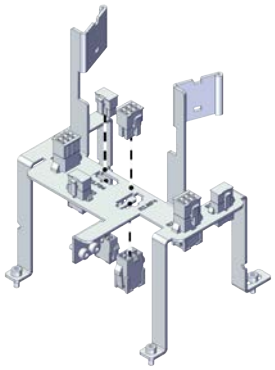
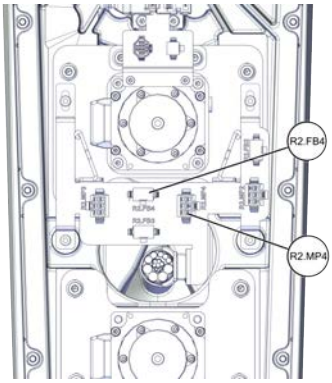
5.4.1 Replacing the base

Continued

Reconnecting the connectors for axis-4 motor

	Action	Note
	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495
1	Reconnect the connectors. • R2.MP4 • R2.FB4 **Tip** See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000492
2	Route the cabling on the axis-4 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

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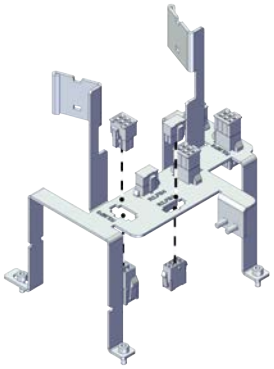
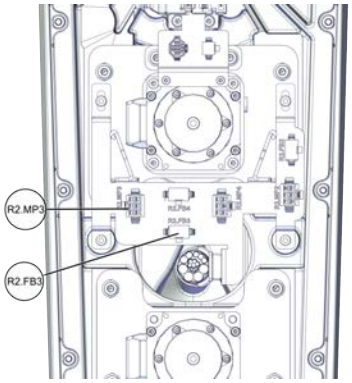
Reconnecting the connectors for axis-3 motor

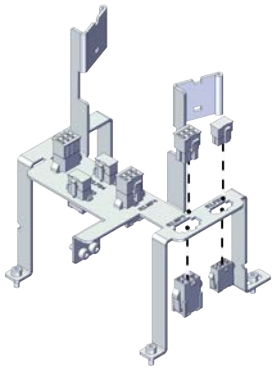
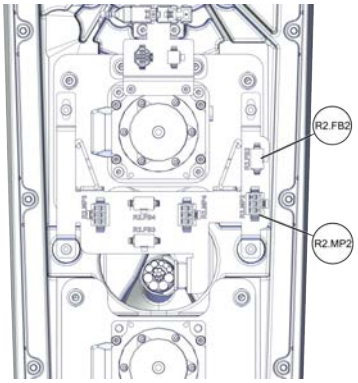
	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494
2	Reconnect the connectors. • R2.MP3 • R2.FB3 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000491
3	Route the cabling on the axis-3 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.4.1 Replacing the base

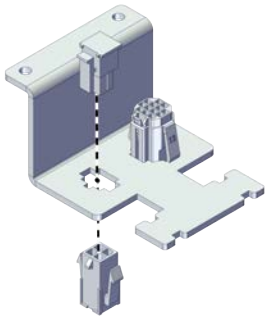
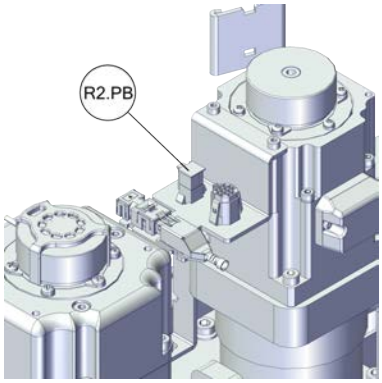
Continued

Reconnecting the connectors for axis-2 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Reconnecting the connector for PB

	Action	Note
1	Insert the female head of the PB connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545
2	Reconnect the connector. • R2.PB **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000543
3	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed incorrectly the cables can be damaged.	

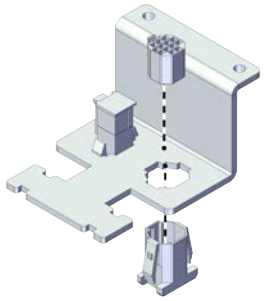
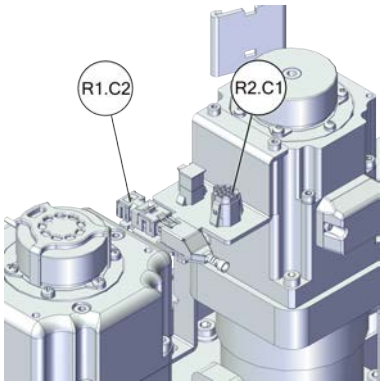
Reconnecting the air hoses, CP/CS cabling and Ethernet cabling (if equipped)

	Action	Note
1	Route the air hoses on the process hub behind the bracket. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.4.1 Replacing the base

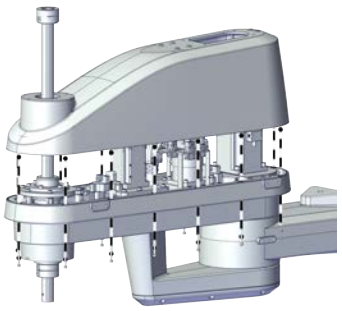
Continued

	Action	Note
2	Insert the female head of the C1 cabling connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544
3	**For robots with C1 cabling** Reconnect the connector. • R2.C1 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	 xx2300000542
4	**For robots with C2 cabling** Reconnect the connector. • R1.C2 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	
5	Secure the C2 cabling to the C2 bracket with the cable straps.	
6	Reconnect the air hoses in a cross pattern with the L-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	

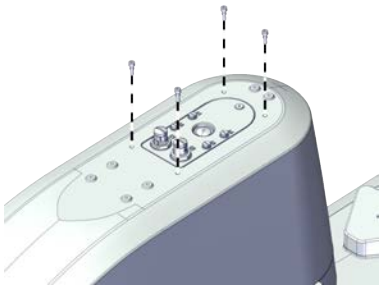
Continues on next page

	Action	Note
7	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

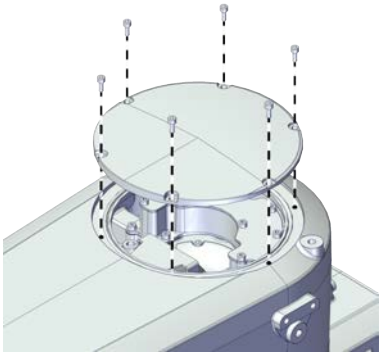
	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487

Continues on next page

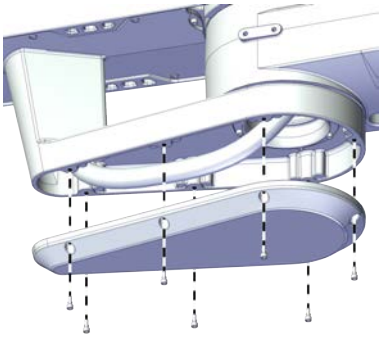
5.4.1 Replacing the base
Continued

	Action	Note
4	Remove the screw.	

Refitting the axis-1 cover

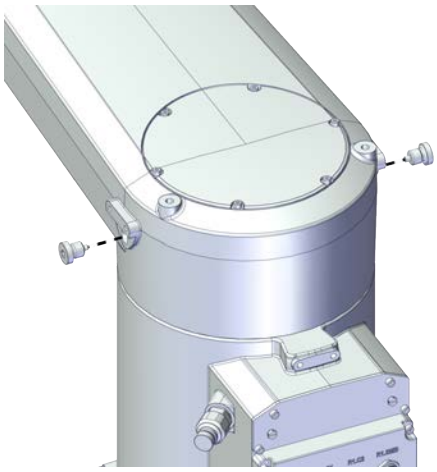
	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.4 Nm ±3% For robots with protection class IP30  xx2300000498
2	Refit the screws.	

Refitting the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the cover.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (7 pcs) Tightening torque: 6 Nm ±3% For robots with protection class IP30  xx2300000499
3	Refit the screws.	

Continues on next page

Refilling oil to axis-1 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	
3	Open the oil plugs, one for filling and the other for venting.	 xx2300000547
4	**WARNING** 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.	
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.
6	Refit the oil plugs.	Tightening torque: 10 Nm

Continues on next page

5.4.1 Replacing the base

Continued

Concluding procedure

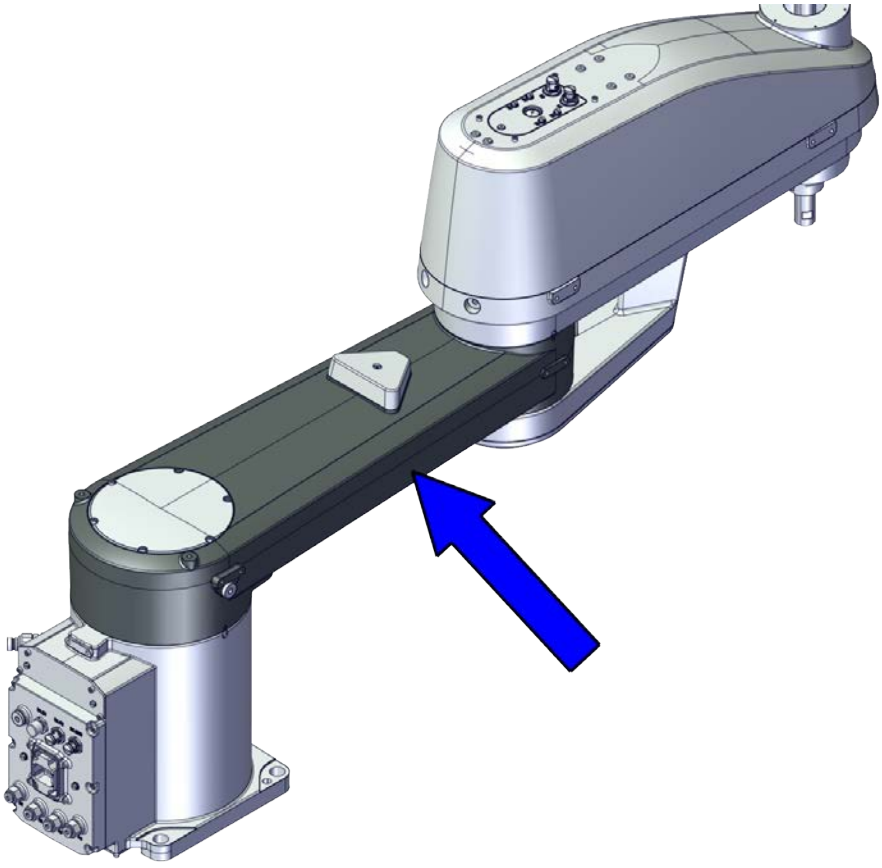
	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 55*.	

5.5 Inner arm

5.5.1 Replacing the inner arm

Location of the inner arm

The inner arm is located as shown in the figure.



xx2300000471

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

Spare part	Article number	Note
Inner arm, 850 mm	3HAC087304-001	Including A1 sealing 3HAB3702-22 and A2 sealing 3HAC070148-005.
Inner arm, 1,050 mm	3HAC087305-001	Including A1 sealing 3HAB3702-22 and A2 sealing 3HAC070148-005.
Axis 1 Cover	3HAC087308-001	

Continues on next page

5.5.1 Replacing the inner arm
Continued

Spare part	Article number	Note
Oil tank	3HAC081810-001	Replace if damaged.
Oil tank cover	3HAC081812-001	Replace if damaged.
Oil tank gasket	3HAC081814-001	Replace if damaged.
Oil tank O-ring	3HAB3772-138	Replace if damaged.
A2 Swing	3HAC087306-001	
A1 sealing	3HAB3702-22	
A2 sealing	3HAC070148-005	
Rubber stop	3HAC081815-001	With bolt
Damper	3HAC084073-001	Replace if damaged.
Magnetic plug, G 1/4"	3HAC037925-001	With bolt
Cable arm bracket	3HAC081793-001	
Inner arm bracket	3HAC081792-001	
Hex socket head cap flange screw	3HAB3412-416	Used for axis-1 mechanical stop.
Hex socket head cap flange	3HAB3412-412	Used for axis-2 mechanical stop.
Washer	3HAC065801-001	Used for inner arm and axis-2 gear.
Spring washer,conical	9ADA334-7	Used for inner arm and axis-1 gear.

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.
A1 Sealing press tool	3HAC087848-001	Used to install the A1 sealing. Special tool for L2.
A2 Sealing press tool	3HAC090313-001	Used to install the A2 sealing. Special tool for L2.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Continues on next page

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the inner arm

Use these procedures to remove the inner arm.

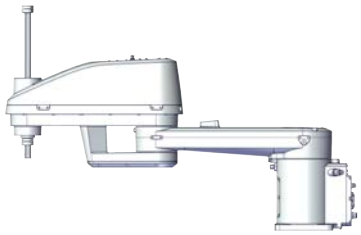
Preparations before removing the inner arm

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket.  **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	

Continues on next page

5.5.1 Replacing the inner arm

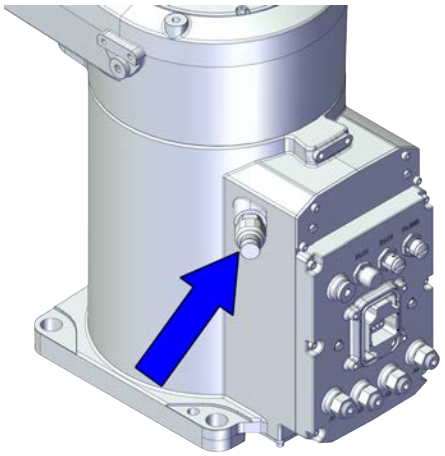
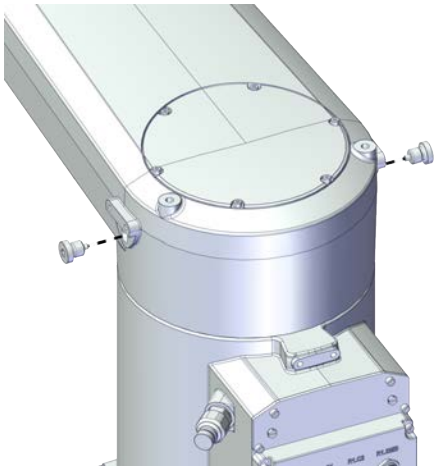
Continued

	Action	Note
3	Jog all axes to zero position.	 xx2300000486
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Draining oil of axis-1 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	
3	Lay down the robot to let the quick coupling facing the ground if needed.	

Continues on next page

	Action	Note
4	Place the oil collecting vessel underneath the quick coupling.	 xx2300000546
5	Remove the oil plugs and keep them opened to speed up the drainage.	 xx2300000547
6	Plug a G3/8 quick coupling connector with pipe to the quick coupling on base.	
7	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 605* for more information.	
8	Drain the gearbox oil.	**Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.

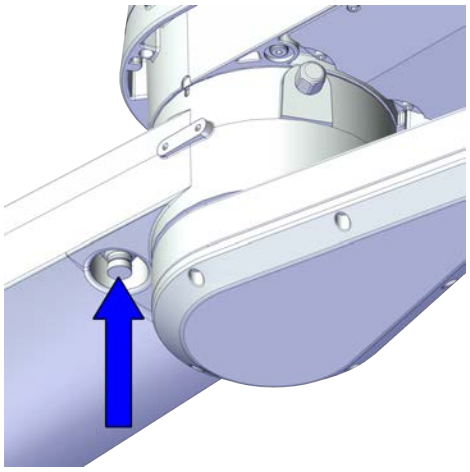
Continues on next page

5.5.1 Replacing the inner arm

Continued

	Action	Note
9	Remove the quick coupling connector and clean the pipe after the oil is drained. **Note** There will be some oil left in the gearbox after draining.	
10	Refit oil plugs.	Tightening torque: 10 Nm

Draining oil of axis-2 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	
3	Place the oil collecting vessel underneath the oil plug, draining.	 xx2300000548
4	Plug a clean pipe to the oil plug, draining, with the other end to the oil collecting vessel.	

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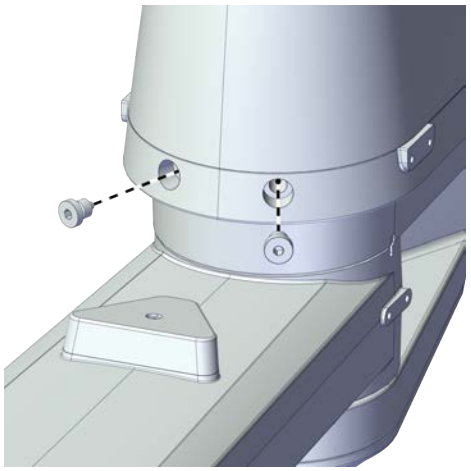
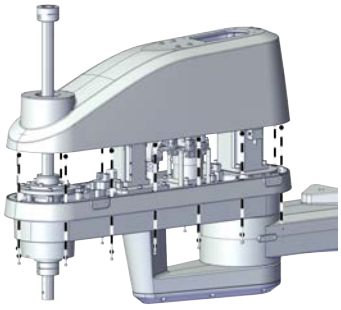
	Action	Note
5	Remove the oil plug, draining.	 xx2300000549
6	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 605* for more information.	
7	Drain the gearbox oil.	**Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
8	Remove and clean the pipe after the oil is drained. **Note** There will be some oil left in the gearbox after draining.	
9	Refit oil plugs.	Tightening torque: 10 Nm

Removing the cover of the outer arm

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

Continues on next page

5.5.1 Replacing the inner arm
Continued

	Action	Note
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

Disconnecting the air hoses, C1 cabling and C2 cabling (if equipped)

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the air hoses from the L-shaped connectors.	

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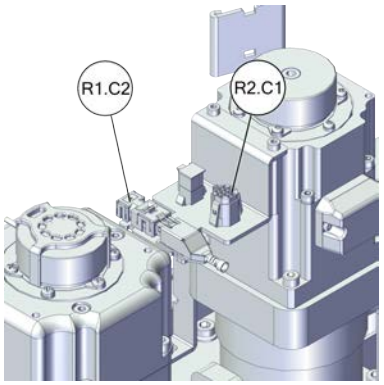
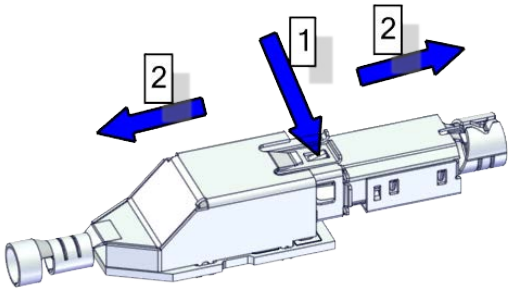
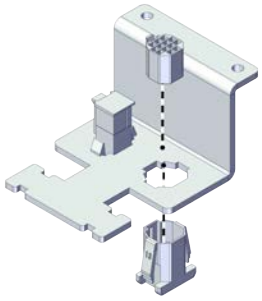
	Action	Note
3	**For robots with C1 cabling** Disconnect the connector. • R2.C1	 xx2300000542
4	**For robots with C2 cabling** Disconnect the connector. • R1.C2 **Tip** Cut the cable straps for the R1.C2 at the same time. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the R1.C2 (for C2 cabling).  xx1800002943	
5	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544

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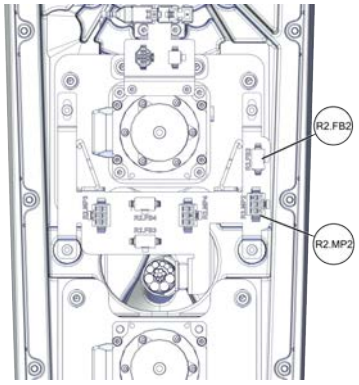
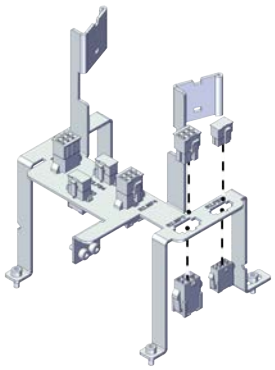
5.5.1 Replacing the inner arm

Continued

Disconnecting the connectors for axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

Disconnecting the connectors for axis-3 motor

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

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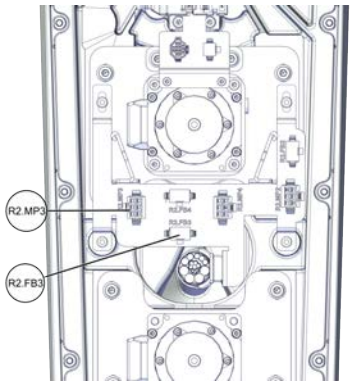
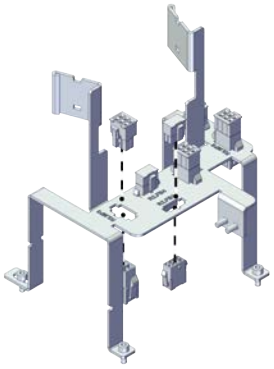
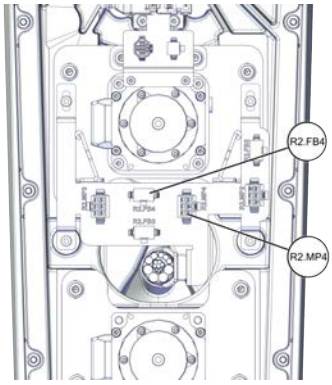
	Action	Note
2	Disconnect the connectors. • R2.MP3 • R2.FB3	 xx2300000491
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494

Disconnecting the connectors for axis-4 motor

	Action	Note
1	Disconnect the axis-4 motor connectors. • R2.MP4 • R2.FB4	 xx2300000492

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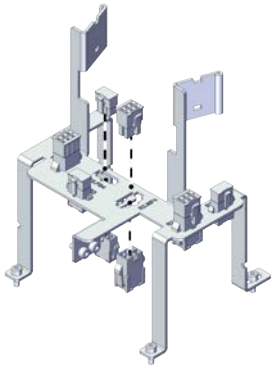
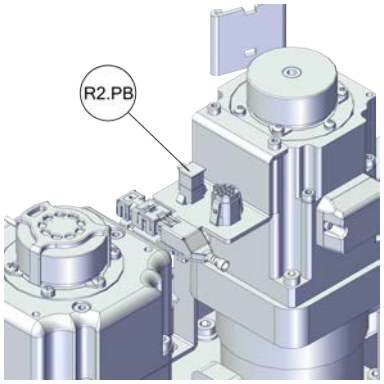
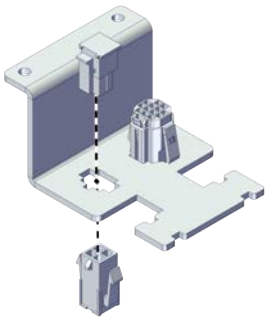
5.5.1 Replacing the inner arm

Continued

	Action	Note
2	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

Disconnecting the connector for PB

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connector. • R2.PB	 xx2300000543
3	Snap loose and remove the female head of the connector from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545

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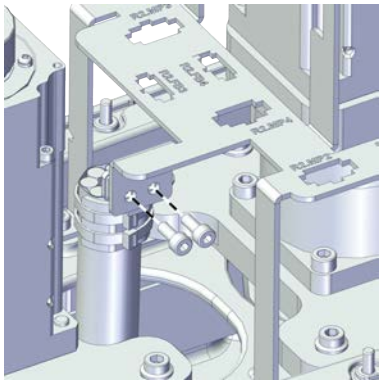
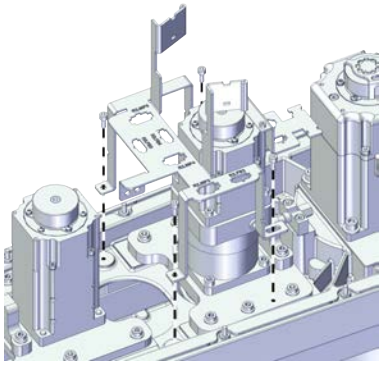
Removing the process hub

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Take out the process hub. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	

Removing the outer arm cable ferrule and bracket

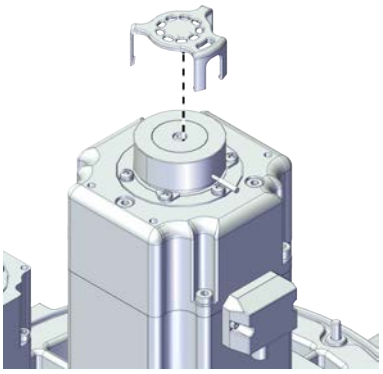
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000496
3	Remove the screws on the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000497

Continues on next page

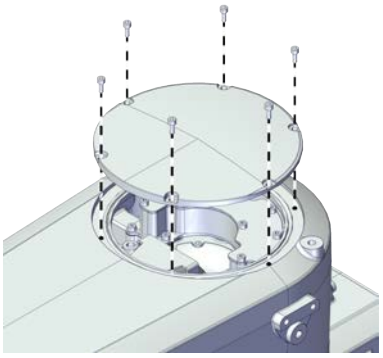
5.5.1 Replacing the inner arm

Continued

Removing the axis-2 motor protection cover

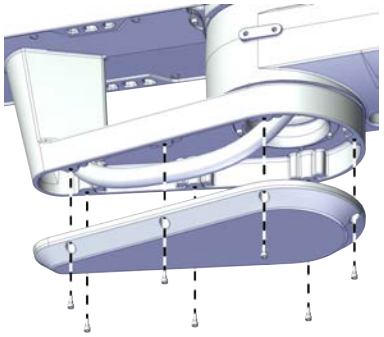
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the protection cover on the motor.	 xx2300000550

Removing the axis-1 cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000498
3	Remove the cover.	

Continues on next page

Removing the cable arm cover

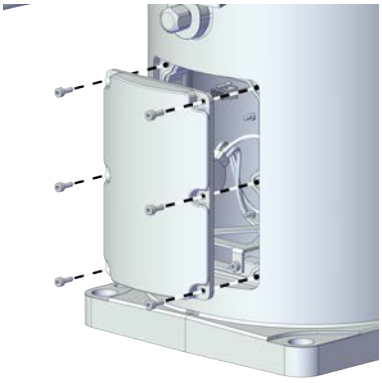
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000499
3	Remove the cover.	

Removing the SMB cover

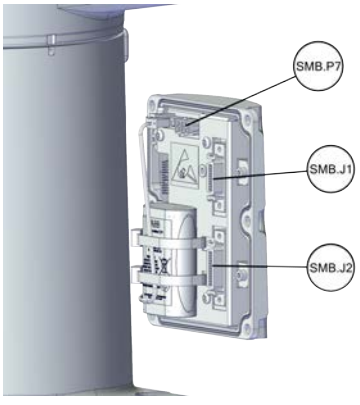
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 46*.	

Continues on next page

5.5.1 Replacing the inner arm
Continued

	Action	Note
3	Remove the screws on the SMB cover to the base.	For robots with protection class IP30
4	Pull the SMB cover with the SMB unit assembly out together.	 xx2300000489

Disconnecting the SMB cabling

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Cut the strips.	
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945

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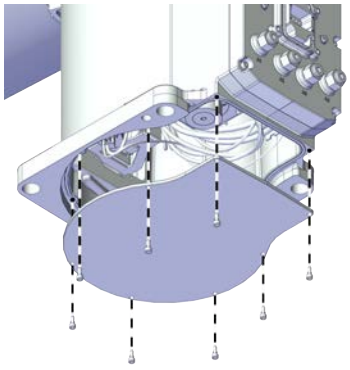
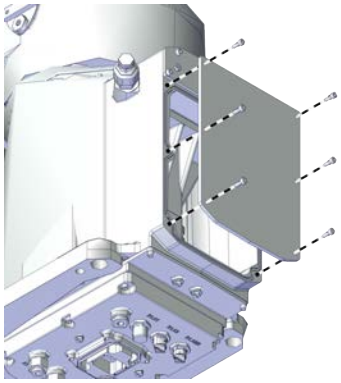
Removing the base plate/ rear plate

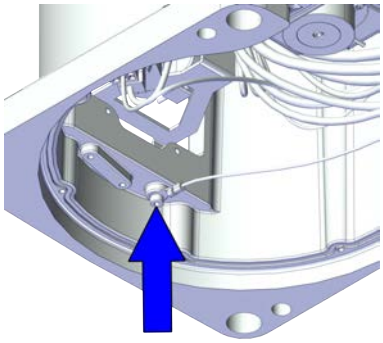
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the base to the ground.	
3	Lay down the robot.	
4	For robot with rear outlet cable version, remove the screws on the base plate.	For rear outlet cable version: For robots with protection class IP30  xx2300000500
5	Remove the base plate.	
6	For robot with underneath outlet cable version, remove the screws on the rear plate.	For underneath outlet cable version: For robots with protection class IP30  xx2300000608
7	Remove the rear plate.	

Continues on next page

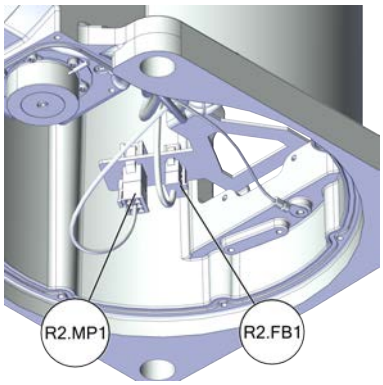
5.5.1 Replacing the inner arm

Continued

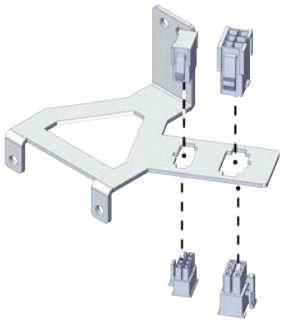
Disconnecting the grounding cable connector

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the grounding cable from the base by unscrew the screw.	 xx2300000502

Disconnecting the connectors for axis-1 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP1 • R2.FB1	 xx2300000504

Continues on next page

	Action	Note
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000505

Removing the base bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000503
3	Remove the screws on the base bracket to the base from the SMB side.	

Removing the bracket of the cable arm

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

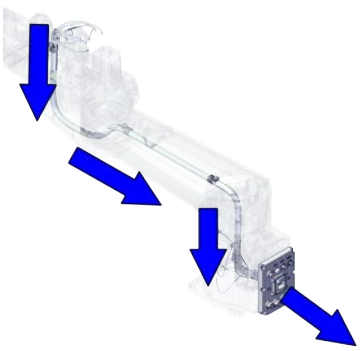
Continues on next page

5.5.1 Replacing the inner arm

Continued

	Action	Note
2	Remove the bracket from the cable arm to release the cable.	 xx2300000506

Removing the main harness from the cable arm position

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Pull the main harness out of the outer arm from lower of the cable arm. **Tip** Wrap the connectors with the masking tape. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	For rear outlet cable version:  xx2300000507 For underneath outlet cable version:  xx2300000612

Continues on next page

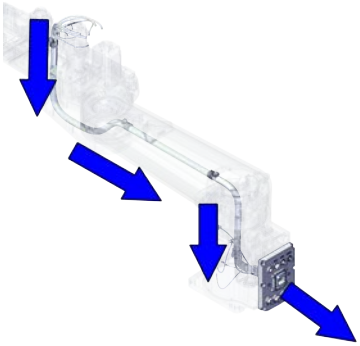
	Action	Note
3	Pull the main harness out of the cable arm from the inner arm.	

Removing the main harness from the axis -1 gearbox position

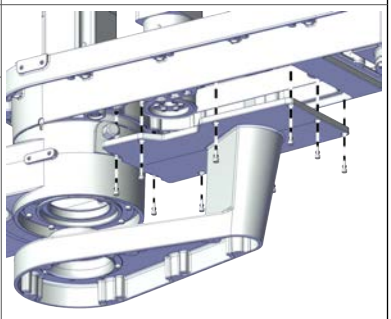
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the bracket from the inner arm to release the cable.	 xx2300000508
3	Remove the screws on the cable ferrule to the bracket and take the bracket out.	

Continues on next page

5.5.1 Replacing the inner arm
Continued

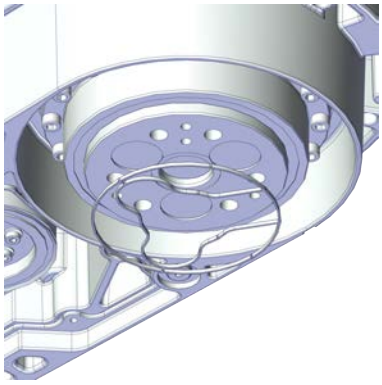
	Action	Note
4	Pull the main harness out of the inner arm from the sleeve of the axis-1 gearbox. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000507 For underneath outlet cable version:  xx2300000612

Removing the cable arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the cable arm to the outer arm.	 xx2300000516
3	Remove the cable arm by pulling out from the inner arm bearing.	

Continues on next page

Removing the outer arm assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the axis -2 gear inside the inner arm.	For robots with protection class IP30
3	Remove the outer arm assembly slightly.	 xx2300000517
4	Remove the gear gasket on the axis-2 gear unit.	 xx2300000603

Removing the oil tank

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

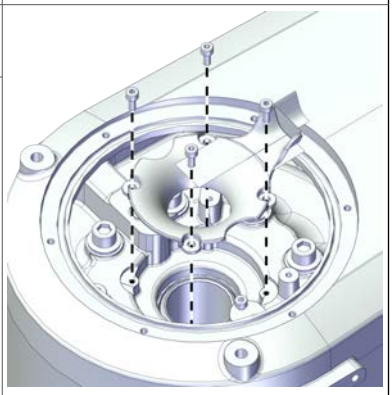
Continues on next page

5.5.1 Replacing the inner arm

Continued

	Action	Note
2	Remove the screws on the oil tank to the inner arm.	 xx2300000511
3	Remove the oil tank.	

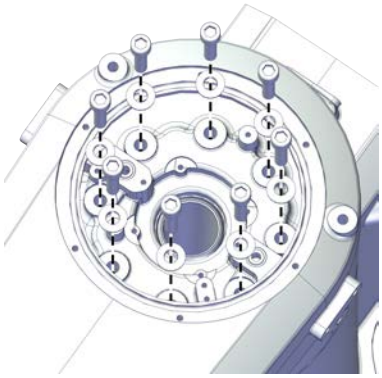
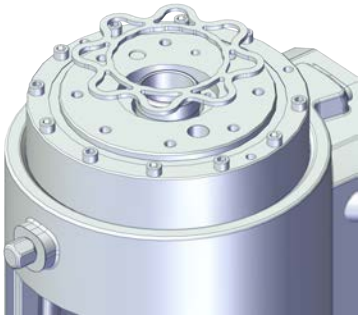
Removing the protection tube

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the protection tube to the inner arm.	 xx2300000513
3	Remove the protection tube.	

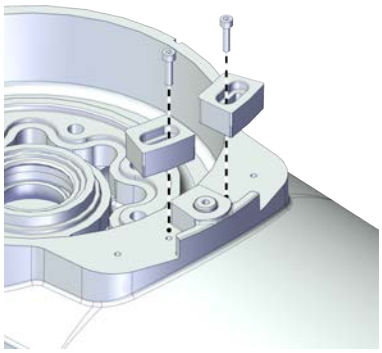
Removing the base from inner arm

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

Continues on next page

	Action	Note
2	Remove the screws and washers on the inner to the axis-1 gear unit.	 xx2300000514
3	Disconnect the axis-1 gear to the inner arm.	
4	Remove the BassSwing gasket on the axis-1 gear unit.	 xx2300000602

Removing the rubber stop from the inner arm

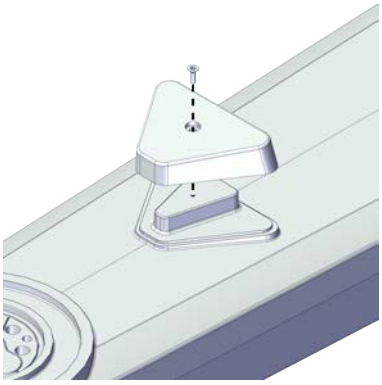
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	 xx2300000551
3	Remove the rubber stop from the inner arm.	

Continues on next page

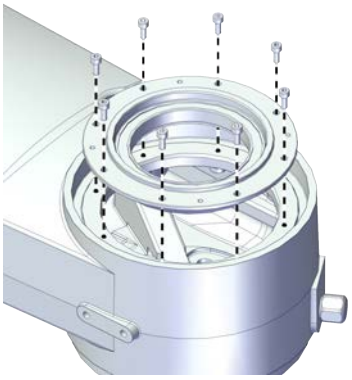
5.5.1 Replacing the inner arm

Continued

Removing the damper from the inner arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	 xx2300000552
3	Remove the rubber stop from the inner arm.	

Removing the A2 swing from the inner arm

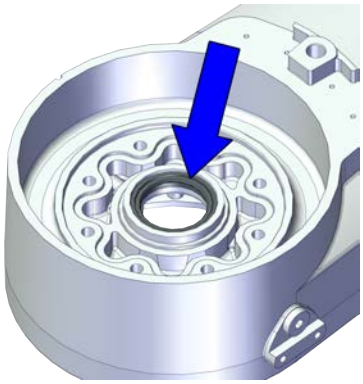
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	 xx2300000554
3	Remove the A2 swing from the inner arm.	

Continues on next page

Removing the A2 sealing from the inner arm (Only needed during replacing A2 sealing)

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the A2 sealing from the inner arm.	 xx2300001913

Removing the A1 sealing from the inner arm (Only needed during replacing A1 sealing)

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the A1 sealing from the inner arm.	 xx2300000553

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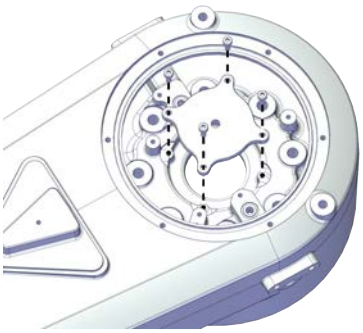
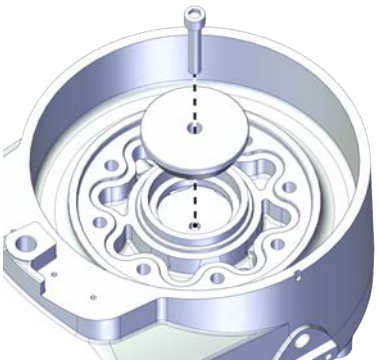
5.5.1 Replacing the inner arm
Continued

Refitting the inner arm

Use these procedures to refit the inner arm.

Refitting the A1 sealing to the inner arm (Only needed during replacing A1 sealing)

	Action	Note
1	Install the holding part of the A1 sealing press tool (3HAC087848-001) to the inner arm and locking with the screws.	A1 Sealing press tool:3HAC087848-001 Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs)  xx2300000585
2	Insert the A1 sealing to the pressing part of the sealing press tool.	 xx2300000586
3	Press the A1 sealing to the inner arm by tightening the pressing part with the screw to the holding part.	Screws: Hex socket head cap screw M8x45 12.9 Gleitmo 603+Geomet 500 (1 pcs)  xx2300000587

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	Action	Note
4	Remove the pressing part by unscrewing the screw.	
5	Remove the holding part by unscrewing the screws.	

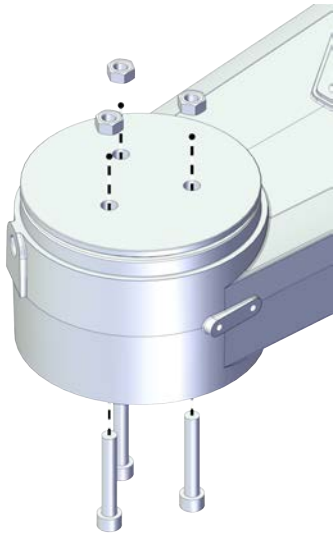
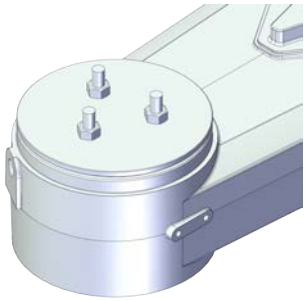
Refitting the A2 sealing to the inner arm (Only needed during replacing A2 sealing)

	Action	Note
1	Apply the grease to the sealing.	Grease: FM222  xx2300001908
2	Insert the A2 sealing to the pressing part of the sealing press tool.	 xx2300001909
3	Press the A2 sealing to the inner arm.	 xx2300001910

Continues on next page

5.5.1 Replacing the inner arm

Continued

	Action	Note
4	Install the three screws of the A2 sealing press tool (3HAC090313-001) to the inner arm and lock with the nuts.	A2 Sealing press tool:3HAC090313-001  xx2300001911
5	Tighten the nuts to press the sealing to the inner arm.	 xx2300001912
6	Remove the screws and nuts.	 xx2300001913
7	Remove the pressing part.	

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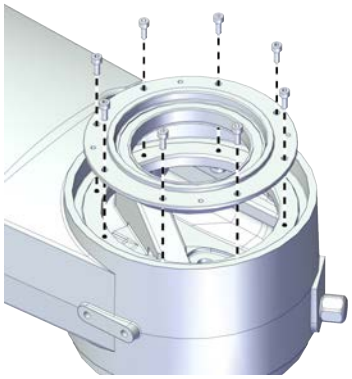
Refitting the A2 swing to the inner arm

	Action	Note
1	Refit the A2 swing back to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 2.8 Nm±3  xx2300000554
2	Secure with the screws.	

Refitting the damper to the inner arm

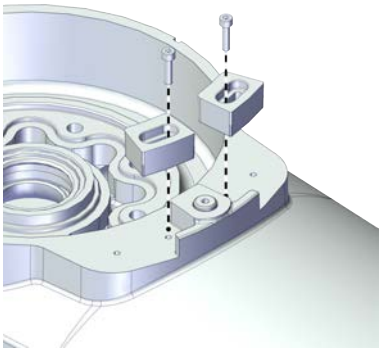
	Action	Note
1	Refit the damper back to the inner arm.	Screws: Torx pan head screw 9ADA625-34 M4x10 8.8-A2F(1 pcs) Tightening torque: 1 Nm ±3%  xx2300000552
2	Secure with the screws.	

Continues on next page

5.5.1 Replacing the inner arm

Continued

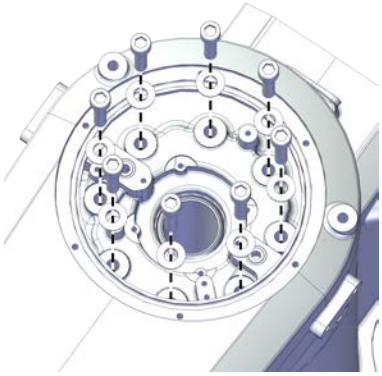
Refitting the rubber stop to the inner arm

	Action	Note
1	Refit the rubber stop back to the inner arm.	Screws: Hex socket head cap screw M4x16 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 1 Nm  xx2300000551
2	Secure with the screws.	

Refitting the base to the inner arm

	Action	Note
1	Refit the BassSwing gasket to the axis-1 gearbox.	 xx2300000602

Continues on next page

	Action	Note
2	Refit the inner arm to the axis-1 gearbox as the illustration.	Screws: Hex socket head cap screw M8x40 12.9 Gleitmo 603+Geomet 500 (8 pcs) Washers: Spring washer, conical 9ADA334-7 18x4x2 Steel (8 pcs) Tightening torque: 25 Nm ±3%  xx2300000514
3	Refit the screws.	

Refitting the protection tube

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the protection tube.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1 Nm  xx2300000513
3	Secure the screws on the protection tube to the inner arm.	

Continues on next page

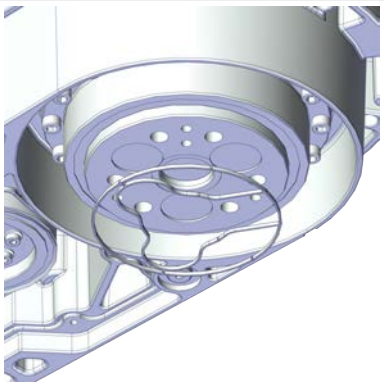
5.5.1 Replacing the inner arm

Continued

Refitting the oil tank

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the oil tank.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (5 pcs) Tightening torque: 2.4 Nm ±3%  xx2300000511
3	Secure the screws on the oil tank to the inner arm.	

Refitting the outer arm to the inner arm

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
2	Refit the gear gasket to the axis-2 gear unit.	 xx2300000603

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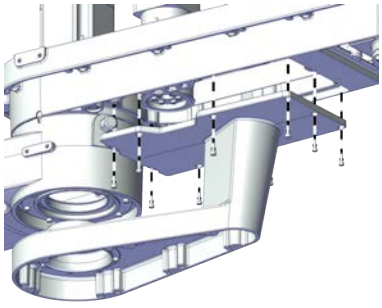
	Action	Note
3	Refit the outer arm to the inner arm. **Tip** When the gear unit is in the right position, you can hear a clear "Click".	Screws: Hex socket head cap screw M10x25 12.9 Gleitmo 603+Geomet 500 (6 pcs) Tightening torque:55 Nm Screws: Hex socket head cap screw M6x20 12.9 Gleitmo 603+Geomet 500 (3 pcs) Tightening torque:10 Nm
4	Refit the screws. **Note** The two screw holes under the axis-2 belt location are left empty.	 xx2300000517

Refitting the cable arm

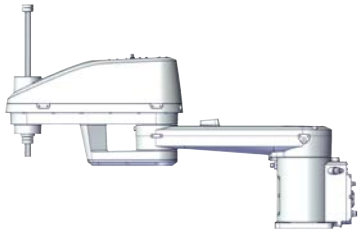
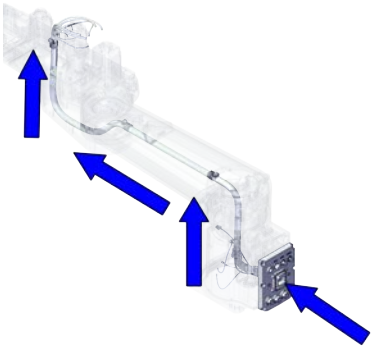
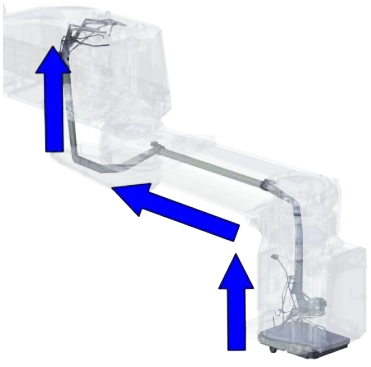
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the cable arm to the inner arm and outer arm.	
3	Secure the cable arm to the outer arm with the screws.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque:3.3 Nm2.4 Nm ±3%  xx2300000516

Continues on next page

5.5.1 Replacing the inner arm

Continued

Inserting the main harness through the axis -1 gearbox position

	Action	Note
1	Make sure that the robot is at zero position.	 xx2300000486
2	Insert the main harness into the inner arm through the protection tube of the axis-1 gearbox from the base. **Tip** Wrap the connectors with the masking tape. **Tip** The air hoses should face the axis-1 motor. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610

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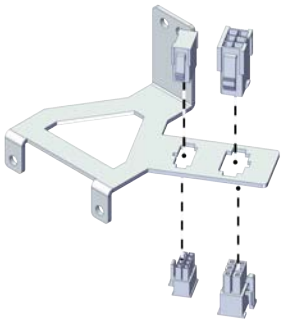
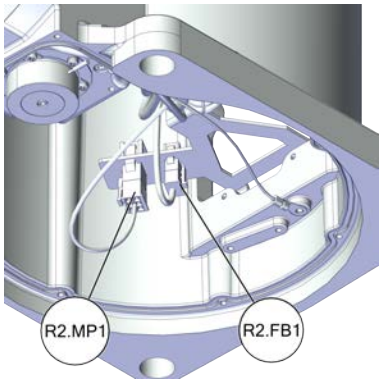
Reconnecting the connectors for axis-1 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000505
2	Reconnect the connectors. • R2.MP1 • R2.FB1 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000504
3	Route the cabling behind the axis-1 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the base bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Lay the main harness in a natural state without distortion.	

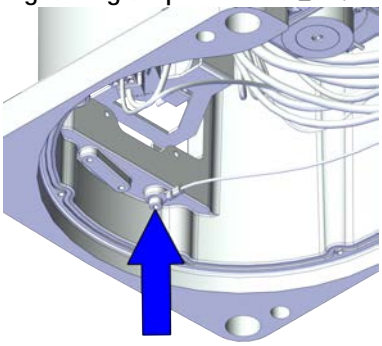
Continues on next page

5.5.1 Replacing the inner arm

Continued

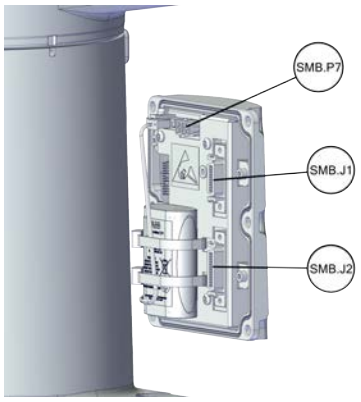
	Action	Note
	Refit the cable ferrule to the bracket. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000503
3	Refit the base bracket to the base and secure with the screws.	

Reconnecting the grounding cable connector

	Action	Note
1	Secure the grounding cable to the bracket with the screw.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (1 pcs) Tightening torque: 1.2 Nm ±10%  xx2300000502
2	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Refitting the SMB cover

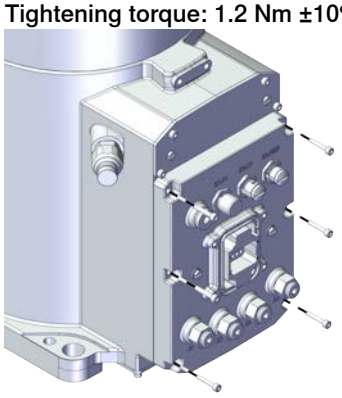
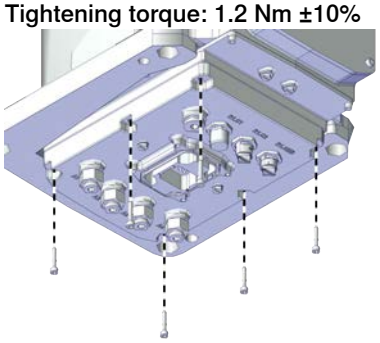
	Action	Note
1	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945
2	Refit the SMB cover assembly.	For robots with protection class IP30 Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.6 Nm  xx2300000489
3	Secure the SMB cover to the base with the screws.	

Continues on next page

5.5.1 Replacing the inner arm

Continued

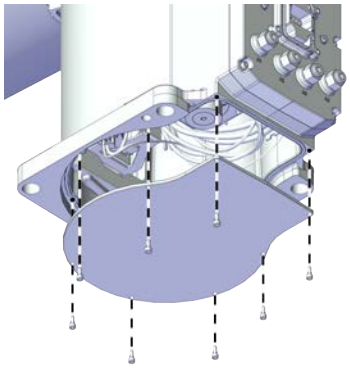
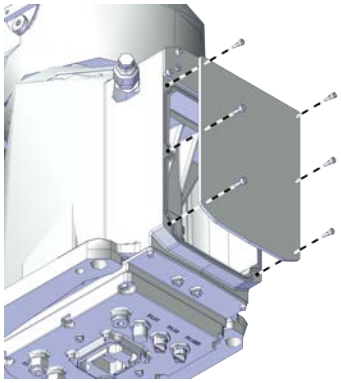
Refitting the main harness

	Action	Note
1	For rear outlet cable version, refit the main harness to the base.	For rear outlet cable version: For robots with protection class IP30 Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm ±10%  xx2300000509
2	Secure with the screws.	
3	For underneath outlet cable version, refit the main harness assembly to the base. **Note** Refit the bottom plate to the main harness if needed.	For underneath outlet cable version: For robots with protection class IP30 Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.2 Nm ±10%
4	Secure with the screws.	 xx2300000609

Refitting the base plate/ rear plate

	Action	Note
1	Apply grease to the internal harness, cover all moving area of the harness.	

Continues on next page

	Action	Note
2	For rear outlet cable version, refit the base plate to the base. For underneath outlet cable version, refit the rear plate to the base.	Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm ±10%
3	Secure the base plate/ rear plate to the base with the screws.	For rear outlet cable version: For robots with protection class IP30  xx2300000500 For underneath outlet cable version: For robots with protection class IP30  xx2300000608
4	Refit the robot back to the ground.	
5	Secure with the screws.	Screws: Hex socket head cap screw M12x35 12.9 Gleitmo 603+Geomet 500 (4 pcs) Steel Washers: 24 mm x 13 mm x 2.5 mm (4 pcs) Tightening torque: 56 Nm ±10%

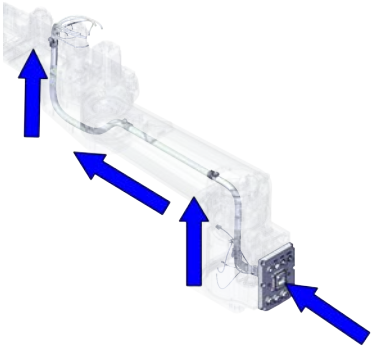
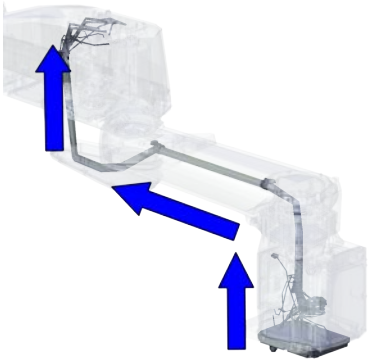
Inserting the main harness through the inner arm position

	Action	Note
1	Secure the cable with the cable ferrule to the two brackets in inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) x 2 Tightening torque: 2.4 Nm ±10%

Continues on next page

5.5.1 Replacing the inner arm

Continued

	Action	Note
2	Insert the main harness into the cable arm through the inner arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
3	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000508

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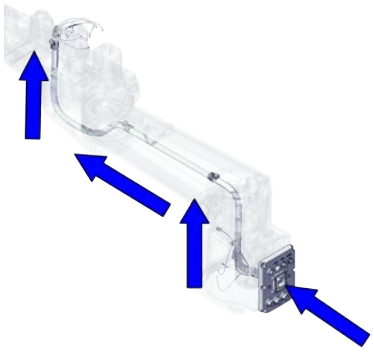
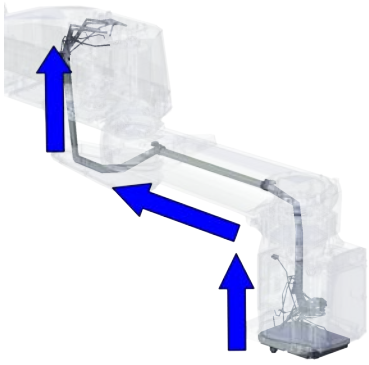
Inserting the main harness through the cable arm

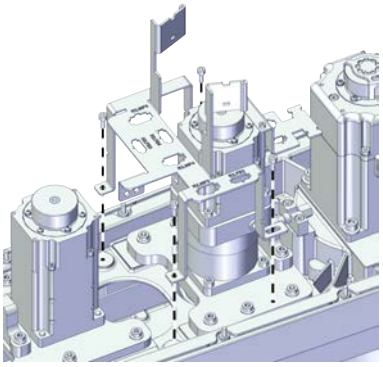
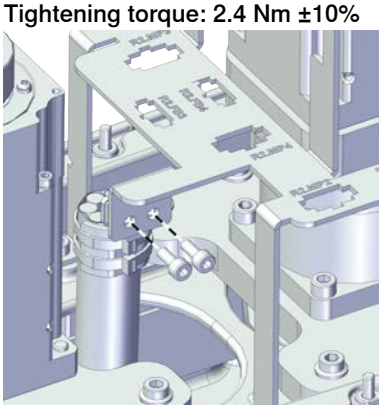
	Action	Note
1	Insert the main harness into the outer arm through the cable arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
2	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000506

Continues on next page

5.5.1 Replacing the inner arm

Continued

Refitting the cable ferrule and bracket in the outer arm

	Action	Note
1	Lay the internal harness in a natural state without distortion.	
2	Refit the bracket. **Tip** Do not secure it with the screws before the cable ferrule installed well. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000497
3	Secure the cable ferrule to the bracket with the screws. **Tip** The air hoses should face the process hub side. **Tip** The position with wrapped tape is the marked position for the cable ferrule. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000496

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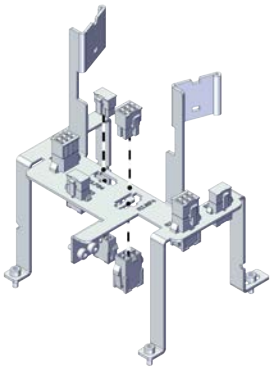
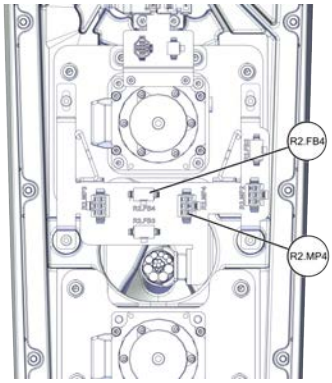
Reconnecting the connectors for axis-4 motor

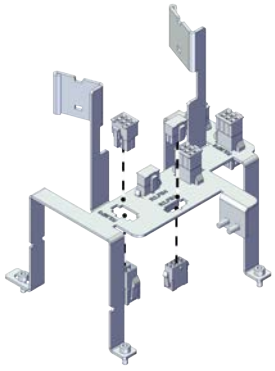
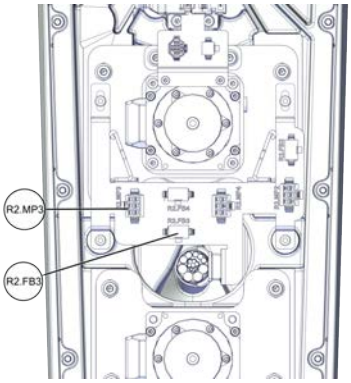
	Action	Note
	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495
1	Reconnect the connectors. • R2.MP4 • R2.FB4 **Tip** See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000492
2	Route the cabling on the axis-4 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.5.1 Replacing the inner arm

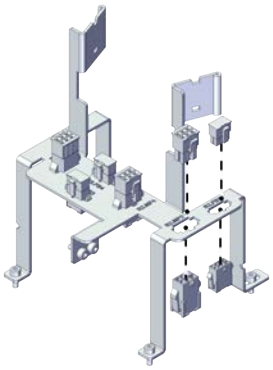
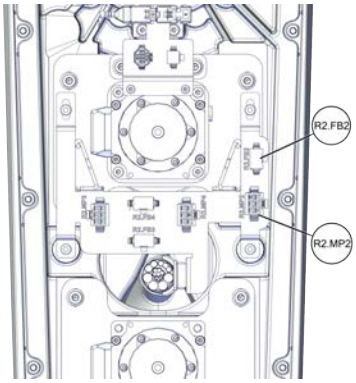
Continued

Reconnecting the connectors for axis-3 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494
2	Reconnect the connectors. • R2.MP3 • R2.FB3 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000491
3	Route the cabling on the axis-3 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Reconnecting the connectors for axis-2 motor

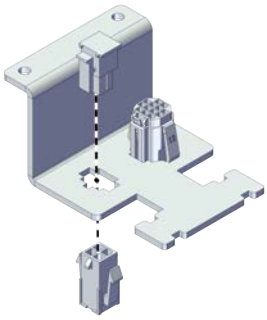
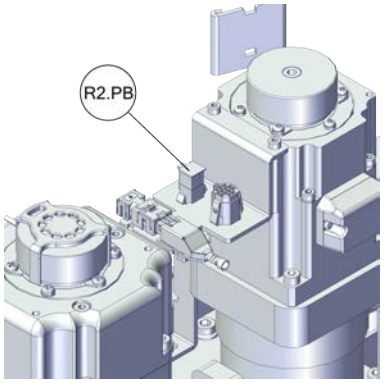
	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.5.1 Replacing the inner arm

Continued

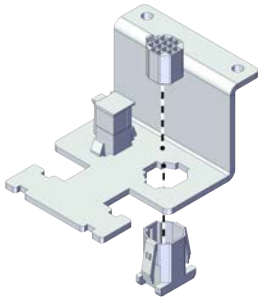
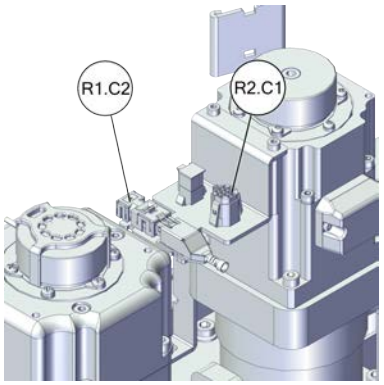
Reconnecting the connector for PB

	Action	Note
1	Insert the female head of the PB connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545
2	Reconnect the connector. • R2.PB **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000543
3	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed incorrectly the cables can be damaged.	

Reconnecting the air hoses, CP/CS cabling and Ethernet cabling (if equipped)

	Action	Note
1	Route the air hoses on the process hub behind the bracket. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

	Action	Note
2	Insert the female head of the C1 cabling connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544
3	**For robots with C1 cabling** Reconnect the connector. • R2.C1 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	 xx2300000542
4	**For robots with C2 cabling** Reconnect the connector. • R1.C2 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	
5	Secure the C2 cabling to the C2 bracket with the cable straps.	
6	Reconnect the air hoses in a cross pattern with the L-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	

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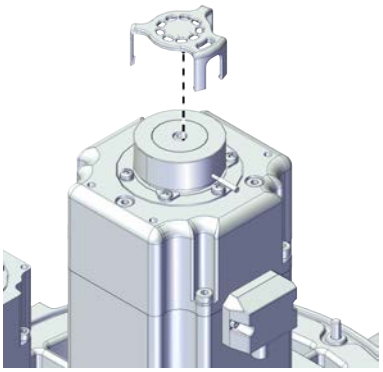
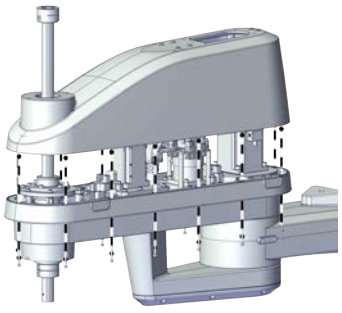
5.5.1 Replacing the inner arm
Continued

	Action	Note
7	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the axis-2 motor pulley protection cover

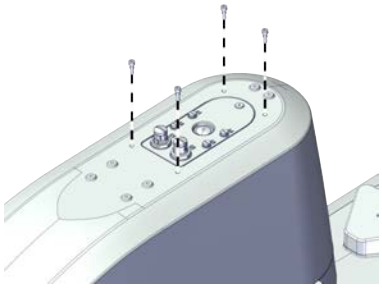
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the protection cover back to the motor.	 xx2300000550

Refitting the cover of the outer arm

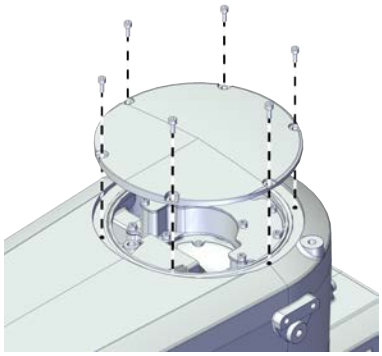
	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Continues on next page

Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487
4	Remove the screw.	

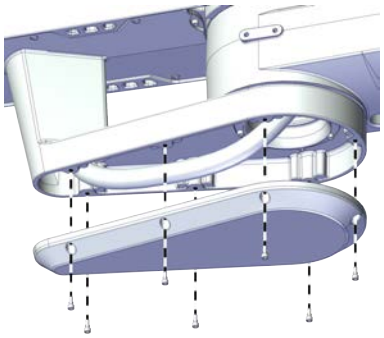
Refitting the axis-1 cover

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.4 Nm ±3% For robots with protection class IP30  xx2300000498
2	Refit the screws.	

Continues on next page

5.5.1 Replacing the inner arm
Continued

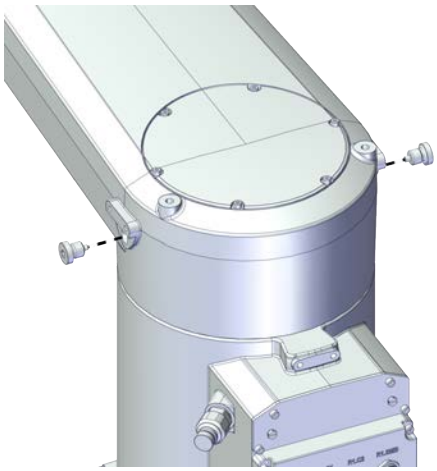
Refitting the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the cover.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (7 pcs) Tightening torque: 6 Nm ±3% For robots with protection class IP30  xx2300000499
3	Refit the screws.	

Refilling oil to axis-1 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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
3	Open the oil plugs, one for filling and the other for venting.	 xx2300000547
4	**WARNING** 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.	
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.
6	Refit the oil plugs.	Tightening torque: 10 Nm

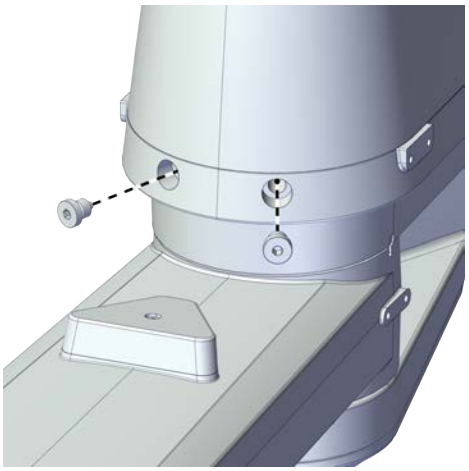
Refilling oil to axis-2 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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

5.5.1 Replacing the inner arm

Continued

	Action	Note
3	Open the upper oil plug. **Note** The lower oil plug has to be closed; otherwise, the oil may leak before required oil amount is filled.	 xx2300000549
4	**WARNING** 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.	
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained. **CAUTION** Oil filling must be slow to make sure air venting is fluent.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.
6	Refit the oil plug.	Tightening torque: 10 Nm
7	**DANGER** Make sure all safety requirements are met when performing the first test run.	

Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.

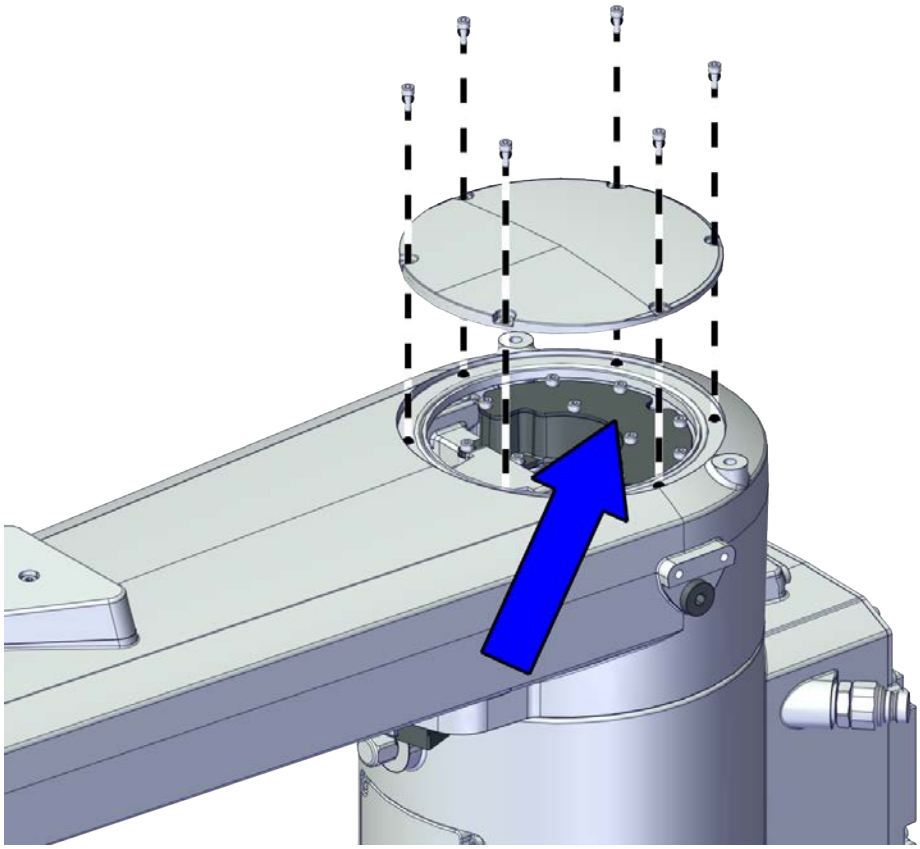
Continues on next page

	Action	Note
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 55*.	

5.5.2 Replacing the axis-1 oil tank

Location of the axis-1 oil tank

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



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 930 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Oil tank	3HAC081810-001	Replace if damaged.
Oil tank cover	3HAC081812-001	Replace if damaged.
Oil tank gasket	3HAC081814-001	Replace if damaged.
Oil tank O-ring	3HAB3772-138	Replace if damaged.

Continues on next page

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the axis-1 oil tank

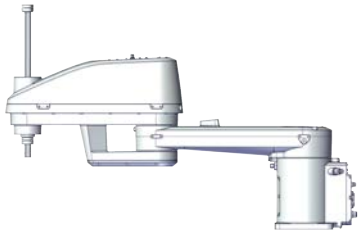
Use these procedures to remove the axis-1 oil tank.

Preparations before removing the oil tank

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	

Continues on next page

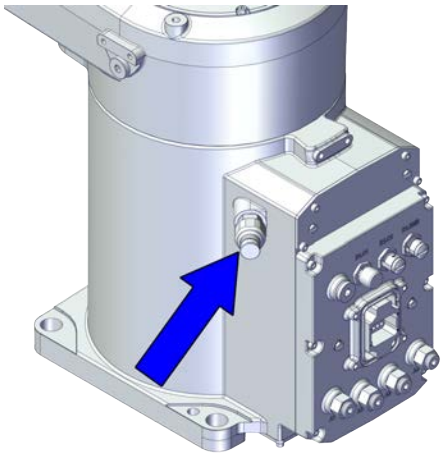
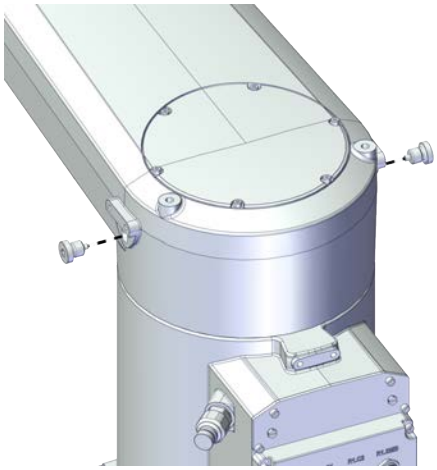
5.5.2 Replacing the axis-1 oil tank
Continued

	Action	Note
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	Jog all axes to zero position.	 xx2300000486
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Draining oil of axis-1 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	
3	Lay down the robot to let the quick coupling facing the ground if needed.	

Continues on next page

	Action	Note
4	Place the oil collecting vessel underneath the quick coupling.	 xx2300000546
5	Remove the oil plugs and keep them opened to speed up the drainage.	 xx2300000547
6	Plug a G3/8 quick coupling connector with pipe to the quick coupling on base.	
7	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 605* for more information.	
8	Drain the gearbox oil.	**Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.

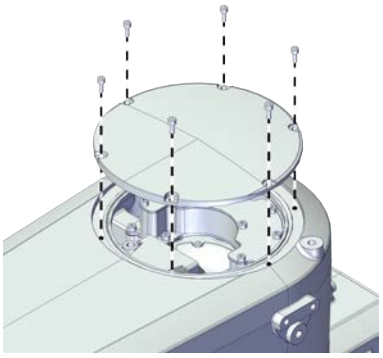
Continues on next page

5.5.2 Replacing the axis-1 oil tank

Continued

	Action	Note
9	Remove the quick coupling connector and clean the pipe after the oil is drained. **Note** There will be some oil left in the gearbox after draining.	
10	Refit oil plugs.	Tightening torque: 10 Nm

Removing the axis-1 cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000498
3	Remove the cover.	

Removing the oil tank

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

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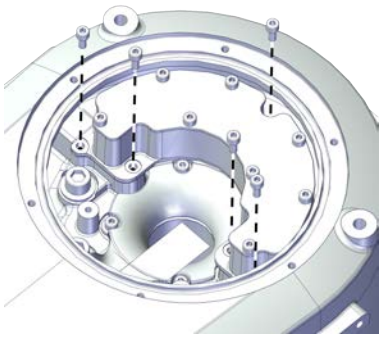
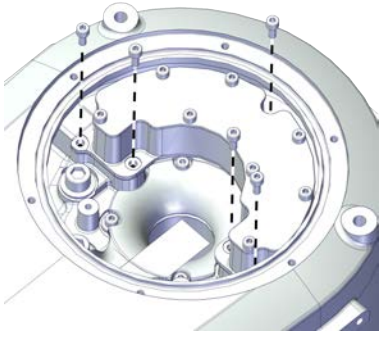
	Action	Note
2	Remove the screws on the oil tank to the inner arm.	 xx2300000511
3	Remove the oil tank.	

Refitting the axis-1 oil tank

Use these procedures to refit the axis-1 oil tank.

Refitting the oil tank

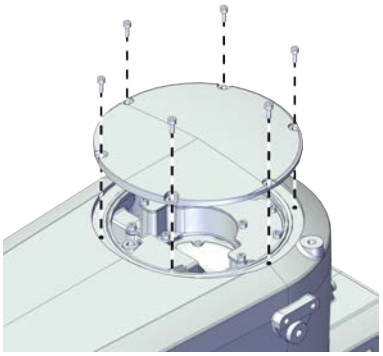
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the oil tank.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (5 pcs) Tightening torque: 2.4 Nm ±3%  xx2300000511
3	Secure the screws on the oil tank to the inner arm.	

Continues on next page

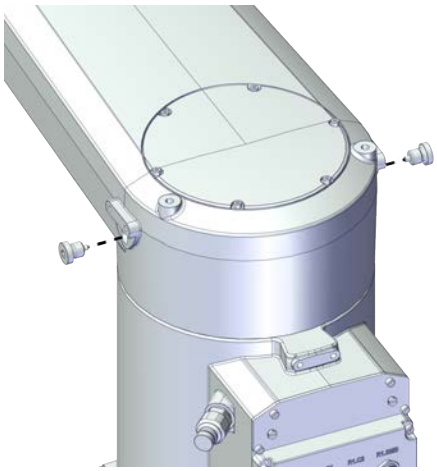
5.5.2 Replacing the axis-1 oil tank

Continued

Refitting the axis-1 cover

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.4 Nm ±3% For robots with protection class IP30  xx2300000498
2	Refit the screws.	

Refilling oil to axis-1 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	
3	Open the oil plugs, one for filling and the other for venting.	 xx2300000547

Continues on next page

	Action	Note
4	**WARNING** 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.	
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.
6	Refit the oil plugs.	Tightening torque: 10 Nm

Concluding procedure

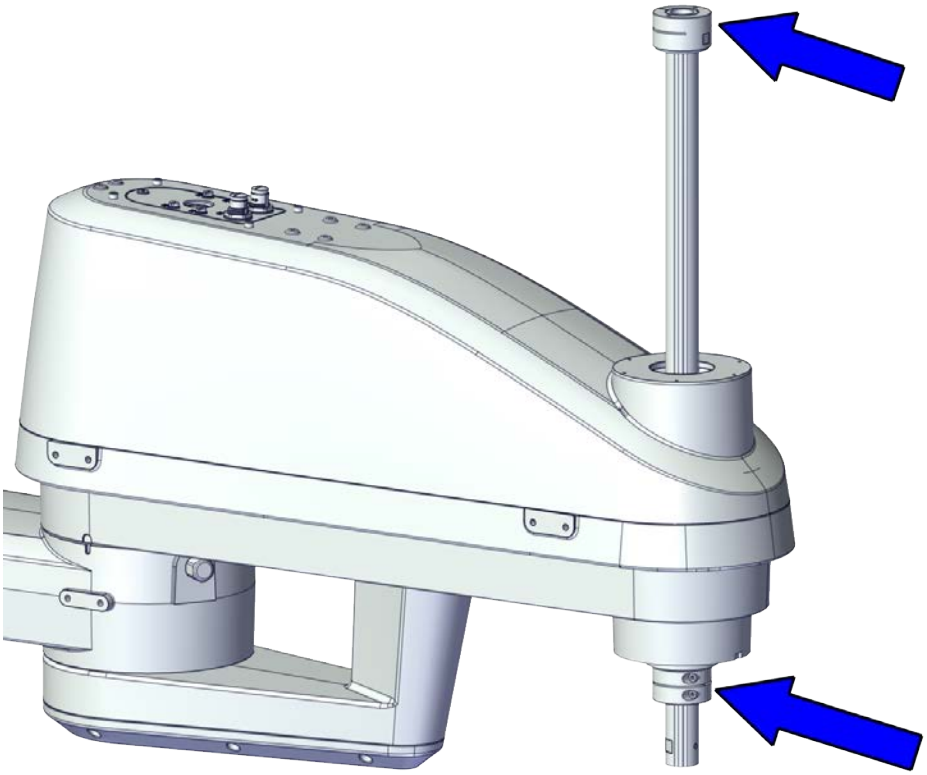
	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 55*.	

5.6 Outer arm

5.6.1 Replacing the mechanical stopper

Location of the mechanical stoppers

The mechanical stoppers are located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 930 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Rubber bumper	3HAC081787-001	
Mechanical stopper	3HAC081786-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Continues on next page

Equipment	Article number	Note
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
24 VDC power supply	-	Used to release the motor brakes.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	-	THK AFA
Grease	3HAC077740-001	Gastrol Spheerol EPL 1

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the upper mechanical stopper

Use these procedures to remove the upper mechanical stopper.

Preparations before removing the upper mechanical stopper

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	

Continues on next page

5.6.1 Replacing the mechanical stopper

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 upper mechanical stopper

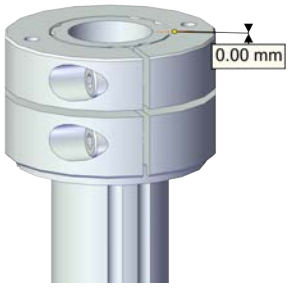
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	 xx2300000555
3	Remove the mechanical stopper. **Tip** Hold the ball screw to prevent it from dropping. Or the ball screw may be destroyed. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Continues on next page

Refitting the upper mechanical stopper

Use these procedures to refit the upper mechanical stopper.

Refitting the upper mechanical stopper

	Action	Note
1	Refit the mechanical stopper to the ball screw with the upper surface on the same level with the upper of the ball screw. **Tip** Hold the ball screw to prevent it from dropping. Or the ball screw may be destroyed. **Tip** Make sure that the limit block opening gap is aligned with the ball screw origin point. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	For robots with protection class IP30  xx2300000560
2	Refit the screws.	Screws: Hex socket head cap screw M4x14 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 6 Nm  xx2300000555

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 55*.	

Continues on next page

5.6.1 Replacing the mechanical stopper
Continued

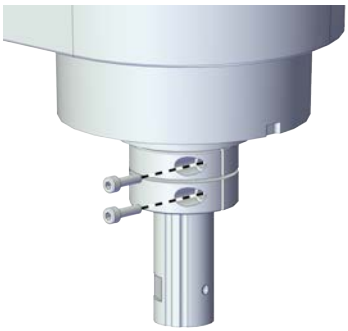
Removing the lower mechanical stopper

Use these procedures to remove the lower mechanical stopper.

Preparations before removing the lower mechanical stopper

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Move the ball screw to lower position.	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the lower mechanical stopper

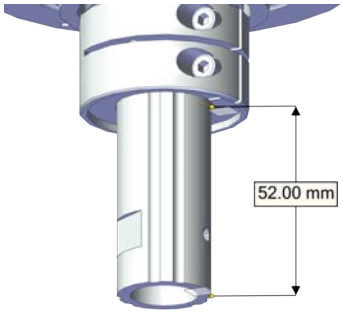
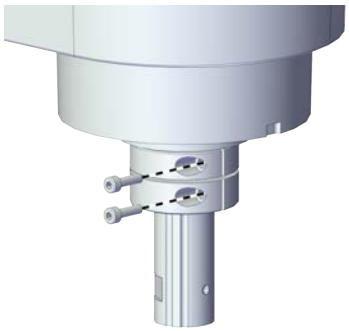
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000556
3	Remove the mechanical stopper. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Continues on next page

Refitting the lower mechanical stopper

Use these procedures to refit the lower mechanical stopper.

Refitting the mechanical stopper

	Action	Note
1	Refit the mechanical stopper to the ball screw at 52 mm position to the lower of the ball screw. **Tip** Make sure that the limit block opening gap is aligned with the ball screw origin point. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this. **Note** Be careful with the orientation of the mechanical stopper. The flat side is on the upper side.	For robots with protection class IP30  xx2300000561
2	Refit the screws.	Screws: Hex socket head cap screw M4x14 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 6 Nm For robots with protection class IP30  xx2300000556

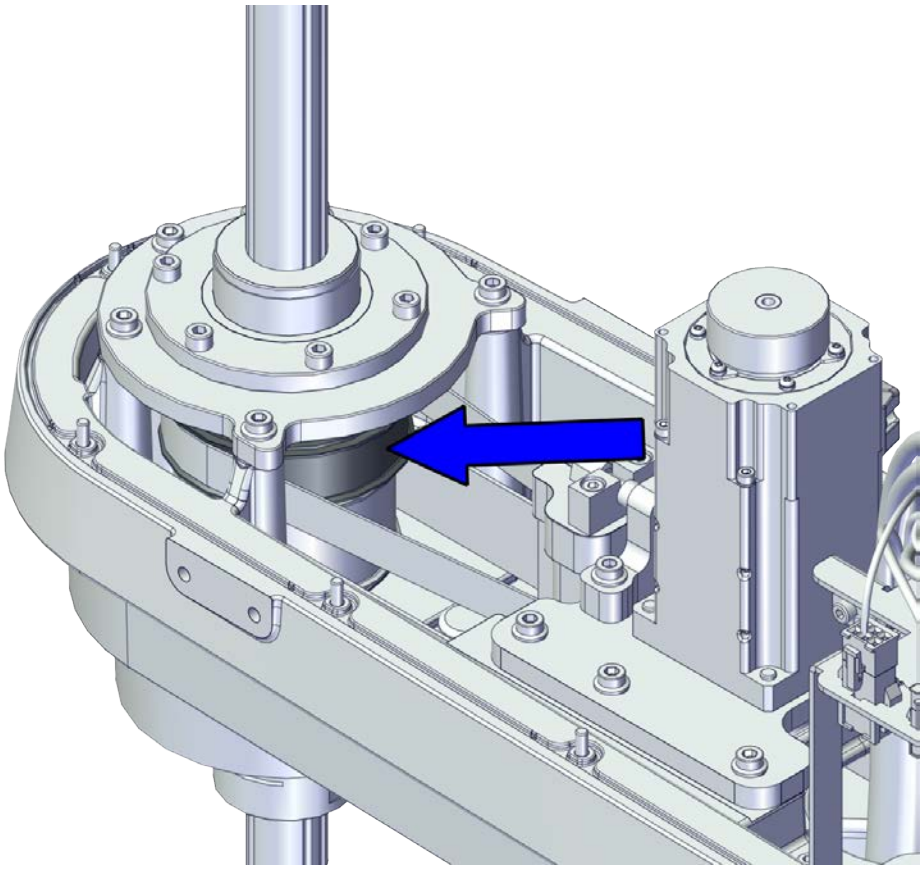
Concluding procedure

	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 55*.	

5.6.2 Replacing the pulley on the ball screw upper position

Location of the pulley

The pulley is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 930 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Pulley on the ball screw upper position	3HAC081703-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Continues on next page

Equipment	Article number	Note
IRB 930 auxiliary shaft	3HAC087847-001	Used to install the ball screw nut. Special tool for L2
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	-	THK AFA
Grease	3HAC077740-001	Gastrol Spheerol EPL 1

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

5.6.2 Replacing the pulley on the ball screw upper position
Continued

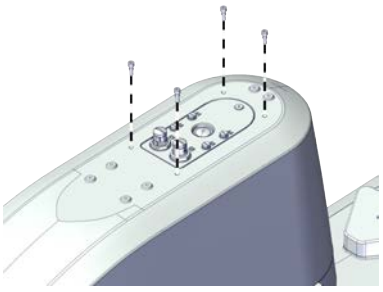
Removing the pulley on the ball screw upper position

Use these procedures to remove the pulley.

Preparations before removing the pulley

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the process hub screws

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

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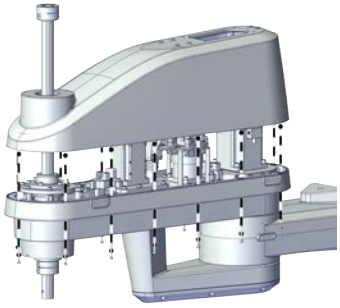
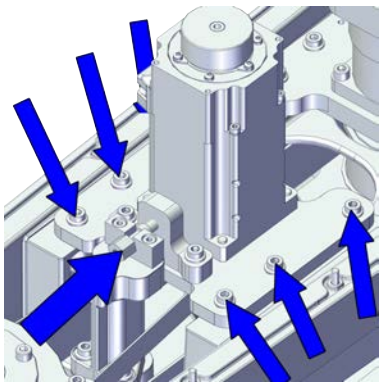
Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

Releasing the axis-3 timing belt

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Loosen the screws of the axis-3 motor sub-assembly to let the axis-3 timing belt free.	 xx2300000557

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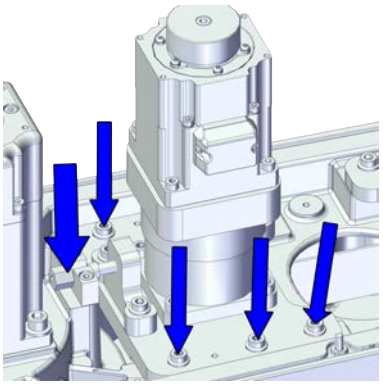
5.6.2 Replacing the pulley on the ball screw upper position

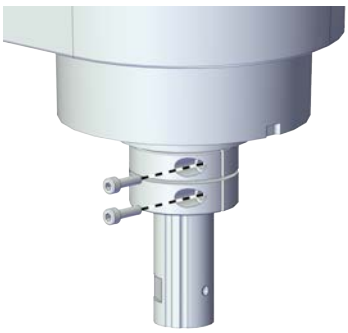
Continued

	Action	Note
4	Release the timing belt.	

Releasing the axis-4 timing belt

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Loosen the six screws of the axis-4 motor sub-assembly to let the axis-4 timing belt be free.	 xx2300000558
3	Release the timing belt.	

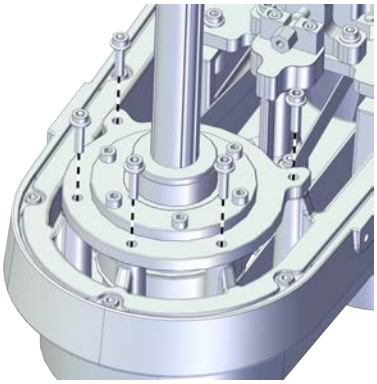
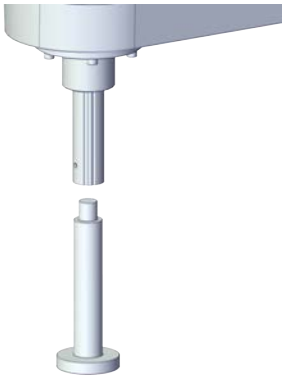
Removing the lower mechanical stopper

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000556

Continues on next page

	Action	Note
3	Remove the mechanical stopper. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Removing the ball screw with the flange

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Remove the screws and washers on the ball screw flange.	 xx2300000559
4	Insert the special tool auxiliary shaft into the ball screw shaft.	IRB 930 auxiliary shaft:3HAC087847-001  xx2300000562

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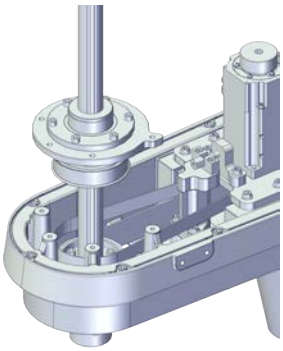
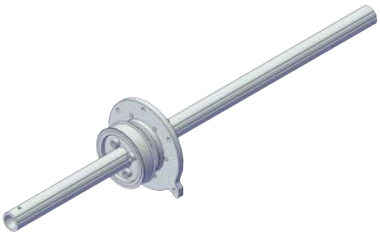
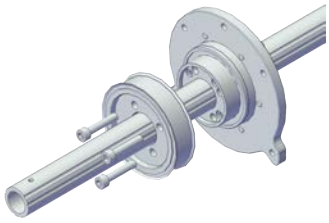
5.6.2 Replacing the pulley on the ball screw upper position
Continued

	Action	Note
5	Mark the location of the ball screw shaft grooves on the ball screw lower nut.	 xx2300000563
6	Take out the ball screw with the flange assembly carefully. **CAUTION** Move the special tool along with the ball screw shaft until it is totally inserted into the lower nut of the ball screw and keep the status. When the special tool is totally inserted to the lower nut of the ball screw, support the special tool with some thing. Or the ball screw lower nut will be destroyed.	 xx2300000564
7	Lay down the ball screw assembly. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	 xx2300000565

Removing the pulley on the ball screw upper position

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

Continues on next page

	Action	Note
2	**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 46*.	
3	Remove the screws.	 xx2300000566
4	Remove the pulley carefully. **Tip** Hold the ball screw to prevent it from dropping. Or the ball screw may be destroyed. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Refitting the pulley on the ball screw upper position

Use these procedures to refit the pulley.

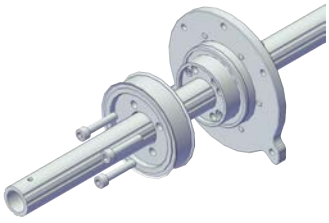
Refitting the pulley on the ball screw upper position

	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 46*.	

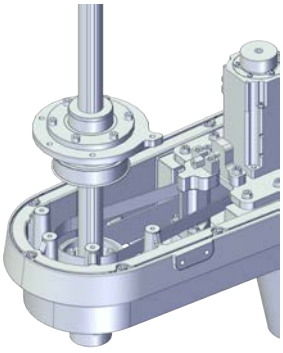
Continues on next page

5.6.2 Replacing the pulley on the ball screw upper position

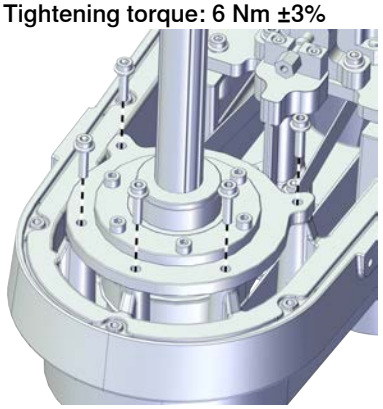
Continued

	Action	Note
2	Refit the pulley to the ball screw carefully. **Tip** Hold the ball screw to prevent it from dropping. Or the ball screw may be destroyed. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	Screws: Hex socket head cap screw M6x30 12.9 Gleitmo 603+Geomet 500 (4 pcs) Tightening torque: 8.8 Nm  xx2300000566
3	Refit the screws. **Tip** Secure with the stopping tool to prevent the pulley from rotating.	

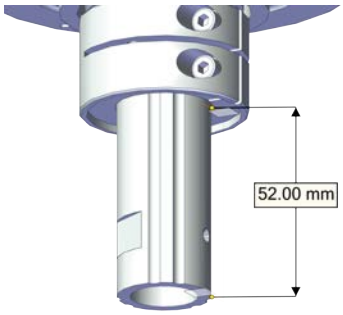
Refitting the ball screw with the flange

	Action	Note
1	Refit the ball screw assembly to the outer arm. **Tip** Make sure the marked location is aligned with the ball screw shaft grooves. **CAUTION** With the inserting of the ball screw shaft, remove the special tool auxiliary shaft along with the ball screw shaft carefully.	IRB 930 auxiliary shaft:3HAC087847-001  xx2300000564  xx2300000563

Continues on next page

	Action	Note
2	Refit the screws and washers to the secure the ball screw flange to the outer arm. **Tip** Pre-tighten the screws at 0.5Nm and slide the ball screw up and down for five times. Then tighten the screws at 6 Nm ±3% to secure it.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (5 pcs) Tightening torque: 6 Nm ±3%  xx2300000559

Refitting the mechanical stopper

	Action	Note
1	Refit the mechanical stopper to the ball screw at 52 mm position to the lower of the ball screw. **Tip** Make sure that the limit block opening gap is aligned with the ball screw origin point. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this. **Note** Be careful with the orientation of the mechanical stopper. The flat side is on the upper side.	For robots with protection class IP30  xx2300000561

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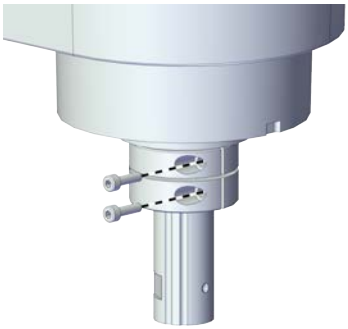
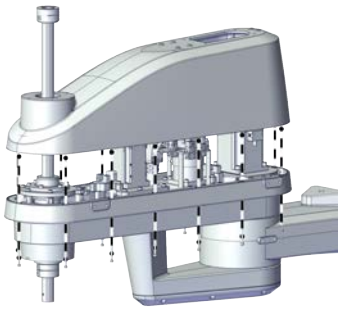
5.6.2 Replacing the pulley on the ball screw upper position
Continued

	Action	Note
2	Refit the screws.	Screws: Hex socket head cap screw M4x14 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 6 Nm For robots with protection class IP30  xx2300000556

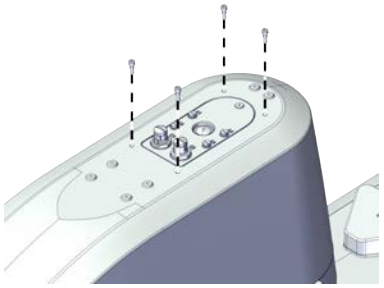
Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	

Continues on next page

	Action	Note
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487
4	Remove the screw.	

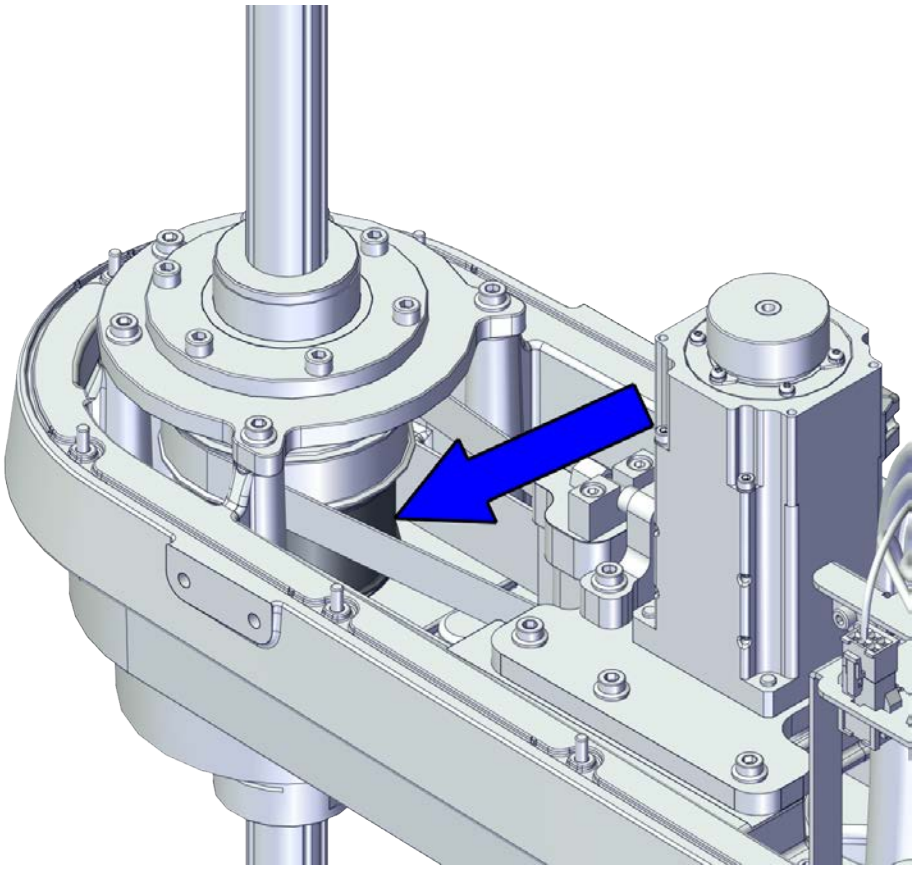
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
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 55*.	

5.6.3 Replacing the pulley on the ball screw lower position

Location of the pulley

The pulley is located as shown in the figure.



xx2300000474

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

Spare part	Article number	Note
Pulley on the ball screw lower position	3HAC081704-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Continues on next page

Equipment	Article number	Note
IRB 930 auxiliary shaft	3HAC087847-001	Used to install the ball screw nut. Special tool for L2
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	-	THK AFA
Grease	3HAC077740-001	Gastrol Spheerol EPL 1

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

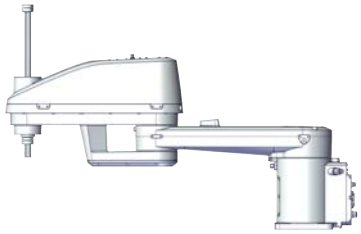
5.6.3 Replacing the pulley on the ball screw lower position
Continued

Removing the pulley on the ball screw lower position

Use these procedures to remove the pulley.

Preparations before removing the pulley

Remove the robot from the wall.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	Jog all axes to zero position.	 xx2300000486
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the process hub screws

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

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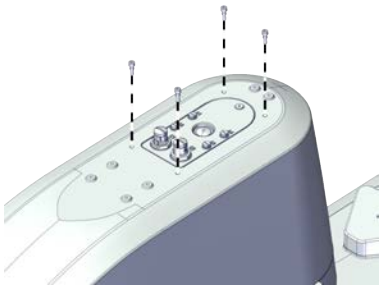
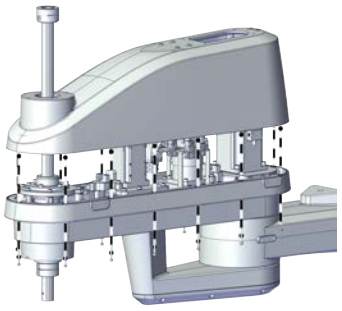
	Action	Note
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

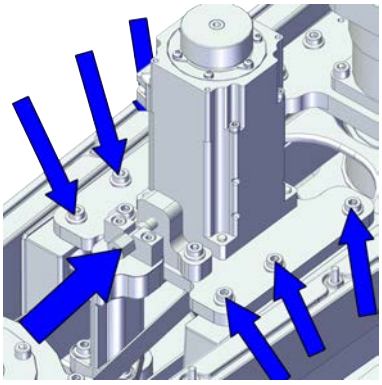
Releasing the axis-3 timing belt

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

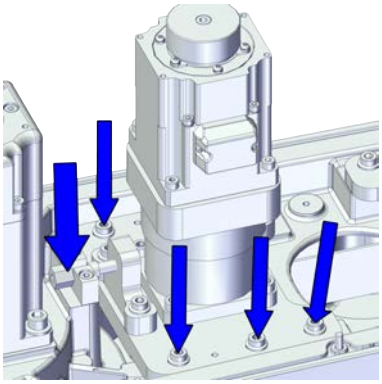
Continues on next page

5.6.3 Replacing the pulley on the ball screw lower position

Continued

	Action	Note
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Loosen the screws of the axis-3 motor sub-assembly to let the axis-3 timing belt free.	 xx2300000557
4	Release the timing belt.	

Releasing the axis-4 timing belt

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Loosen the six screws of the axis-4 motor sub-assembly to let the axis-4 timing belt be free.	 xx2300000558
3	Release the timing belt.	

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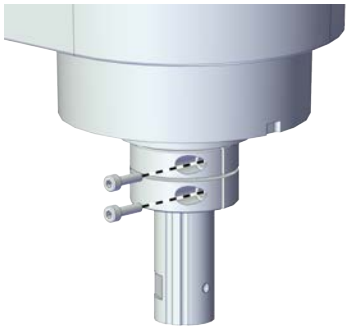
Removing the lower mechanical stopper

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000556
3	Remove the mechanical stopper. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Removing the ball screw with the flange

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	

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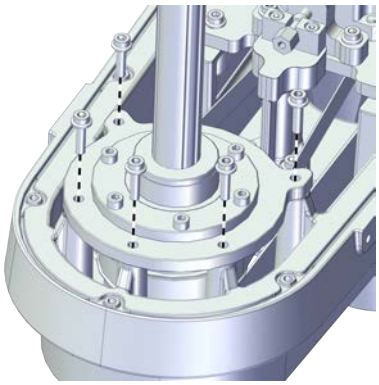
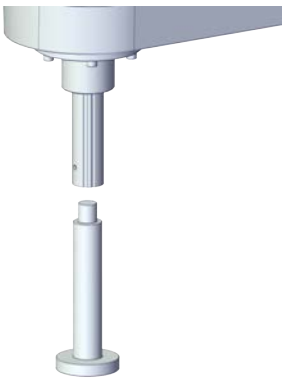
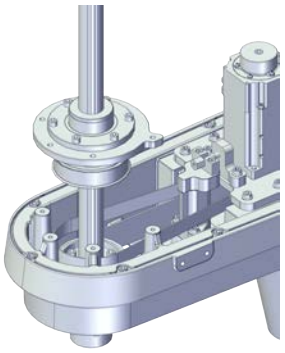
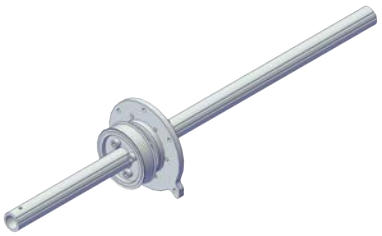
5.6.3 Replacing the pulley on the ball screw lower position

Continued

	Action	Note
3	Remove the screws and washers on the ball screw flange.	 xx2300000559
4	Insert the special tool auxiliary shaft into the ball screw shaft.	IRB 930 auxiliary shaft:3HAC087847-001  xx2300000562
5	Mark the location of the ball screw shaft grooves on the ball screw lower nut.	 xx2300000563

Continues on next page

	Action	Note
6	Take out the ball screw with the flange assembly carefully. **CAUTION** Move the special tool along with the ball screw shaft until it is totally inserted into the lower nut of the ball screw and keep the status. When the special tool is totally inserted to the lower nut of the ball screw, support the special tool with some thing. Or the ball screw lower nut will be destroyed.	 xx2300000564
7	Lay down the ball screw assembly. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	 xx2300000565

Removing the pulley on the ball screw lower position

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	

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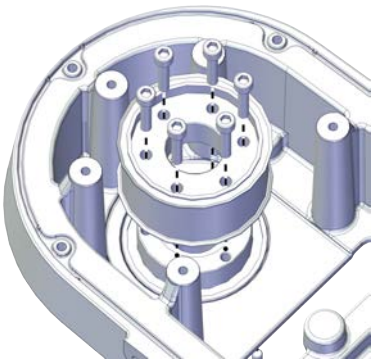
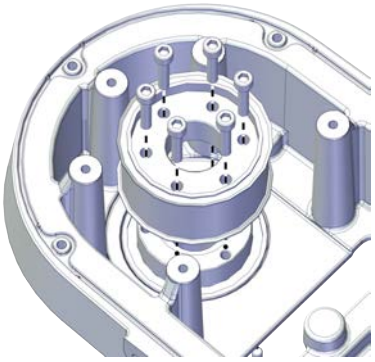
5.6.3 Replacing the pulley on the ball screw lower position
Continued

	Action	Note
3	Remove the screws and washers.	 xx2300000567
4	Remove the pulley carefully. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Refitting the pulley on the ball screw lower position

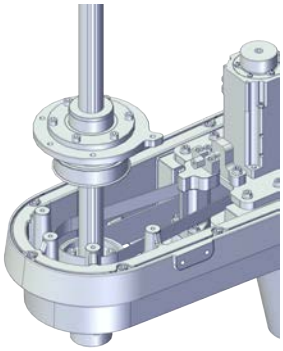
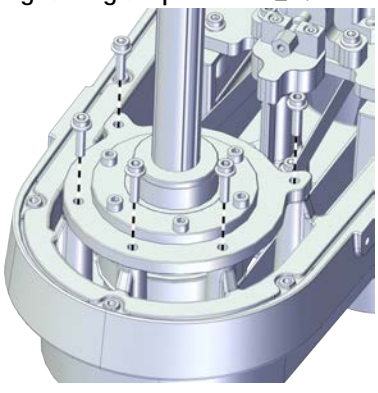
Use these procedures to refit the pulley.

Refitting the pulley on the ball screw lower position

	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 46*.	
2	Refit the pulley to the ball screw carefully. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	Screws: Hex socket head cap screw M5x25 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 6 Nm ±3%  xx2300000567
3	Refit the screws. **Tip** Secure with the stopping tool to prevent the pulley from rotating.	

Continues on next page

Refitting the ball screw with the flange

	Action	Note
1	Refit the ball screw assembly to the outer arm. **Tip** Make sure the marked location is aligned with the ball screw shaft grooves. **CAUTION** With the inserting of the ball screw shaft, remove the special tool auxiliary shaft along with the ball screw shaft carefully.	IRB 930 auxiliary shaft:3HAC087847-001  xx2300000564  xx2300000563
2	Refit the screws and washers to the secure the ball screw flange to the outer arm. **Tip** Pre-tighten the screws at 0.5Nm and slide the ball screw up and down for five times. Then tighten the screws at 6 Nm ±3% to secure it.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (5 pcs) Tightening torque: 6 Nm ±3%  xx2300000559

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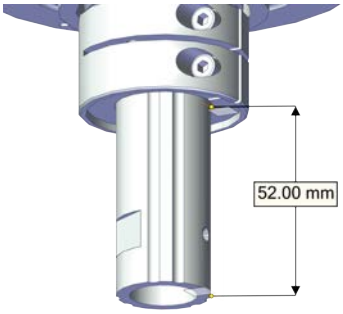
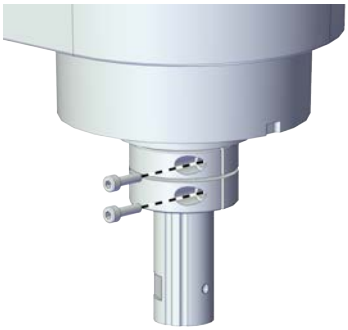
5.6.3 Replacing the pulley on the ball screw lower position

Continued

Refitting the mechanical stopper

	Action	Note
1	Refit the mechanical stopper to the ball screw at 52 mm position to the lower of the ball screw. **Tip** Make sure that the limit block opening gap is aligned with the ball screw origin point. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this. **Note** Be careful with the orientation of the mechanical stopper. The flat side is on the upper side.	For robots with protection class IP30  xx2300000561
2	Refit the screws.	Screws: Hex socket head cap screw M4x14 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 6 Nm For robots with protection class IP30  xx2300000556

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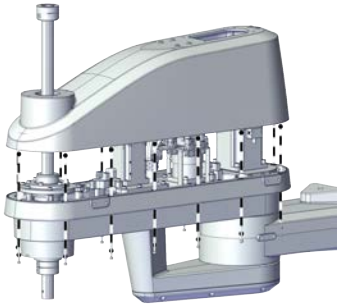
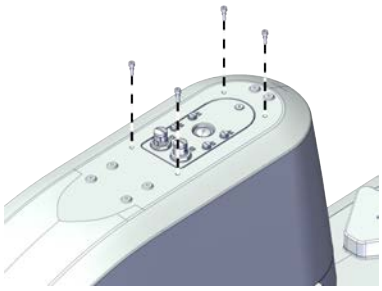
Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487
4	Remove the screw.	

Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.

Continues on next page

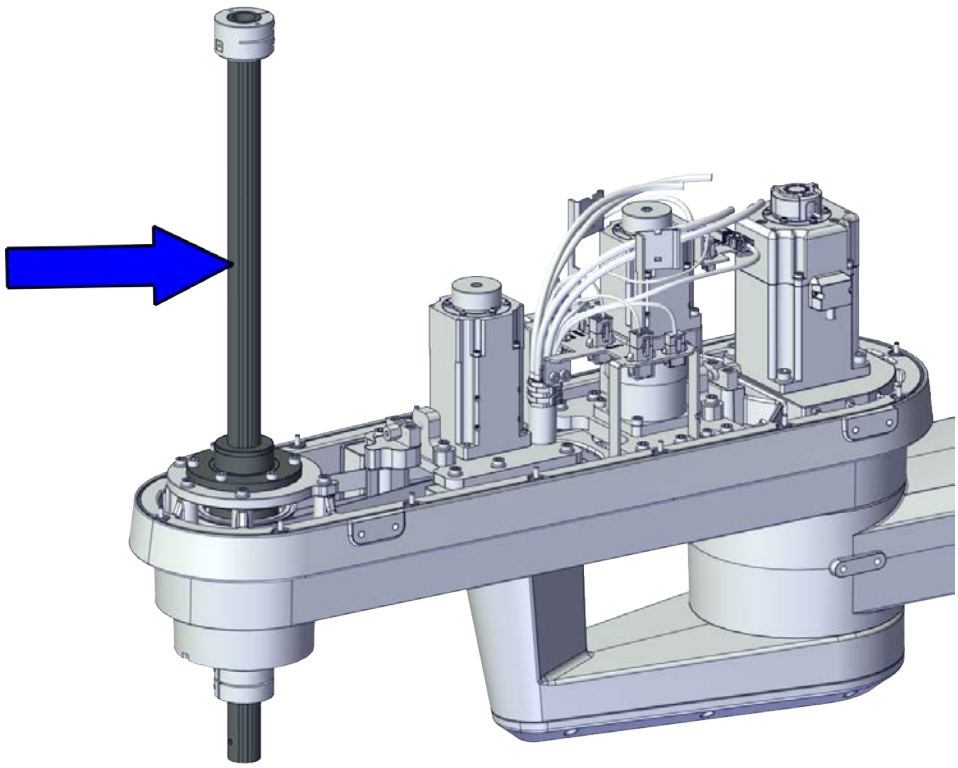
5.6.3 Replacing the pulley on the ball screw lower position
Continued

	Action	Note
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 55*.	

5.6.4 Replacing the ball screw

Location of the ball screw

The ball screw is located as shown in the figure.



xx2300000475

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

Spare part	Article number	Note
Ball screw	3HAC081796-001	
Ball screw, long stroke	3HAC081797-001	
Ball screw flange	3HAC081785-001	
Rubber bumper	3HAC081787-001	
Mechanical stopper	3HAC081786-001	
Pulley on the ball screw upper position	3HAC081703-001	

Continues on next page

5.6.4 Replacing the ball screw
Continued

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.
IRB 930 auxiliary shaft	3HAC087847-001	Used to install the ball screw nut. Special tool for L2
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC077740-001	Gastrol Spheerol EPL 1

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

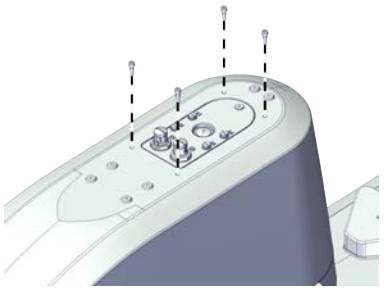
Removing the ball screw

Use these procedures to remove the ball screw.

Preparations before removing the ball screw

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the process hub screws

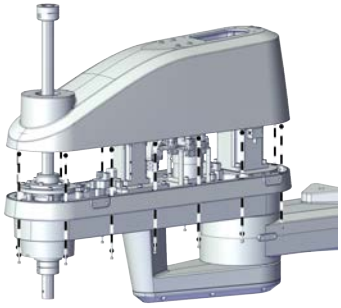
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

Continues on next page

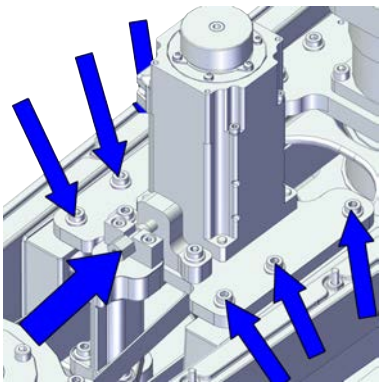
5.6.4 Replacing the ball screw

Continued

Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

Releasing the axis-3 timing belt

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Loosen the screws of the axis-3 motor sub-assembly to let the axis-3 timing belt free.	 xx2300000557

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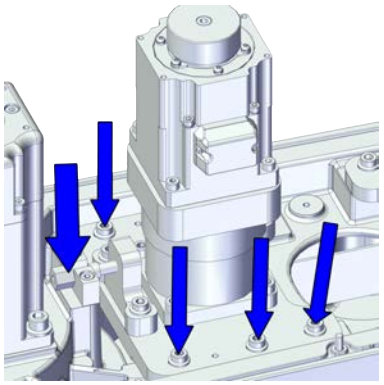
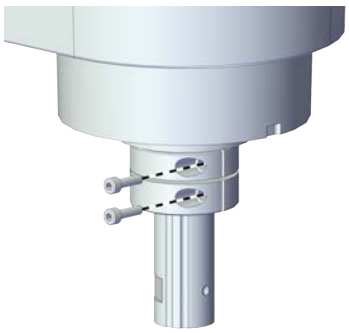
	Action	Note
4	Release the timing belt.	

Releasing the axis-4 timing belt

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Loosen the six screws of the axis-4 motor sub-assembly to let the axis-4 timing belt be free.	 xx2300000558
3	Release the timing belt.	

Removing the lower mechanical stopper

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000556

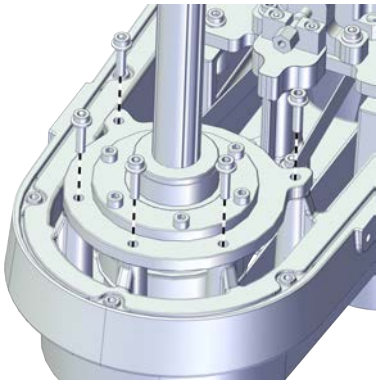
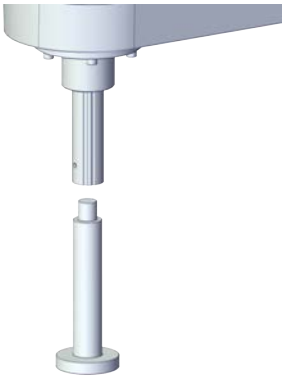
Continues on next page

5.6.4 Replacing the ball screw

Continued

	Action	Note
3	Remove the mechanical stopper. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Removing the ball screw with the flange

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Remove the screws and washers on the ball screw flange.	 xx2300000559
4	Insert the special tool auxiliary shaft into the ball screw shaft.	IRB 930 auxiliary shaft:3HAC087847-001  xx2300000562

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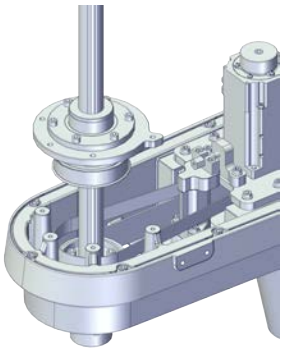
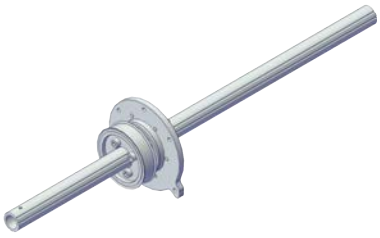
	Action	Note
5	Mark the location of the ball screw shaft grooves on the ball screw lower nut.	 xx2300000563
6	Take out the ball screw with the flange assembly carefully. **CAUTION** Move the special tool along with the ball screw shaft until it is totally inserted into the lower nut of the ball screw and keep the status. When the special tool is totally inserted to the lower nut of the ball screw, support the special tool with some thing. Or the ball screw lower nut will be destroyed.	 xx2300000564
7	Lay down the ball screw assembly. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	 xx2300000565

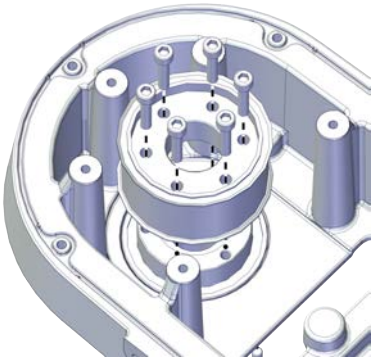
Removing the pulley on the ball screw lower position

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

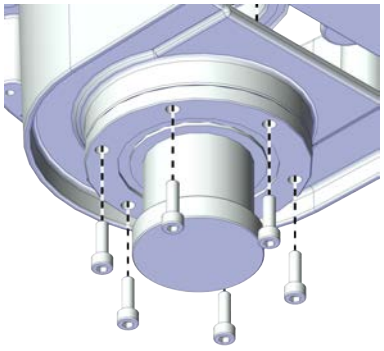
Continues on next page

5.6.4 Replacing the ball screw

Continued

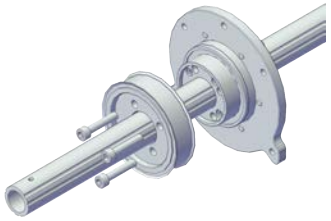
	Action	Note
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 46*.	
3	Remove the screws and washers.	 xx2300000567
4	Remove the pulley carefully. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Removing the ball screw lower nut

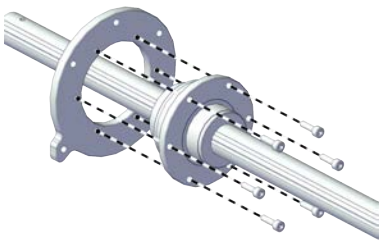
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the lower nut to the outer arm. **Tip** Hold the ball screw to prevent it from dropping. Or the ball screw may be destroyed.	IRB 930 auxiliary shaft:3HAC087847-001  xx2300000568
3	Hold the ball screw lower nut with the special tool to take them out of the outer arm carefully. **Tip** Hold the lower part of the ball screw to prevent it from dropping. Or the ball screw may be destroyed. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Continues on next page

Removing the pulley on the ball screw upper position

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Remove the screws.	 xx2300000566
4	Remove the pulley carefully. **Tip** Hold the ball screw to prevent it from dropping. Or the ball screw may be destroyed. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Removing the ball screw flange

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	 xx2300000590
3	Remove the ball screw flange from the ball screw shaft. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Continues on next page

5.6.4 Replacing the ball screw
Continued

Refitting the ball screw

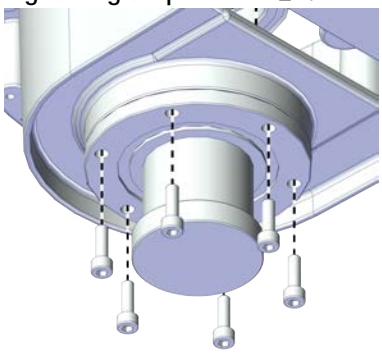
Use these procedures to refit the ball screw.

Preparing the new ball screw

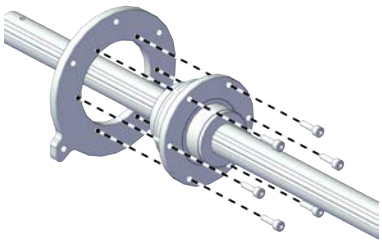
	Action	Note
1	Mark the location of the ball screw shaft grooves on the ball screw lower nut.	 xx2300000591
2	Insert the special tool into the ball screw shaft.	IRB 930 auxiliary shaft:3HAC087847-001  xx2300000592
3	Move the ball screw nut from the ball screw shaft to the special tool.	 xx2300000593

Continues on next page

Refitting the ball screw lower nut

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Put the ball screw lower nut to the outer arm carefully. **CAUTION** Make sure the ball screw nut works fluently.	Screws: Hex socket head cap screw M5x16 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 6 Nm ±3%  xx2300000568
3	Secure the screws on the lower nut to the outer arm.	

Refitting the flange to the ball screw shaft

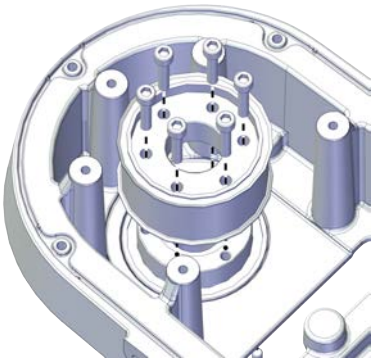
	Action	Note
1	Refit the ball screw flange to the ball screw shaft. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	Screws: Hex socket head cap screw M5x16 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 6 Nm  xx2300000590
2	Refit the screws.	

Continues on next page

5.6.4 Replacing the ball screw

Continued

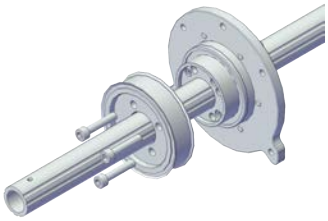
Refitting the pulley on the ball screw lower position

	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 46*.	
2	Refit the pulley to the ball screw carefully. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	Screws: Hex socket head cap screw M5x25 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 6 Nm ±3%  xx2300000567
3	Refit the screws. **Tip** Secure with the stopping tool to prevent the pulley from rotating.	

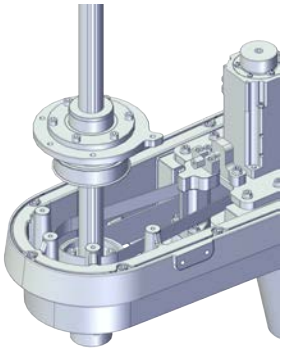
Refitting the pulley on the ball screw upper position

	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 46*.	

Continues on next page

	Action	Note
2	Refit the pulley to the ball screw carefully. **Tip** Hold the ball screw to prevent it from dropping. Or the ball screw may be destroyed. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	Screws: Hex socket head cap screw M6x30 12.9 Gleitmo 603+Geomet 500 (4 pcs) Tightening torque: 8.8 Nm  xx2300000566
3	Refit the screws. **Tip** Secure with the stopping tool to prevent the pulley from rotating.	

Refitting the ball screw with the flange

	Action	Note
1	Refit the ball screw assembly to the outer arm. **Tip** Make sure the marked location is aligned with the ball screw shaft grooves. **CAUTION** With the inserting of the ball screw shaft, remove the special tool auxiliary shaft along with the ball screw shaft carefully.	IRB 930 auxiliary shaft:3HAC087847-001  xx2300000564  xx2300000563

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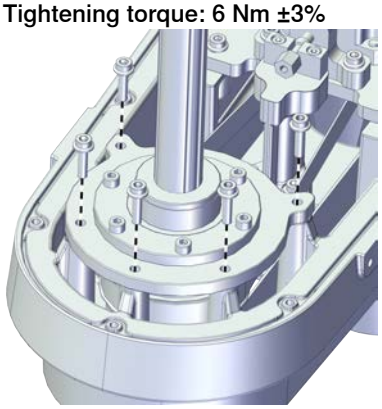
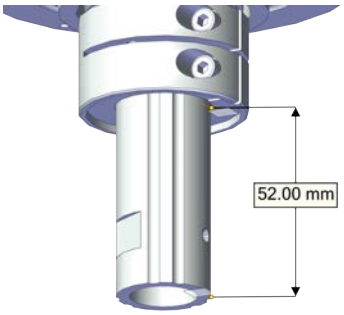
5.6.4 Replacing the ball screw

Continued

	Action	Note
2	Refit the screws and washers to the secure the ball screw flange to the outer arm. **Tip** Pre-tighten the screws at 0.5Nm and slide the ball screw up and down for five times. Then tighten the screws at 6 Nm ±3% to secure it.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (5 pcs) Tightening torque: 6 Nm ±3%  xx2300000559

Refitting the mechanical stopper

	Action	Note
1	Refit the mechanical stopper to the ball screw at 52 mm position to the lower of the ball screw. **Tip** Make sure that the limit block opening gap is aligned with the ball screw origin point. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this. **Note** Be careful with the orientation of the mechanical stopper. The flat side is on the upper side.	For robots with protection class IP30  xx2300000561

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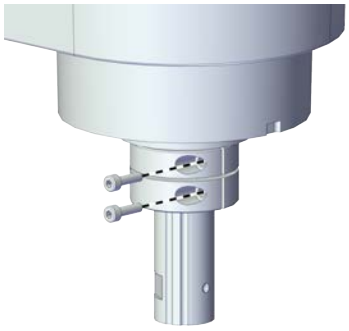
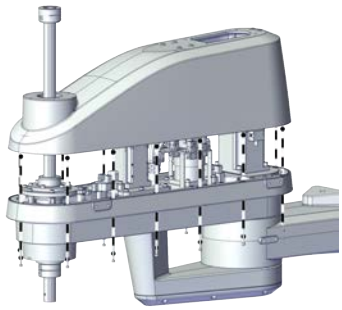
	Action	Note
2	Refit the screws.	Screws: Hex socket head cap screw M4x14 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 6 Nm For robots with protection class IP30  xx2300000556

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

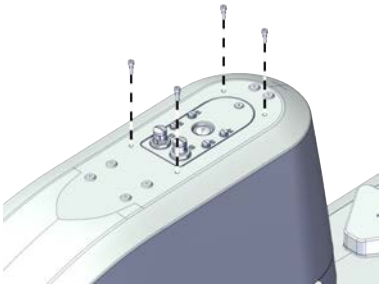
Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	

Continues on next page

5.6.4 Replacing the ball screw

Continued

	Action	Note
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487
4	Remove the screw.	

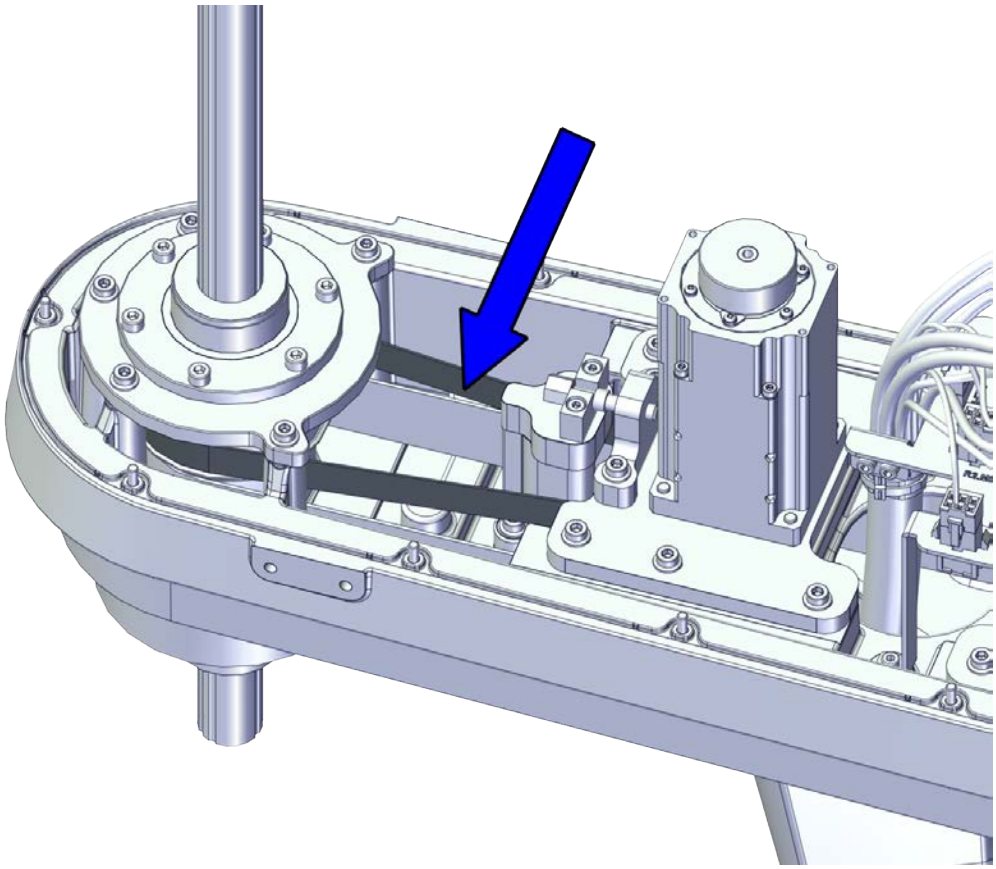
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
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 55*.	

5.6.5 Replacing the axis-3 timing belt

Location of the axis-3 timing belt

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



xx2300000476

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

Spare part	Article number	Note
Timing belt, A3	3HAC081705-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Continues on next page

5.6.5 Replacing the axis-3 timing belt
Continued

Equipment	Article number	Note
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

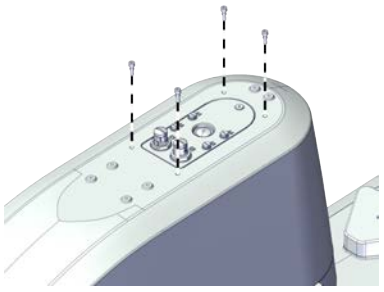
Removing the axis-3 timing belt

Use these procedures to remove the axis-3 timing belt.

Preparations before removing the axis-3 timing belt

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

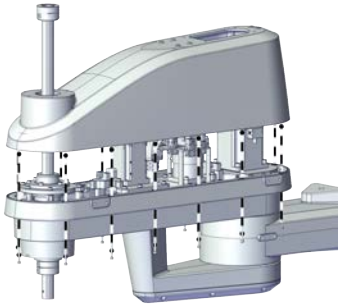
Removing the process hub screws

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

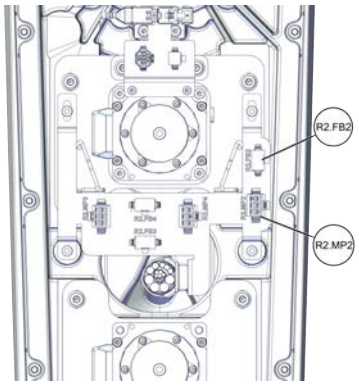
Continues on next page

5.6.5 Replacing the axis-3 timing belt
Continued

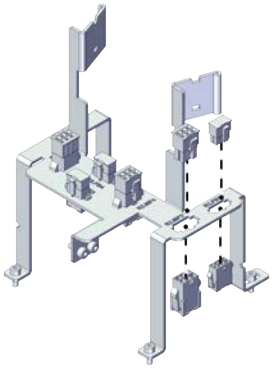
Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

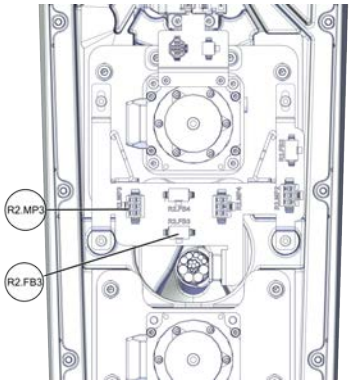
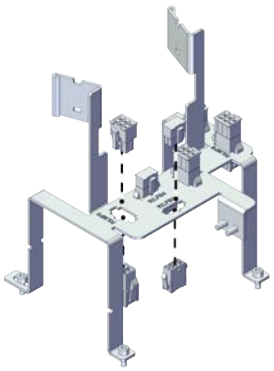
Disconnecting the connectors for axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490

Continues on next page

	Action	Note
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

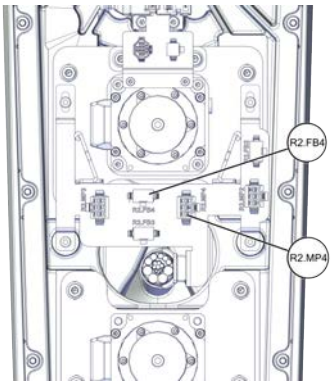
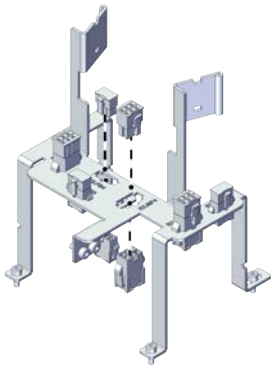
Disconnecting the connectors for axis-3 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP3 • R2.FB3	 xx2300000491
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494

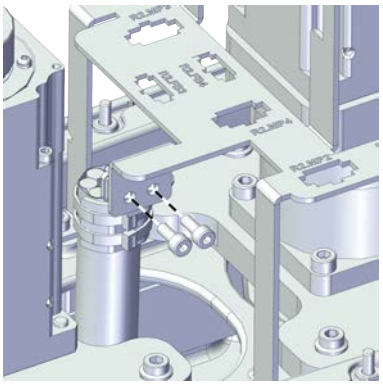
Continues on next page

5.6.5 Replacing the axis-3 timing belt
Continued

Disconnecting the connectors for axis-4 motor

	Action	Note
1	Disconnect the axis-4 motor connectors. • R2.MP4 • R2.FB4	 xx2300000492
2	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

Removing the outer arm cable ferrule and bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000496

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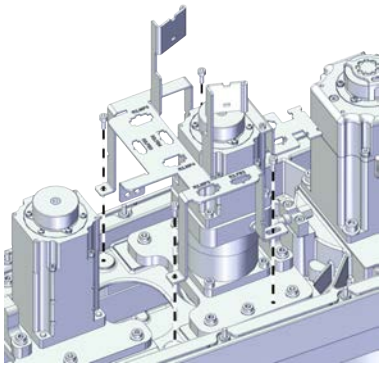
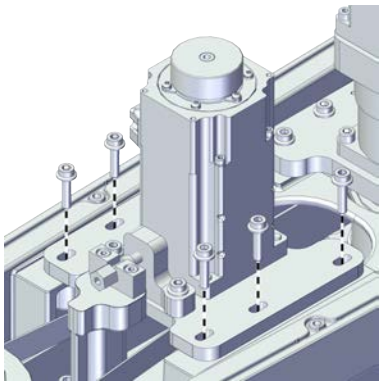
	Action	Note
3	Remove the screws on the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000497

Removing the axis-3 motor sub-assembly

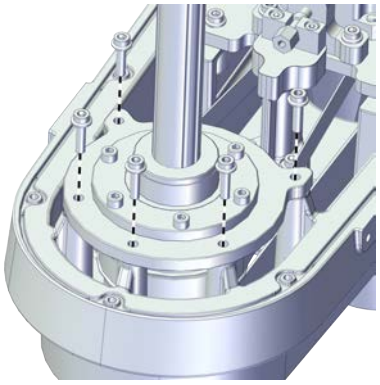
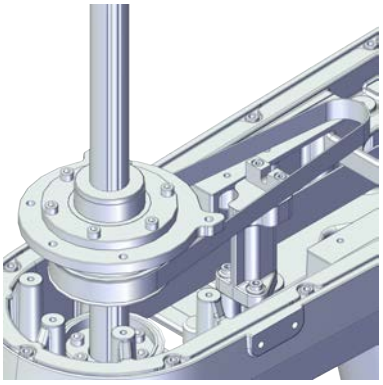
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Remove the screws.	 xx2300000594
4	Remove the axis-3 motor sub-assembly.	

Releasing the ball screw with the flange

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

Continues on next page

5.6.5 Replacing the axis-3 timing belt
Continued

	Action	Note
2	**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 46*.	
3	Remove the screws and washers on the ball screw flange.	 xx2300000559
4	Take the ball screw with the flange assembly a little bit to let the timing belts can go out. **CAUTION** Move the special tool along with the ball screw shaft until it is totally inserted into the lower nut of the ball screw and keep the status. When the special tool is totally inserted to the lower nut of the ball screw, support the special tool with some thing. Or the ball screw lower nut will be destroyed.	 xx2300000595

Removing the axis-3 timing belt

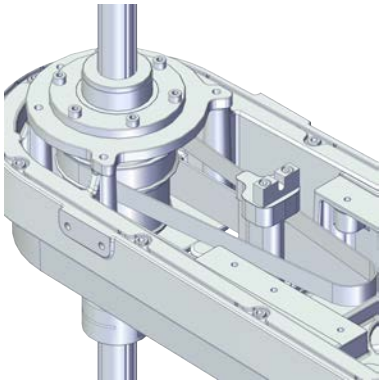
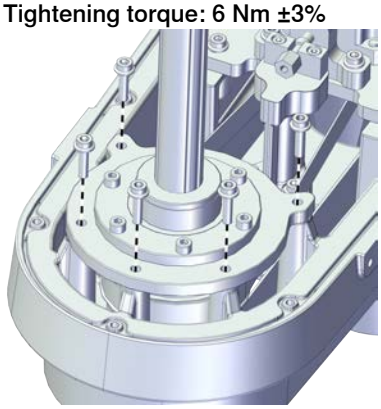
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Remove the axis-3 timing belt.	

Continues on next page

Refitting the axis-3 timing belt

Use these procedures to refit the axis-3 timing belt.

Inserting the axis-3 timing belt through the ball screw flange

	Action	Note
1	Hold the ball screw with the flange assembly a little bit to let the timing belts can go in.	
2	Insert the timing belt to the pulley on the ball screw.	Timing belt, A3: 3HAC081705-001  xx2300000596
3	Refit the screws and washers to the secure the ball screw flange to the outer arm. **Tip** Pre-tighten the screws at 0.5Nm and slide the ball screw up and down for five times. Then tighten the screws at 6 Nm ±3% to secure it.	Screws: Hex socket head cap flange screw 3HAB3412-520M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (5 pcs) Tightening torque: 6 Nm ±3%  xx2300000559

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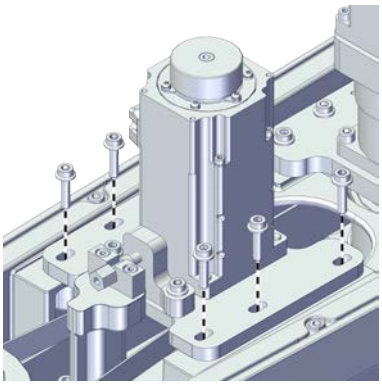
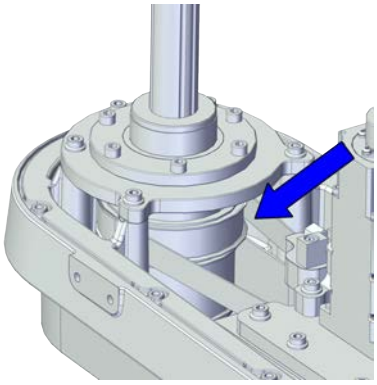
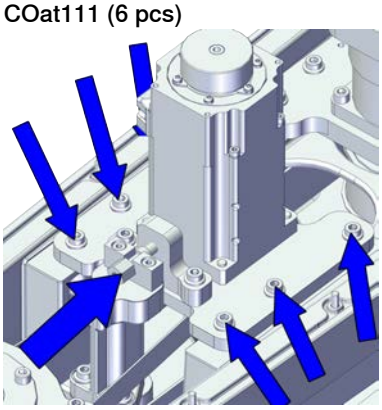
5.6.5 Replacing the axis-3 timing belt

Continued

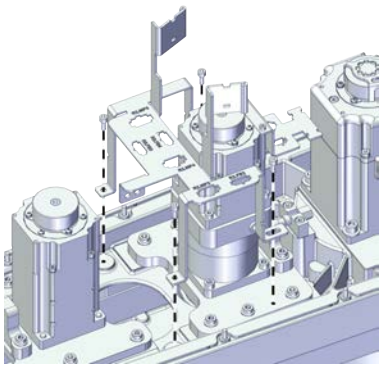
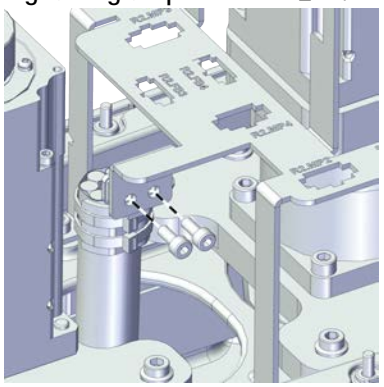
Refitting the axis-3 motor sub-assembly

	Action	Note
	Refit the motor with flange to the outer arm. **Tip** Move the internal harness out of the way.	 xx2300000594
1	Refit the timing belt to the pulley on the ball screw and the motor. Ensure that the belt runs correctly in the grooves.	Timing belt, A3: 3HAC081705-001  xx2300000589
2	Refit the screws and washers without fully tightened.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (6 pcs)  xx2300000557
3	Use a sonic tension meter to measure the timing belt tension.	Used belt: 139-149 Hz New belt:109-119 Hz
4	If the timing belt tension does not meet the requirement, readjust the motor with the adjusting screw.	

Continues on next page

	Action	Note
5	Tighten the motor flange screws when the timing belt meets the requirement.	Tightening torque: 6 Nm ±10%

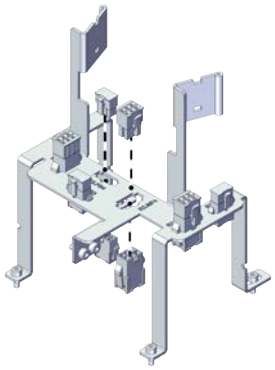
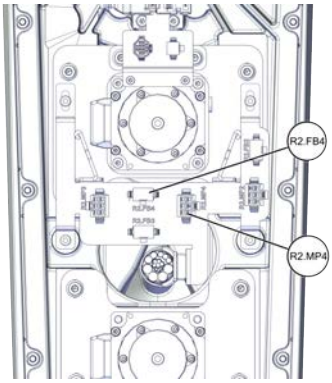
Refitting the cable ferrule and bracket in the outer arm

	Action	Note
1	Lay the internal harness in a natural state without distortion.	
2	Refit the bracket. **Tip** Do not secure it with the screws before the cable ferrule installed well. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000497
3	Secure the cable ferrule to the bracket with the screws. **Tip** The air hoses should face the process hub side. **Tip** The position with wrapped tape is the marked position for the cable ferrule. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000496

Continues on next page

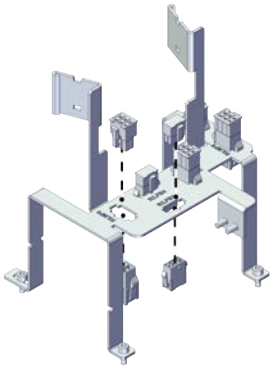
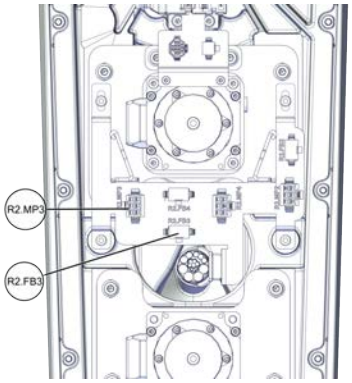
5.6.5 Replacing the axis-3 timing belt
Continued

Reconnecting the connectors for axis-4 motor

	Action	Note
	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495
1	Reconnect the connectors. • R2.MP4 • R2.FB4 **Tip** See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000492
2	Route the cabling on the axis-4 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

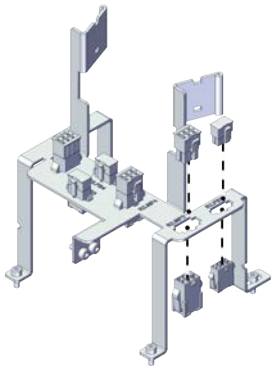
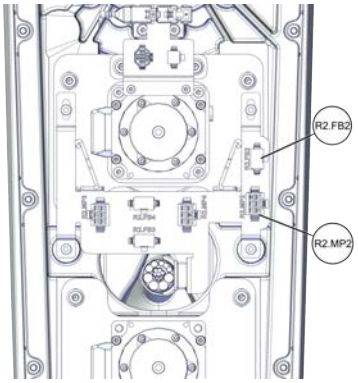
Reconnecting the connectors for axis-3 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494
2	Reconnect the connectors. • R2.MP3 • R2.FB3 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000491
3	Route the cabling on the axis-3 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

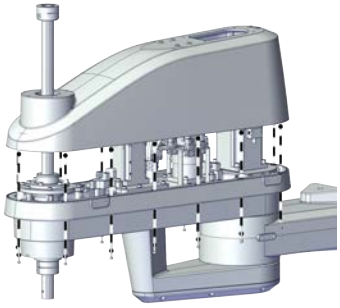
5.6.5 Replacing the axis-3 timing belt
Continued

Reconnecting the connectors for axis-2 motor

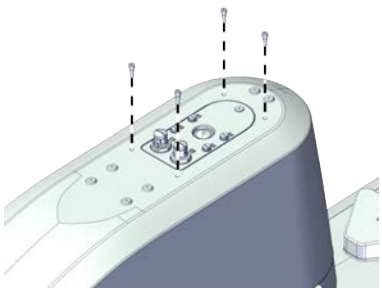
	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487
4	Remove the screw.	

Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.

Continues on next page

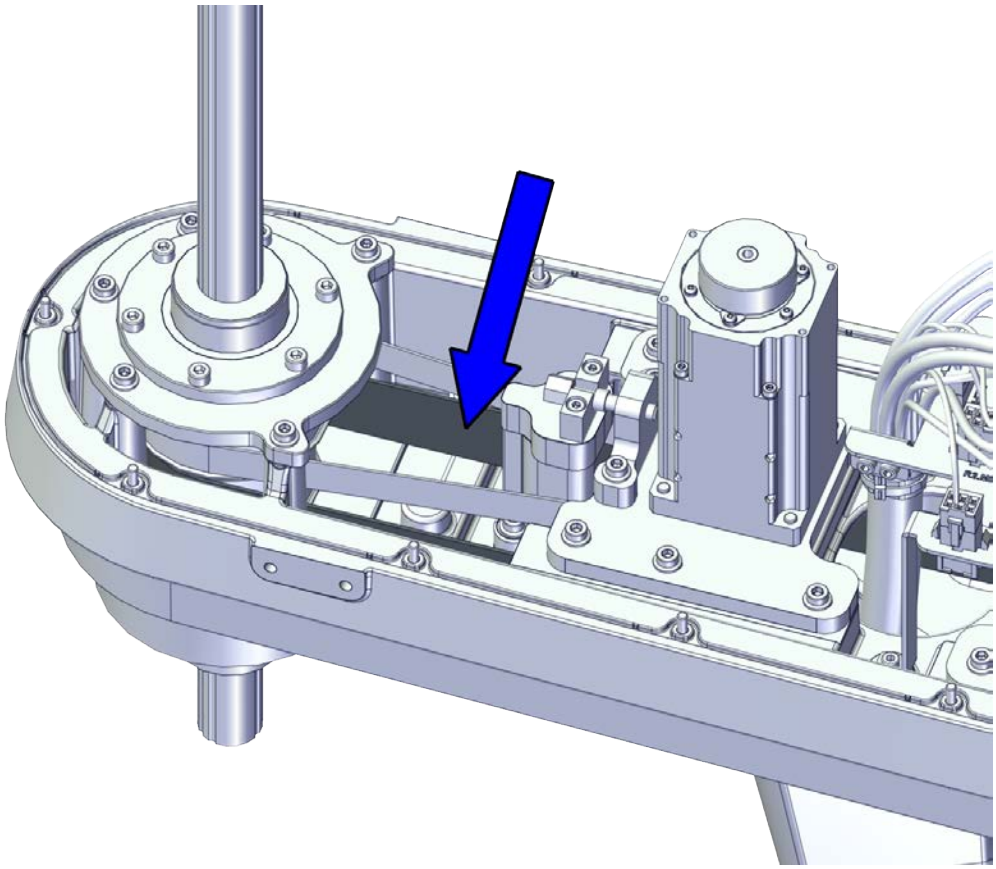
5.6.5 Replacing the axis-3 timing belt
Continued

	Action	Note
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 55*.	

5.6.6 Replacing the axis-4 timing belt

Location of the axis-4 timing belt

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



xx2300000477

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

Spare part	Article number	Note
Timing belt, A4	3HAC081706-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Continues on next page

5.6.6 Replacing the axis-4 timing belt
Continued

Equipment	Article number	Note
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

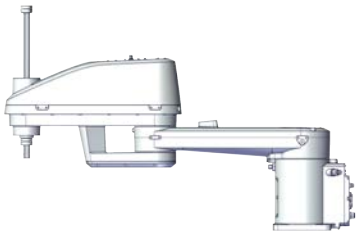
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removing the axis-4 timing belt

Use these procedures to remove the axis-4 timing belt.

Preparations before removing the axis-4 timing belt

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	Jog all axes to zero position.	 xx2300000486
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

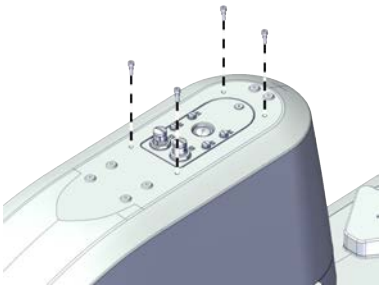
Removing the process hub screws

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

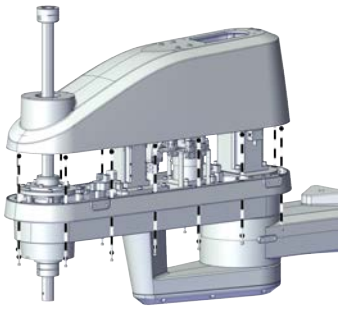
Continues on next page

5.6.6 Replacing the axis-4 timing belt

Continued

	Action	Note
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

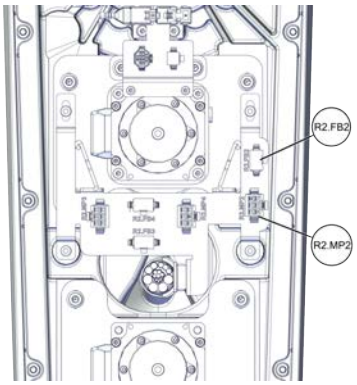
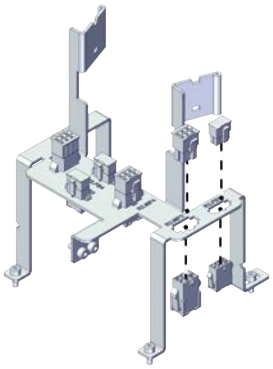
Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

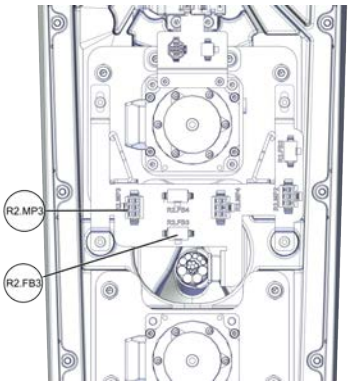
Disconnecting the connectors for axis-2 motor

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

Continues on next page

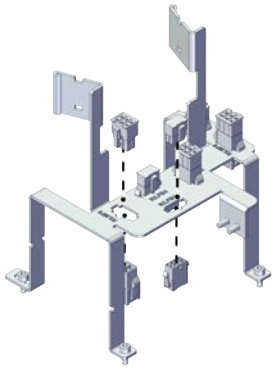
	Action	Note
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

Disconnecting the connectors for axis-3 motor

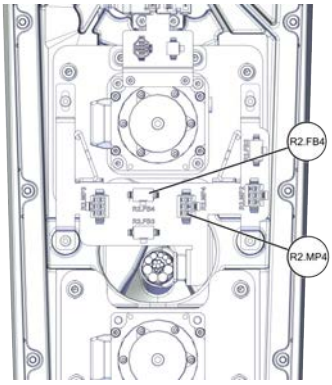
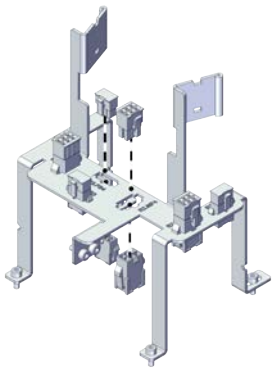
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP3 • R2.FB3	 xx2300000491

Continues on next page

5.6.6 Replacing the axis-4 timing belt
Continued

	Action	Note
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494

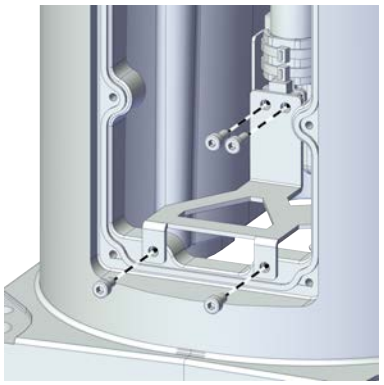
Disconnecting the connectors for axis-4 motor

	Action	Note
1	Disconnect the axis-4 motor connectors. • R2.MP4 • R2.FB4	 xx2300000492
2	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

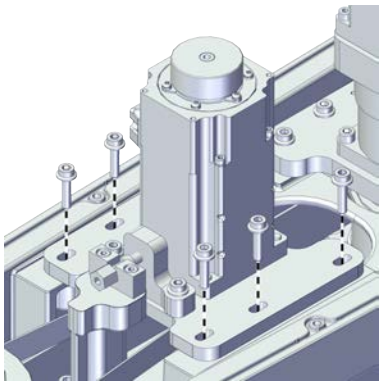
Removing the base bracket

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

Continues on next page

	Action	Note
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000503
3	Remove the screws on the base bracket to the base from the SMB side.	

Removing the axis-3 motor sub-assembly

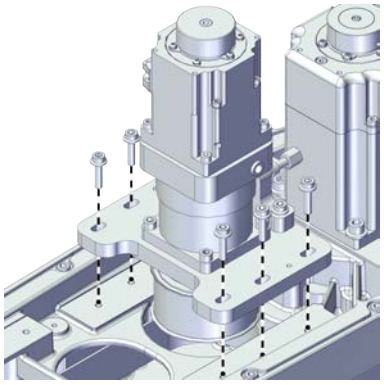
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Remove the screws.	 xx2300000594
4	Remove the axis-3 motor sub-assembly.	

Removing the axis-4 motor sub-assembly

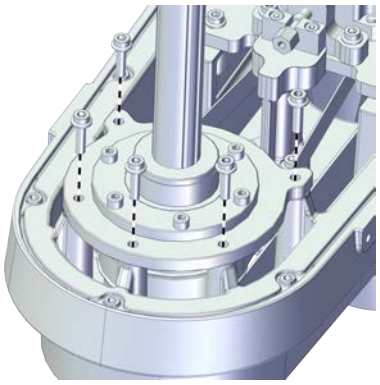
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	

Continues on next page

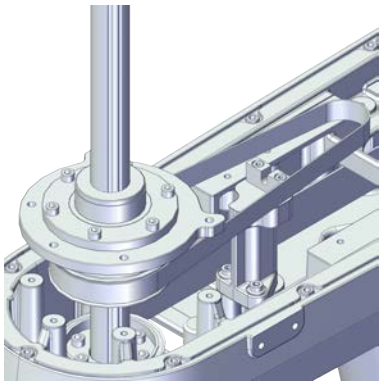
5.6.6 Replacing the axis-4 timing belt
Continued

	Action	Note
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Remove the screws.	 xx2300000597
4	Remove the axis-4 motor sub-assembly.	

Releasing the ball screw with the flange

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Remove the screws and washers on the ball screw flange.	 xx2300000559

Continues on next page

	Action	Note
4	Take the ball screw with the flange assembly a little bit to let the timing belts can go out. **CAUTION** Move the special tool along with the ball screw shaft until it is totally inserted into the lower nut of the ball screw and keep the status. When the special tool is totally inserted to the lower nut of the ball screw, support the special tool with some thing. Or the ball screw lower nut will be destroyed.	 xx2300000595

Removing the axis-3 timing belt

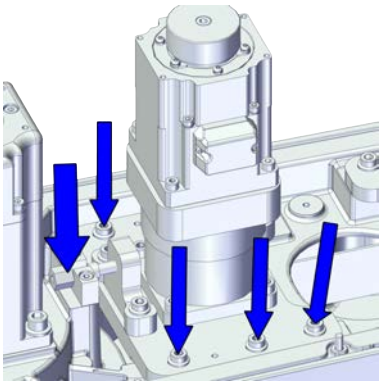
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Remove the axis-3 timing belt.	

Removing the axis-4 timing belt

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

Continues on next page

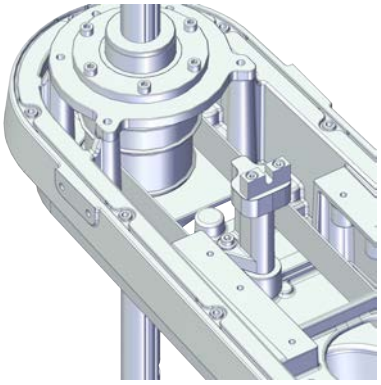
5.6.6 Replacing the axis-4 timing belt
Continued

	Action	Note
2	Loosen the screws of the axis-4 motor sub-assembly to let the axis-4 timing belt be free.	 xx2300000558
3	Remove the timing belt.	

Refitting the axis-4 timing belt

Use these procedures to refit the axis-4 timing belt.

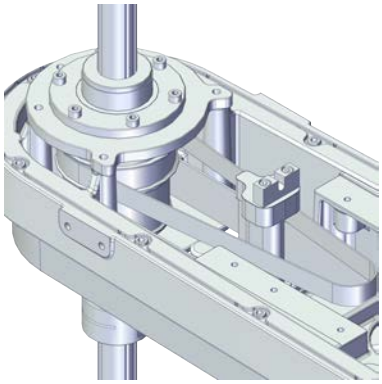
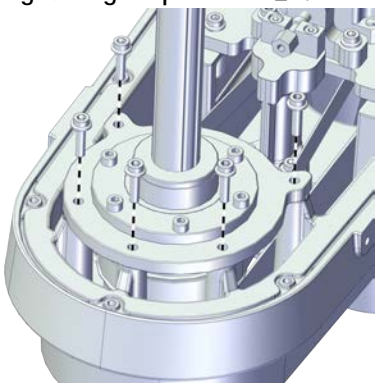
Inserting the axis-4 timing belt through the ball screw flange

	Action	Note
1	Hold the ball screw with the flange assembly a little bit to let the timing belts can go in.	
2	Insert the timing belt to the pulley on the ball screw.	Timing belt, A4: 3HAC081706-001  xx2300000604

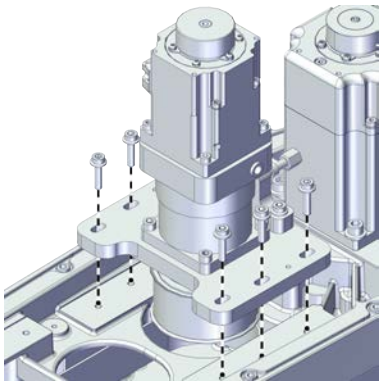
Inserting the axis-3 timing belt through the ball screw flange

	Action	Note
1	Hold the ball screw with the flange assembly a little bit to let the timing belts can go in.	

Continues on next page

	Action	Note
2	Insert the timing belt to the pulley on the ball screw.	Timing belt, A3: 3HAC081705-001  xx2300000596
3	Refit the screws and washers to the secure the ball screw flange to the outer arm. **Tip** Pre-tighten the screws at 0.5Nm and slide the ball screw up and down for five times. Then tighten the screws at 6 Nm ±3% to secure it.	Screws: Hex socket head cap flange screw 3HAB3412-520M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (5 pcs) Tightening torque: 6 Nm ±3%  xx2300000559

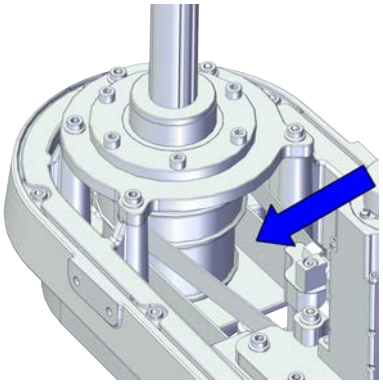
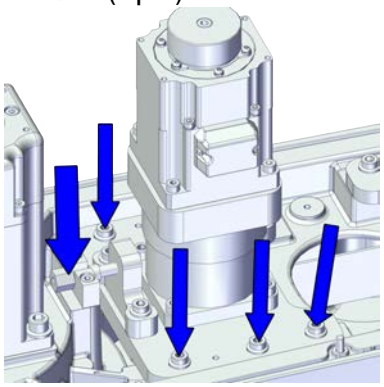
Refitting the axis-4 motor sub-assembly

	Action	Note
1	Refit the motor with flange to the outer arm. **Tip** Move the internal harness out of the way.	 xx2300000597

Continues on next page

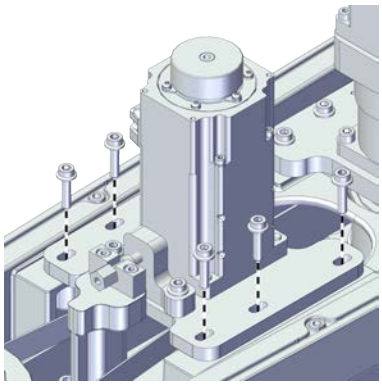
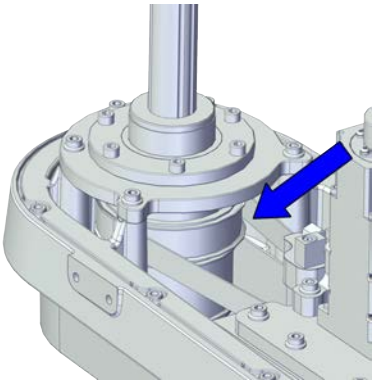
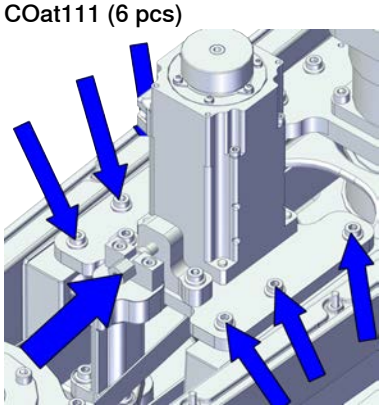
5.6.6 Replacing the axis-4 timing belt

Continued

	Action	Note
2	Refit the timing belt to the pulley on the ball screw and the motor. Ensure that the belt runs correctly in the grooves.	Timing belt, A4: 3HAC081706-001  xx2300000588
3	Refit the screws and washers without fully tightened.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (6 pcs)  xx2300000558
4	Use a sonic tension meter to measure the timing belt tension.	Used belt: 312-333 Hz New belt:88.4-92.7 Hz
5	If the timing belt tension does not meet the requirement, readjust the motor with the adjusting screw.	
6	Tighten the motor screws when the timing belt meets the requirement.	Tightening torque: 6 Nm ±10%

Continues on next page

Refitting the axis-3 motor sub-assembly

	Action	Note
	Refit the motor with flange to the outer arm. **Tip** Move the internal harness out of the way.	 xx2300000594
1	Refit the timing belt to the pulley on the ball screw and the motor. Ensure that the belt runs correctly in the grooves.	Timing belt, A3: 3HAC081705-001  xx2300000589
2	Refit the screws and washers without fully tightened.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (6 pcs)  xx2300000557
3	Use a sonic tension meter to measure the timing belt tension.	Used belt: 139-149 Hz New belt:109-119 Hz
4	If the timing belt tension does not meet the requirement, readjust the motor with the adjusting screw.	

Continues on next page

5.6.6 Replacing the axis-4 timing belt

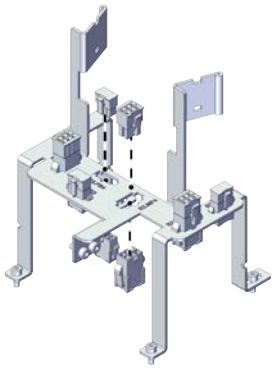
Continued

	Action	Note
5	Tighten the motor flange screws when the timing belt meets the requirement.	Tightening torque: 6 Nm ±10%

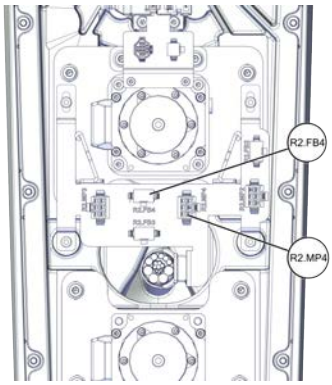
Refitting the base bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Lay the main harness in a natural state without distortion.	
	Refit the cable ferrule to the bracket. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000503
3	Refit the base bracket to the base and secure with the screws.	

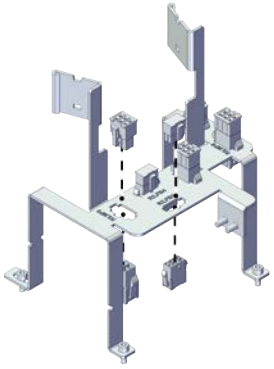
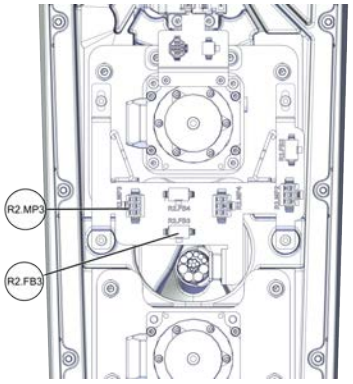
Reconnecting the connectors for axis-4 motor

	Action	Note
	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

Continues on next page

	Action	Note
1	Reconnect the connectors. • R2.MP4 • R2.FB4 **Tip** See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000492
2	Route the cabling on the axis-4 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Reconnecting the connectors for axis-3 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494
2	Reconnect the connectors. • R2.MP3 • R2.FB3 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000491

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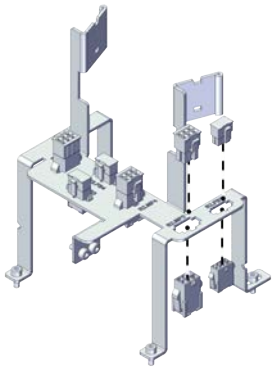
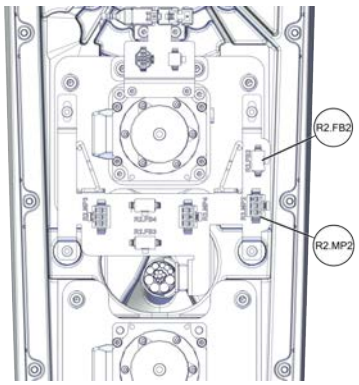
5.6.6 Replacing the axis-4 timing belt

Continued

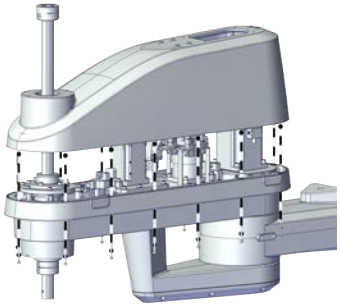
	Action	Note
3	Route the cabling on the axis-3 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Reconnecting the connectors for axis-2 motor

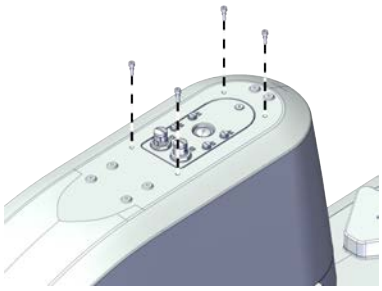
	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487
4	Remove the screw.	

Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.

Continues on next page

5.6.6 Replacing the axis-4 timing belt

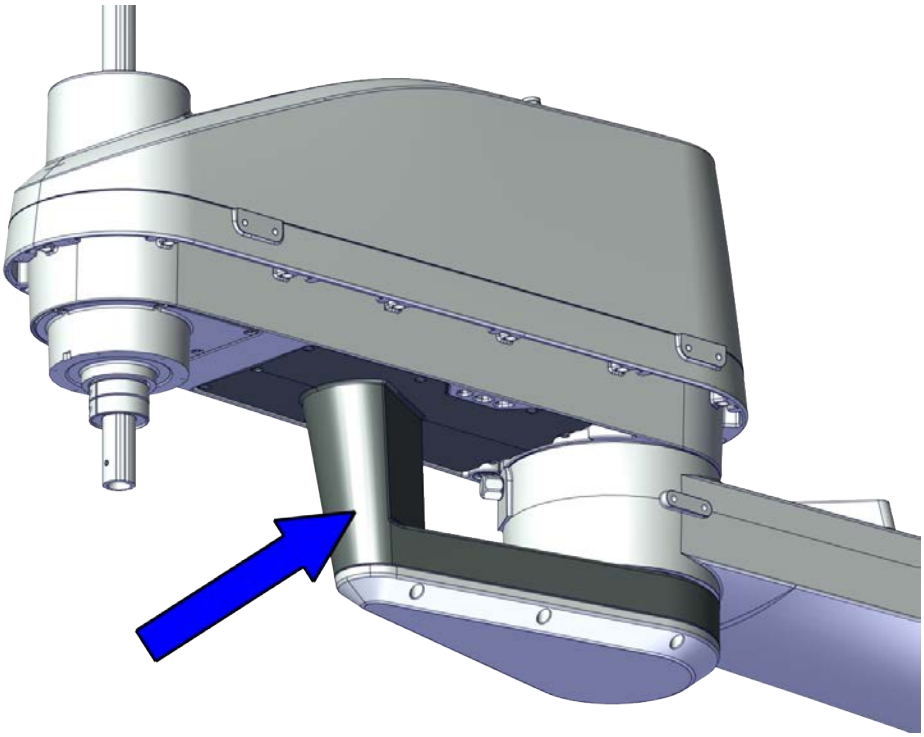
Continued

	Action	Note
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 55*.	

5.6.7 Replacing the cable arm

Location of the cable arm

The cable arm is located as shown in the figure.



xx2300000478

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

Spare part	Article number	Note
Cable arm	3HAC087307-001	
Cable arm sealing ring	3HAC081802-001	
Cable arm cover	3HAC087317-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Continues on next page

5.6.7 Replacing the cable arm
Continued

Equipment	Article number	Note
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removing the cable arm

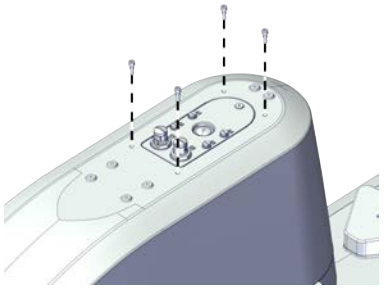
Use these procedures to remove the cable arm.

Preparations before removing the cable arm

Remove the robot from the wall or enough space.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the process hub screws

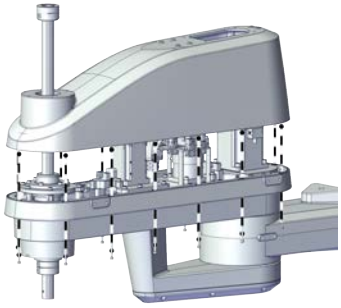
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

Continues on next page

5.6.7 Replacing the cable arm

Continued

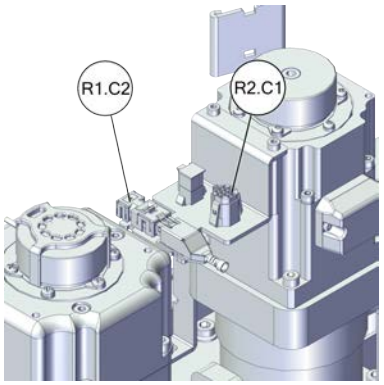
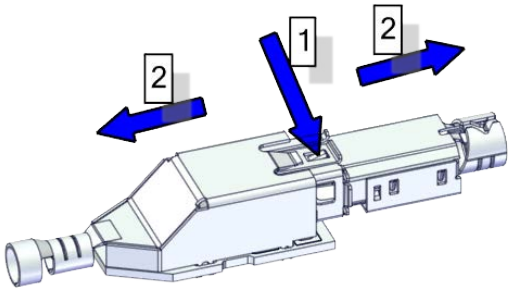
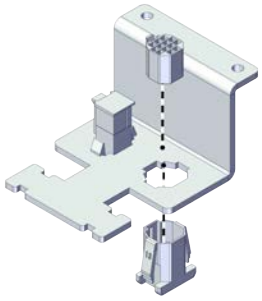
Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

Disconnecting the air hoses, C1 cabling and C2 cabling (if equipped)

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the air hoses from the L-shaped connectors.	

Continues on next page

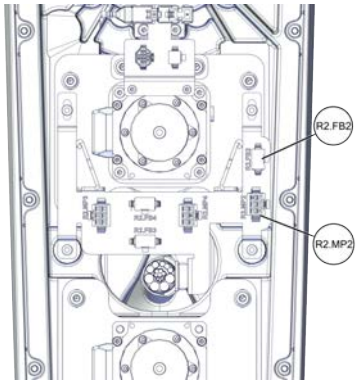
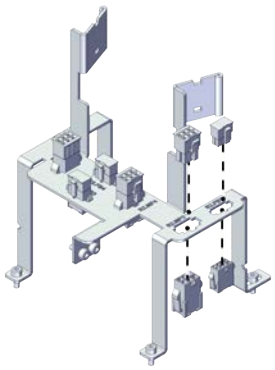
	Action	Note
3	**For robots with C1 cabling** Disconnect the connector. • R2.C1	 xx2300000542
4	**For robots with C2 cabling** Disconnect the connector. • R1.C2 **Tip** Cut the cable straps for the R1.C2 at the same time. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the R1.C2 (for C2 cabling).  xx1800002943	
5	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544

Continues on next page

5.6.7 Replacing the cable arm

Continued

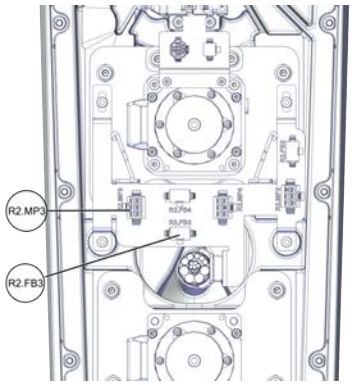
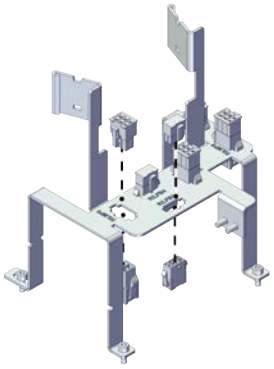
Disconnecting the connectors for axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

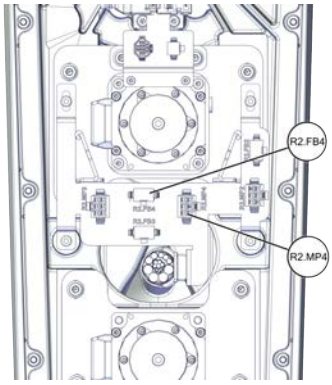
Disconnecting the connectors for axis-3 motor

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

Continues on next page

	Action	Note
2	Disconnect the connectors. • R2.MP3 • R2.FB3	 xx2300000491
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494

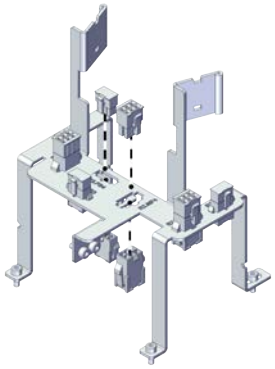
Disconnecting the connectors for axis-4 motor

	Action	Note
1	Disconnect the axis-4 motor connectors. • R2.MP4 • R2.FB4	 xx2300000492

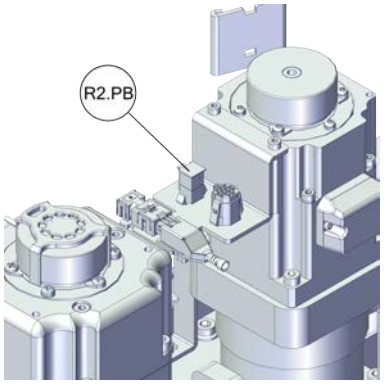
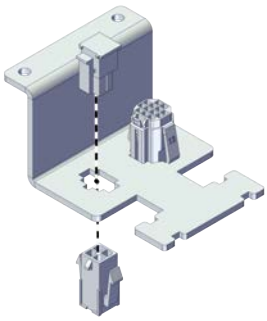
Continues on next page

5.6.7 Replacing the cable arm

Continued

	Action	Note
2	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

Disconnecting the connector for PB

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connector. • R2.PB	 xx2300000543
3	Snap loose and remove the female head of the connector from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545

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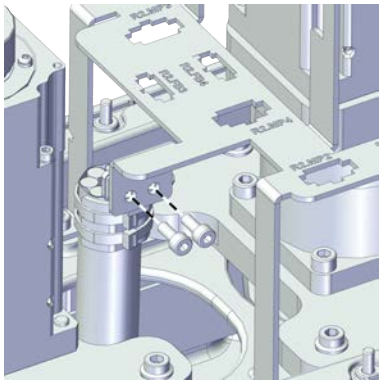
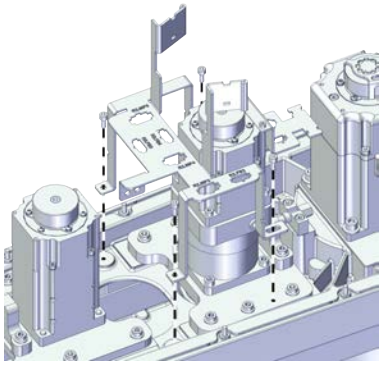
Removing the process hub

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Take out the process hub. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	

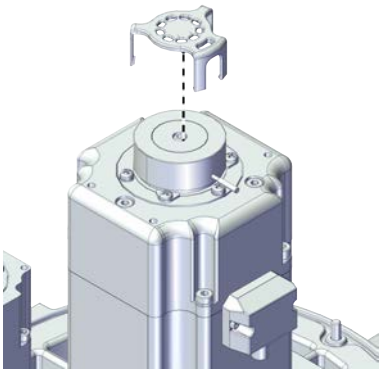
Removing the outer arm cable ferrule and bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000496
3	Remove the screws on the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000497

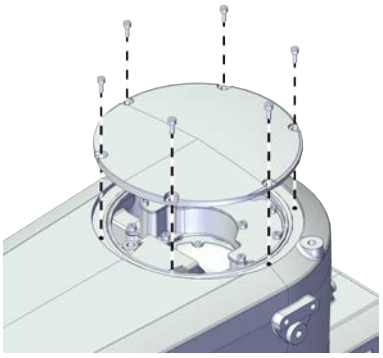
Continues on next page

5.6.7 Replacing the cable arm
Continued

Removing the axis-2 motor protection cover

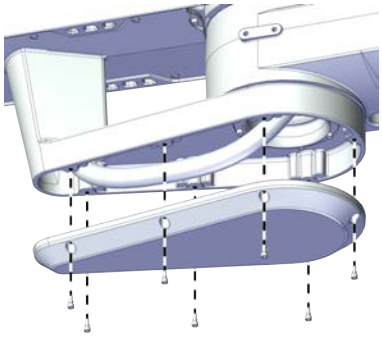
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the protection cover on the motor.	 xx2300000550

Removing the axis-1 cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000498
3	Remove the cover.	

Continues on next page

Removing the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000499
3	Remove the cover.	

Removing the bracket of the cable arm

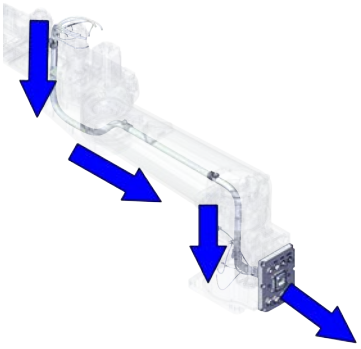
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the bracket from the cable arm to release the cable.	 xx2300000506

Continues on next page

5.6.7 Replacing the cable arm

Continued

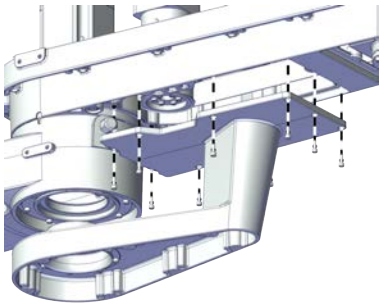
Removing the main harness from the cable arm position

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Pull the main harness out of the outer arm from lower of the cable arm. **Tip** Wrap the connectors with the masking tape. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	For rear outlet cable version:  xx2300000507 For underneath outlet cable version:  xx2300000612
3	Pull the main harness out of the cable arm from the inner arm.	

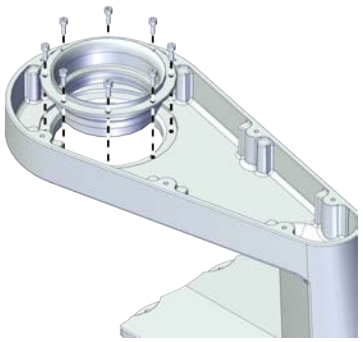
Removing the cable arm

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

Continues on next page

	Action	Note
2	Remove the screws locking the cable arm to the outer arm.	 xx2300000516
3	Remove the cable arm by pulling out from the inner arm bearing.	

Removing the cable arm sealing ring

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the cable arm sealing ring to the cable arm.	 xx2300000601
3	Remove the cable arm sealing ring.	

Refitting the cable arm

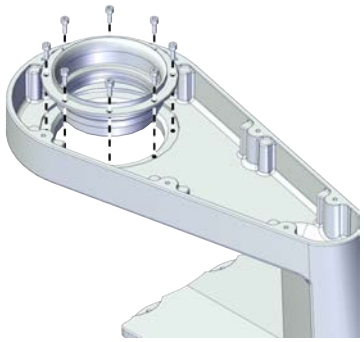
Use these procedures to refit the cable arm.

Refitting the cable arm sealing ring

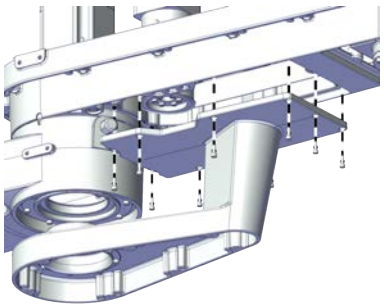
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	

Continues on next page

5.6.7 Replacing the cable arm
Continued

	Action	Note
2	Refit the cable arm sealing ring to the cable arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque:3.3 Nm3.3 Nm ±3%  xx2300000601
3	Secure with the screws.	

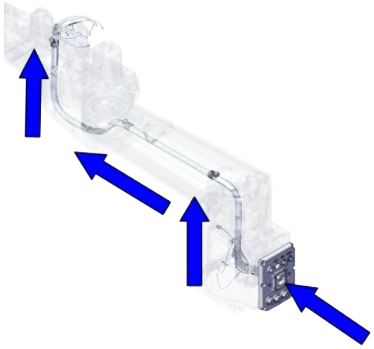
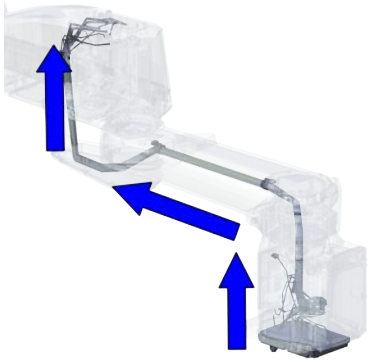
Refitting the cable arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the cable arm to the inner arm and outer arm.	
3	Secure the cable arm to the outer arm with the screws.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque:3.3 Nm2.4 Nm ±3%  xx2300000516

Inserting the main harness through the inner arm position

	Action	Note
1	Secure the cable with the cable ferrule to the two brackets in inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) x 2 Tightening torque: 2.4 Nm ±10%

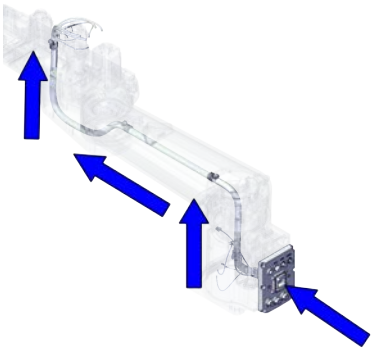
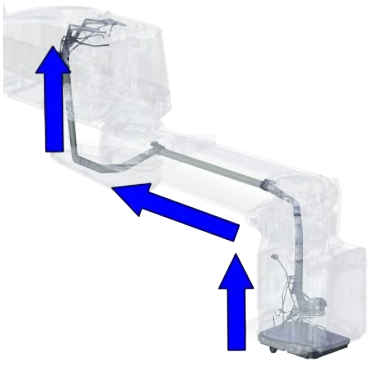
Continues on next page

	Action	Note
2	Insert the main harness into the cable arm through the inner arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
3	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000508

Continues on next page

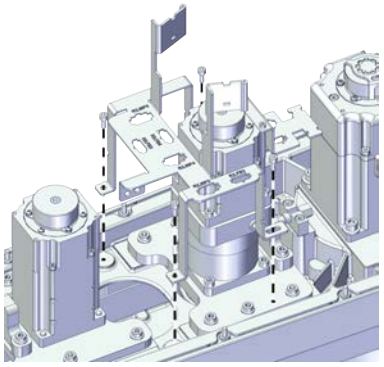
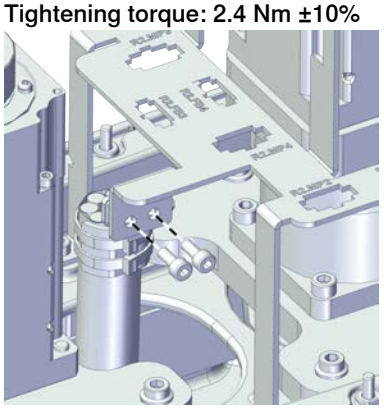
5.6.7 Replacing the cable arm
Continued

Inserting the main harness through the cable arm

	Action	Note
1	Insert the main harness into the outer arm through the cable arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
2	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000506

Continues on next page

Refitting the cable ferrule and bracket in the outer arm

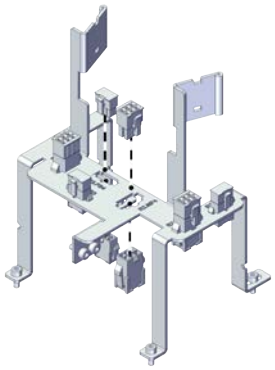
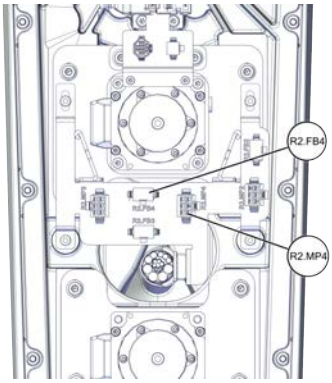
	Action	Note
1	Lay the internal harness in a natural state without distortion.	
2	Refit the bracket. **Tip** Do not secure it with the screws before the cable ferrule installed well. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000497
3	Secure the cable ferrule to the bracket with the screws. **Tip** The air hoses should face the process hub side. **Tip** The position with wrapped tape is the marked position for the cable ferrule. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000496

Continues on next page

5.6.7 Replacing the cable arm

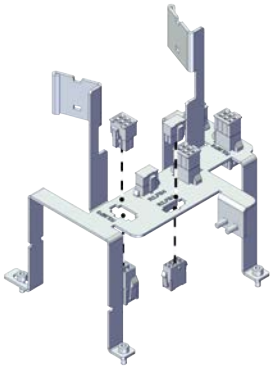
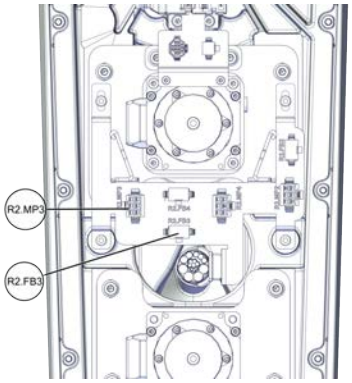
Continued

Reconnecting the connectors for axis-4 motor

	Action	Note
	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495
1	Reconnect the connectors. • R2.MP4 • R2.FB4 **Tip** See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000492
2	Route the cabling on the axis-4 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

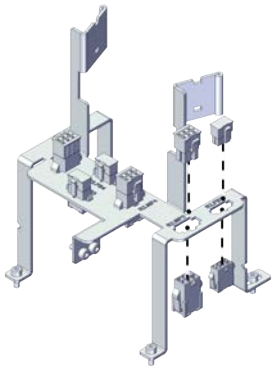
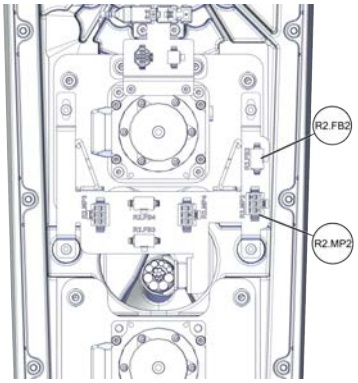
Reconnecting the connectors for axis-3 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494
2	Reconnect the connectors. • R2.MP3 • R2.FB3 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000491
3	Route the cabling on the axis-3 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

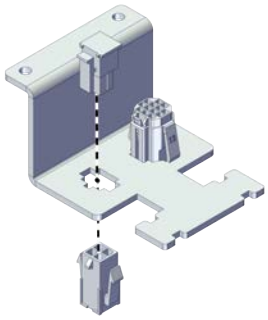
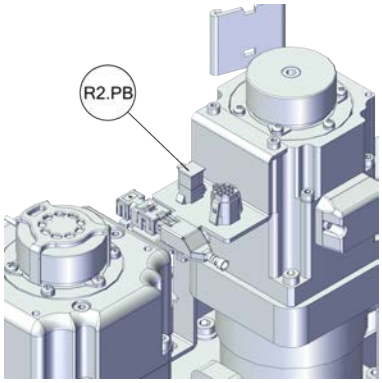
5.6.7 Replacing the cable arm
Continued

Reconnecting the connectors for axis-2 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Reconnecting the connector for PB

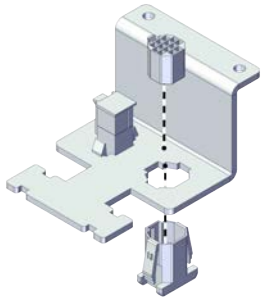
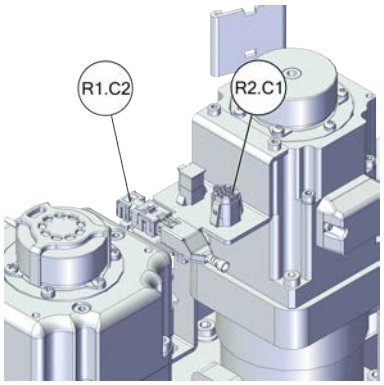
	Action	Note
1	Insert the female head of the PB connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545
2	Reconnect the connector. • R2.PB **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000543
3	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed incorrectly the cables can be damaged.	

Reconnecting the air hoses, CP/CS cabling and Ethernet cabling (if equipped)

	Action	Note
1	Route the air hoses on the process hub behind the bracket. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

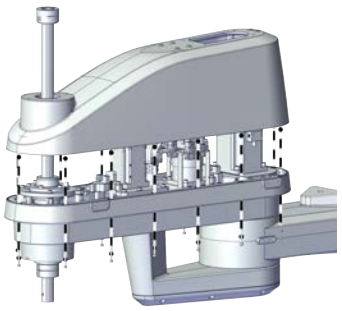
5.6.7 Replacing the cable arm
Continued

	Action	Note
2	Insert the female head of the C1 cabling connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544
3	**For robots with C1 cabling** Reconnect the connector. • R2.C1 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	 xx2300000542
4	**For robots with C2 cabling** Reconnect the connector. • R1.C2 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	
5	Secure the C2 cabling to the C2 bracket with the cable straps.	
6	Reconnect the air hoses in a cross pattern with the L-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	

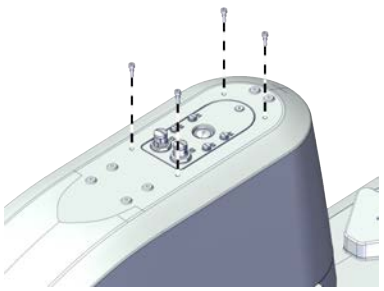
Continues on next page

	Action	Note
7	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

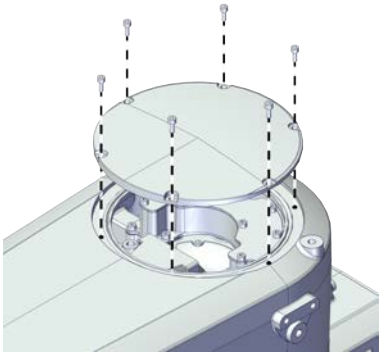
	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487

Continues on next page

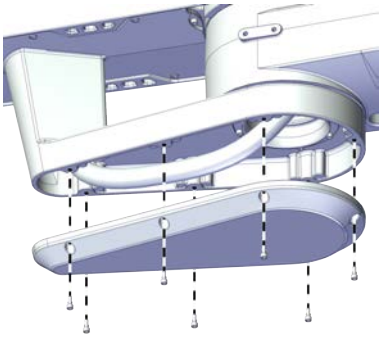
5.6.7 Replacing the cable arm
Continued

	Action	Note
4	Remove the screw.	

Refitting the axis-1 cover

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.4 Nm ±3% For robots with protection class IP30  xx2300000498
2	Refit the screws.	

Refitting the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the cover.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (7 pcs) Tightening torque: 6 Nm ±3% For robots with protection class IP30  xx2300000499
3	Refit the screws.	

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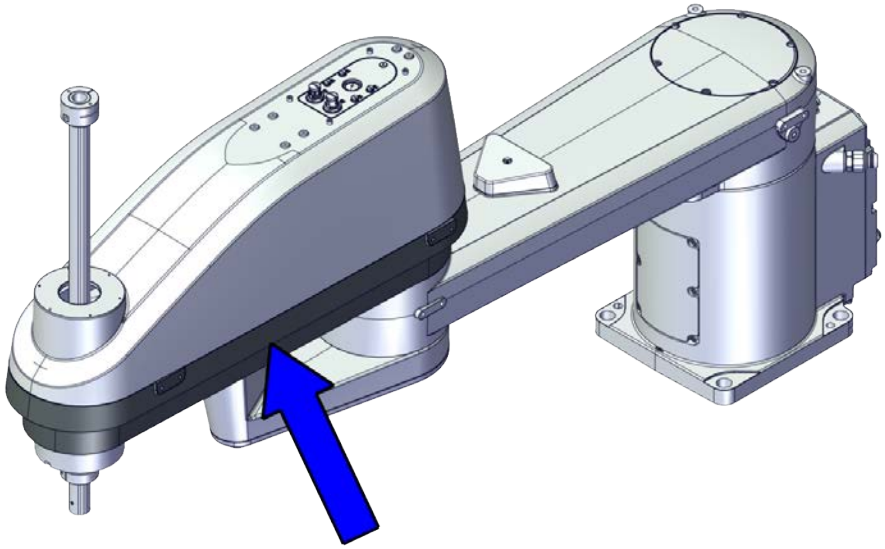
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
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 55*.	

5.6.8 Replacing the outer arm

Location of the outer arm

The outer arm is located as shown in the figure.



xx2300000479

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

Spare part	Article number	Note
Outer arm	3HAC087309-001	
Outer arm cover	3HAC087313-001	
Outer arm bottom cover	3HAC087314-001	
Outer arm bracket	3HAC081794-001	
Pulley on the ball screw lower position	3HAC081704-001	
Timing belt, A3	3HAC081705-001	
Timing belt, A4	3HAC081706-001	
Hex socket head cap flange	3HAB3412-520	Used for axis-3/axis-4 motor flange and adjusting block/screw nut adaptor.

Continues on next page

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.
IRB 930 auxiliary shaft	3HAC087847-001	Used to install the ball screw nut. Special tool for L2
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

5.6.8 Replacing the outer arm
Continued

Removing the outer arm

Use these procedures to remove the outer arm.

Preparations before removing the outer arm

Remove the robot from the wall or enough space.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Draining oil of axis-2 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	

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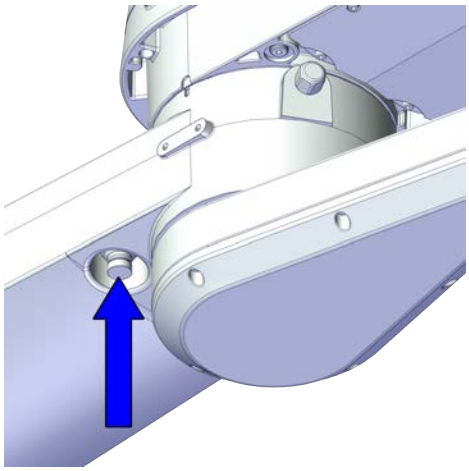
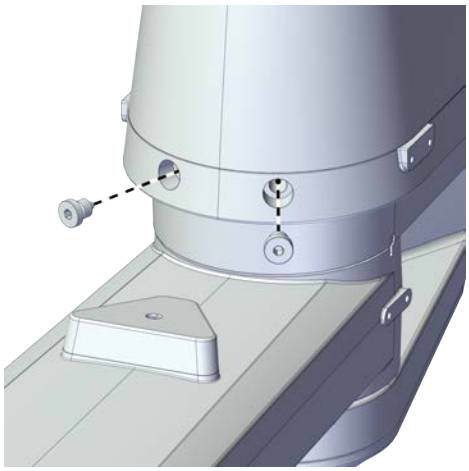
	Action	Note
3	Place the oil collecting vessel underneath the oil plug, draining.	 xx2300000548
4	Plug a clean pipe to the oil plug, draining, with the other end to the oil collecting vessel.	
5	Remove the oil plug, draining.	 xx2300000549
6	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 605* for more information.	
7	Drain the gearbox oil.	**Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.

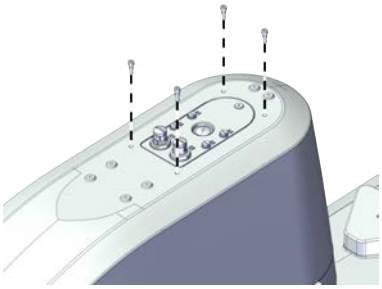
Continues on next page

5.6.8 Replacing the outer arm

Continued

	Action	Note
8	Remove and clean the pipe after the oil is drained. **Note** There will be some oil left in the gearbox after draining.	
9	Refit oil plugs.	Tightening torque: 10 Nm

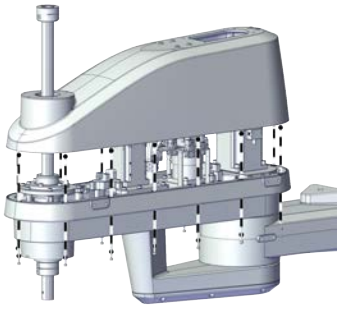
Removing the process hub screws

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

Removing the cover of the outer arm

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

Continues on next page

	Action	Note
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

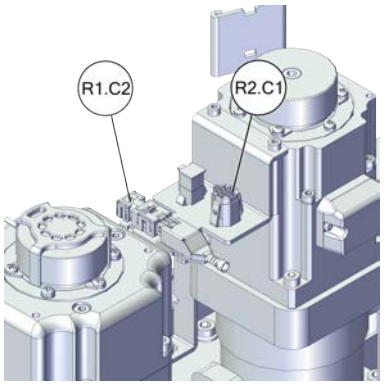
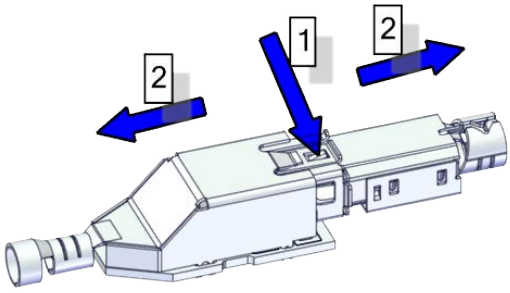
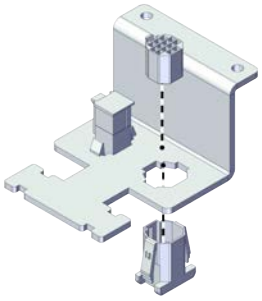
Disconnecting the air hoses, C1 cabling and C2 cabling (if equipped)

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the air hoses from the L-shaped connectors.	

Continues on next page

5.6.8 Replacing the outer arm

Continued

	Action	Note
3	**For robots with C1 cabling** Disconnect the connector. • R2.C1	 xx2300000542
4	**For robots with C2 cabling** Disconnect the connector. • R1.C2 **Tip** Cut the cable straps for the R1.C2 at the same time. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the R1.C2 (for C2 cabling).  xx1800002943	
5	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544

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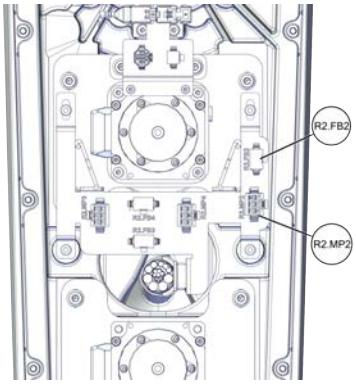
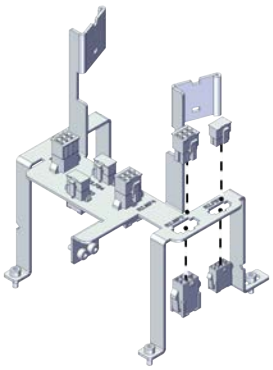
Disconnecting the connectors for axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

Disconnecting the connectors for axis-3 motor

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

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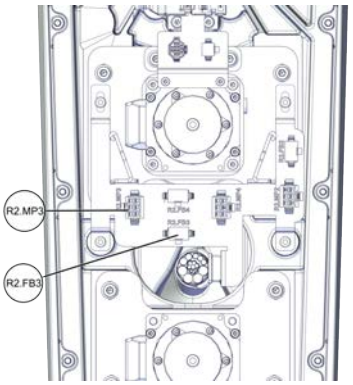
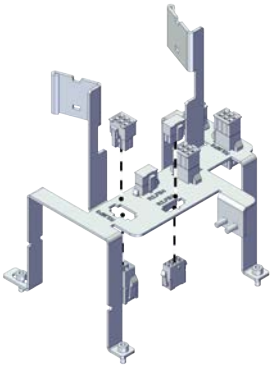
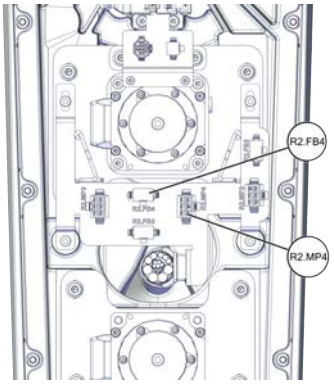
5.6.8 Replacing the outer arm

Continued

	Action	Note
2	Disconnect the connectors. • R2.MP3 • R2.FB3	 xx2300000491
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494

Disconnecting the connectors for axis-4 motor

	Action	Note
1	Disconnect the axis-4 motor connectors. • R2.MP4 • R2.FB4	 xx2300000492

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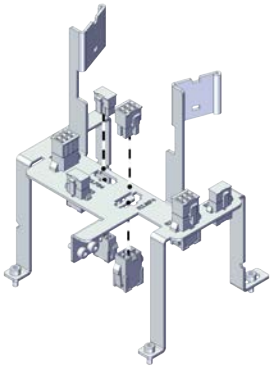
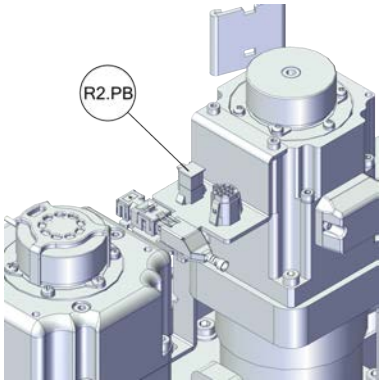
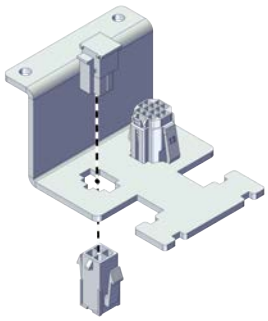
	Action	Note
2	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

Disconnecting the connector for PB

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connector. • R2.PB	 xx2300000543
3	Snap loose and remove the female head of the connector from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545

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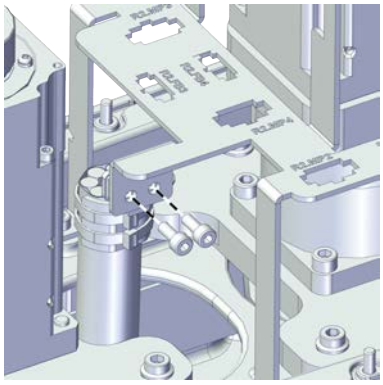
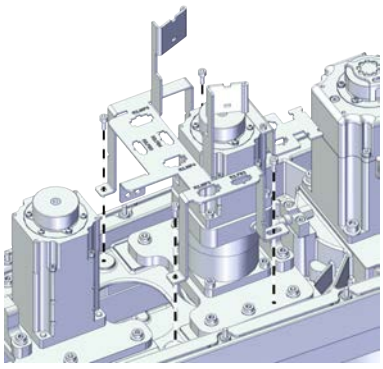
5.6.8 Replacing the outer arm

Continued

Removing the process hub

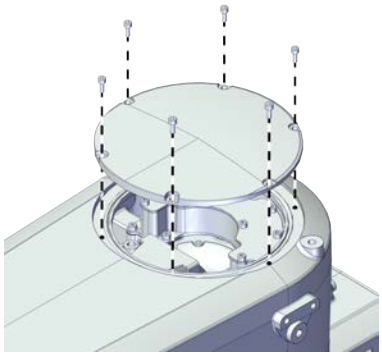
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Take out the process hub. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	

Removing the outer arm cable ferrule and bracket

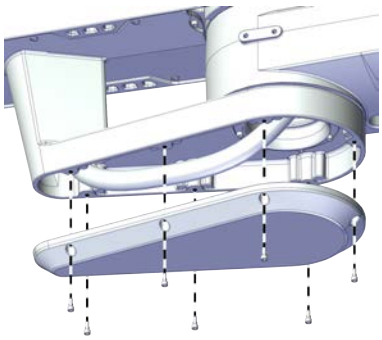
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000496
3	Remove the screws on the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000497

Continues on next page

Removing the axis-1 cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000498
3	Remove the cover.	

Removing the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000499
3	Remove the cover.	

Continues on next page

5.6.8 Replacing the outer arm

Continued

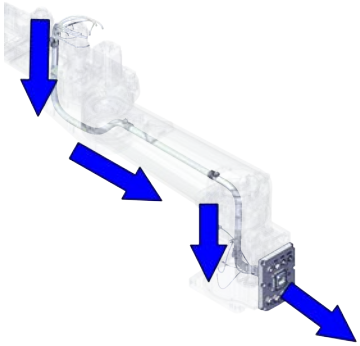
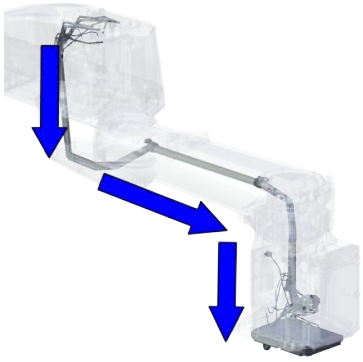
Removing the bracket of the cable arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the bracket from the cable arm to release the cable.	 xx2300000506

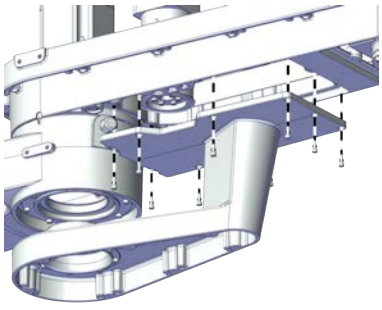
Removing the main harness from the cable arm position

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

Continues on next page

	Action	Note
2	Pull the main harness out of the outer arm from lower of the cable arm. **Tip** Wrap the connectors with the masking tape. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	For rear outlet cable version:  xx2300000507 For underneath outlet cable version:  xx2300000612
3	Pull the main harness out of the cable arm from the inner arm.	

Removing the cable arm

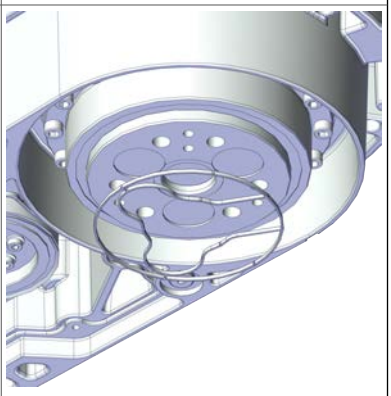
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the cable arm to the outer arm.	 xx2300000516
3	Remove the cable arm by pulling out from the inner arm bearing.	

Continues on next page

5.6.8 Replacing the outer arm

Continued

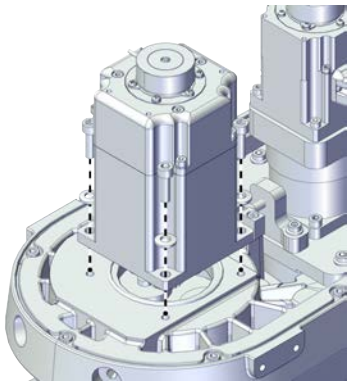
Removing the outer arm assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the axis -2 gear inside the inner arm.	For robots with protection class IP30
3	Remove the outer arm assembly slightly.	 xx2300000517
4	Remove the gear gasket on the axis-2 gear unit.	 xx2300000603

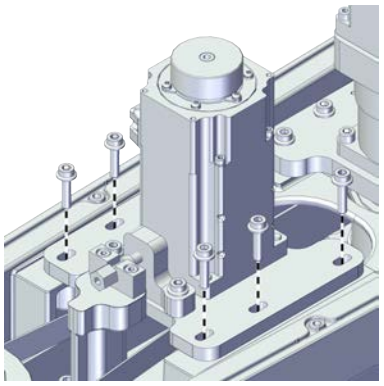
Removing the axis-2 motor sub-assembly

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

Continues on next page

	Action	Note
2	Remove the screws and washers.	 xx2300000605
3	Remove the motor. **Tip** Move the internal harness out of the way.	

Removing the axis-3 motor sub-assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Remove the screws.	 xx2300000594
4	Remove the axis-3 motor sub-assembly.	

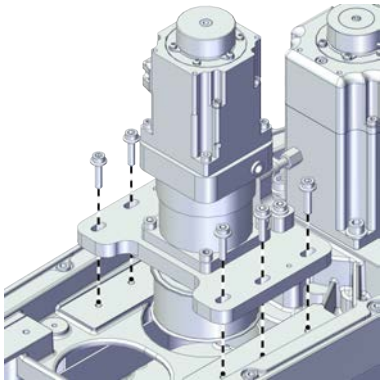
Removing the axis-4 motor sub-assembly

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

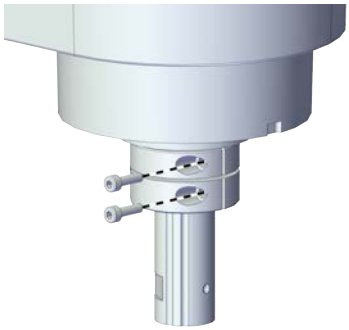
Continues on next page

5.6.8 Replacing the outer arm

Continued

	Action	Note
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Remove the screws.	 xx2300000597
4	Remove the axis-4 motor sub-assembly.	

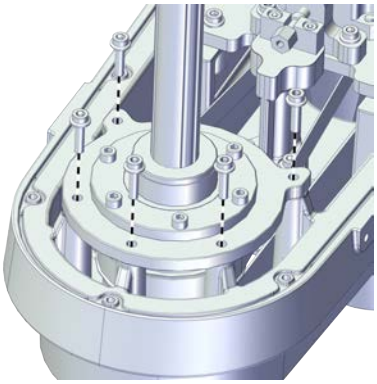
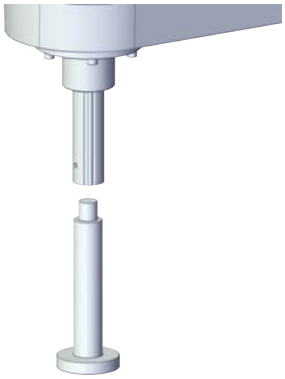
Removing the lower mechanical stopper

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000556

Continues on next page

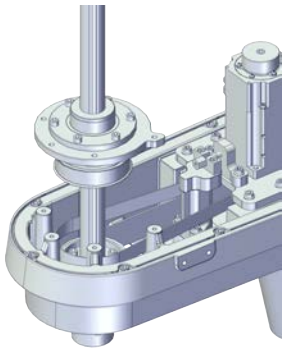
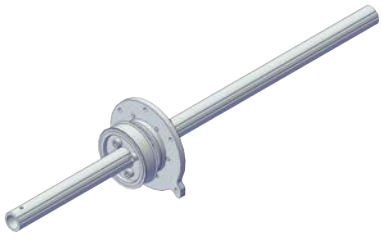
	Action	Note
3	Remove the mechanical stopper. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Removing the ball screw with the flange

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Remove the screws and washers on the ball screw flange.	 xx2300000559
4	Insert the special tool auxiliary shaft into the ball screw shaft.	IRB 930 auxiliary shaft:3HAC087847-001  xx2300000562

Continues on next page

5.6.8 Replacing the outer arm
Continued

	Action	Note
5	Mark the location of the ball screw shaft grooves on the ball screw lower nut.	 xx2300000563
6	Take out the ball screw with the flange assembly carefully. **CAUTION** Move the special tool along with the ball screw shaft until it is totally inserted into the lower nut of the ball screw and keep the status. When the special tool is totally inserted to the lower nut of the ball screw, support the special tool with some thing. Or the ball screw lower nut will be destroyed.	 xx2300000564
7	Lay down the ball screw assembly. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	 xx2300000565

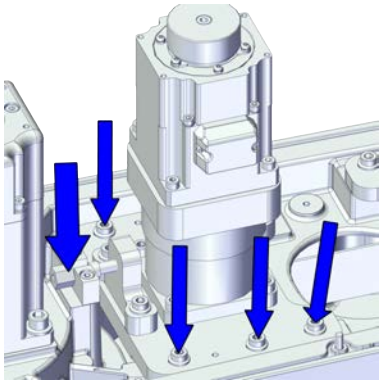
Removing the axis-3 timing belt

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

Continues on next page

	Action	Note
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Remove the axis-3 timing belt.	

Removing the axis-4 timing belt

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Loosen the screws of the axis-4 motor sub-assembly to let the axis-4 timing belt be free.	 xx2300000558
3	Remove the timing belt.	

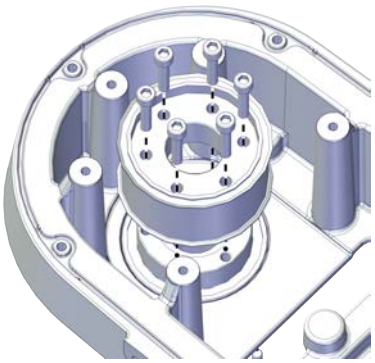
Removing the pulley on the ball screw lower position

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	

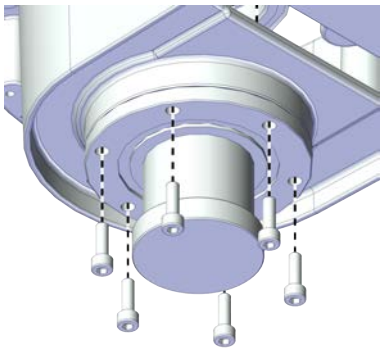
Continues on next page

5.6.8 Replacing the outer arm

Continued

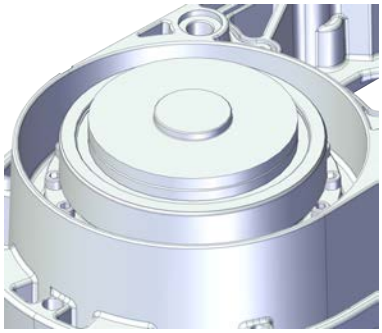
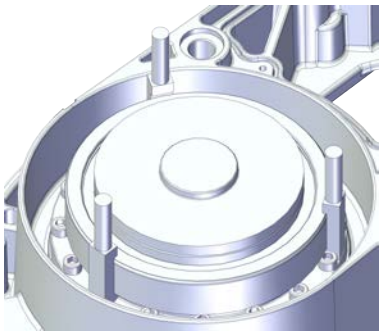
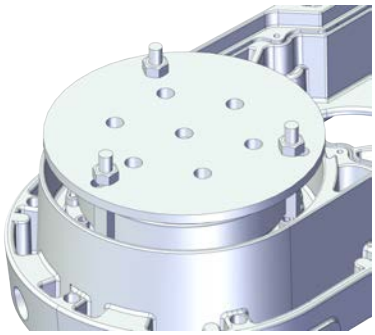
	Action	Note
3	Remove the screws and washers.	 xx2300000567
4	Remove the pulley carefully. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Removing the ball screw lower nut

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the lower nut to the outer arm. **Tip** Hold the ball screw to prevent it from dropping. Or the ball screw may be destroyed.	IRB 930 auxiliary shaft:3HAC087847-001  xx2300000568
3	Hold the ball screw lower nut with the special tool to take them out of the outer arm carefully. **Tip** Hold the lower part of the ball screw to prevent it from dropping. Or the ball screw may be destroyed. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

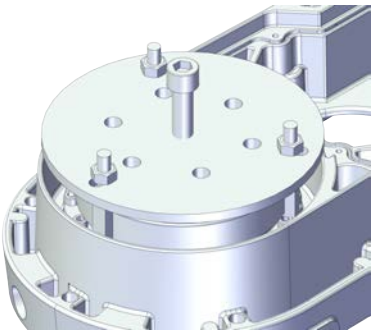
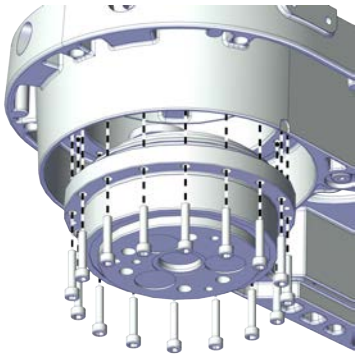
Continues on next page

Removing the axis-2 gear unit sub-assembly from the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Install the supporting plate of the sealing ring disassembling tool (3HAC090315-001) to the axis-2 gear.	A2 Sealing ring disassembling tool:3HAC090315-001  xx2300001904
3	Hook the A2 sealing ring with three pulling sticks (M8) of the sealing ring disassembling tool.	 xx2300001905
4	Thread the upper part of the pulling sticks through the pulling plate and lock with nuts.	 xx2300001906

Continues on next page

5.6.8 Replacing the outer arm
Continued

	Action	Note
5	Tighten the nuts to pull out the A2 sealing ring.	 xx2300001907
6	Take out the A2 sealing ring with the sealing ring disassembling tool. **Tip** Clean the glue on the ring if need to be reused.	
7	Remove the screws on the gear to the outer arm.	For robots with protection class IP30
8	Remove the gear unit.	 xx2300000606

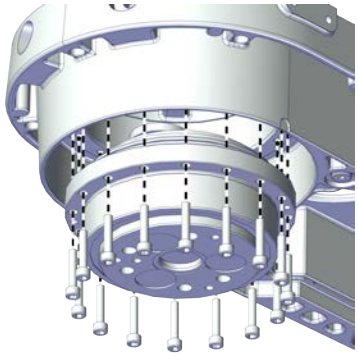
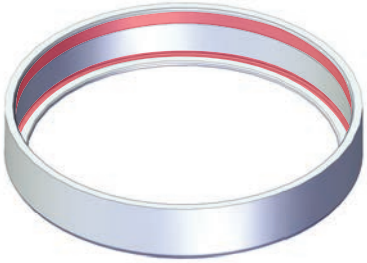
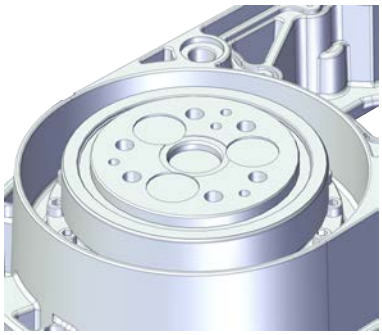
Refitting the outer arm

Use these procedures to refit the outer arm.

Refitting the axis-2 gear unit sub-assembly to the outer arm

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

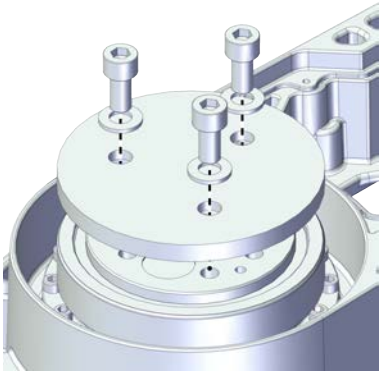
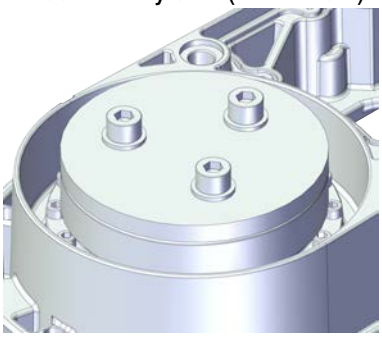
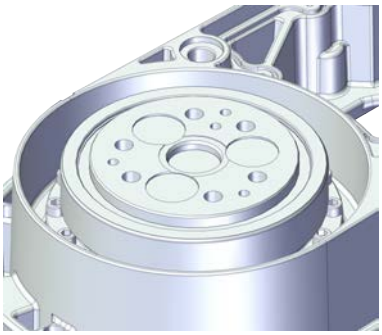
Continues on next page

	Action	Note
2	Refit the gear unit according to the location screws. **Tip** When the gear unit is in the right position, you can hear a clear "Click".	Screws: Hex socket head cap screw M5x25 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 7 Nm ±3% For robots with protection class IP30  xx2300000606
3	Refit the screws.	
4	Apply the glue (Loctite 641) to the inner side of the A2 sealing ring as illustrated.	 xx2300001899
5	Install the A2 sealing ring to the gearbox.	 xx2300001900

Continues on next page

5.6.8 Replacing the outer arm

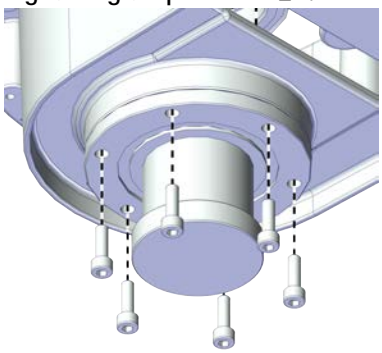
Continued

	Action	Note
6	Install the pressing plate of the sealing ring assembling tool and lock with the screws (M10) to press the A2 sealing ring.	A2 Sealing ring assembling tool:3HAC090314-001  xx2300001901
7	Wait for 30 minutes.	Loctite 641 dry time (30 minutes).  xx2300001902
8	Remove the sealing ring assembling tool and the check that the A2 sealing ring is glued to the gearbox.	 xx2300001903

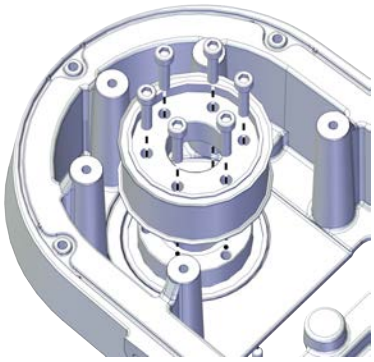
Refitting the ball screw lower nut

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

Continues on next page

	Action	Note
2	Put the ball screw lower nut to the outer arm carefully. **CAUTION** Make sure the ball screw nut works fluently.	Screws: Hex socket head cap screw M5x16 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 6 Nm ±3%  xx2300000568
3	Secure the screws on the lower nut to the outer arm.	

Removing the pulley on the ball screw lower position

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**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 46*.	
3	Remove the screws and washers.	 xx2300000567
4	Remove the pulley carefully. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this.	

Placing the axis-3 and axis-4 timing belts into the outer arm

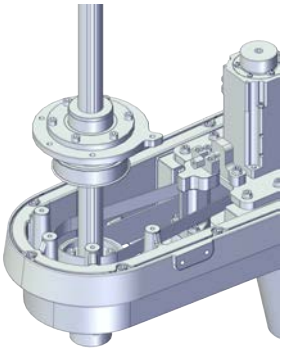
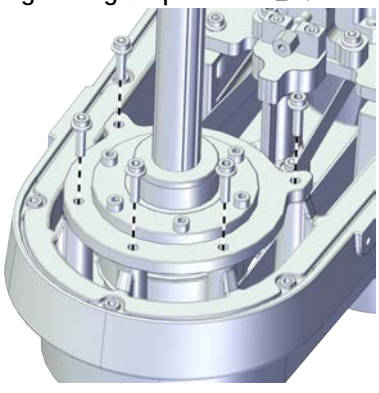
	Action	Note
1	Place the axis-3 and axis-4 timing belts into the outer arm.	

Continues on next page

5.6.8 Replacing the outer arm

Continued

Refitting the ball screw with the flange

	Action	Note
1	Refit the ball screw assembly to the outer arm. **Tip** Make sure the marked location is aligned with the ball screw shaft grooves. **CAUTION** With the inserting of the ball screw shaft, remove the special tool auxiliary shaft along with the ball screw shaft carefully.	IRB 930 auxiliary shaft:3HAC087847-001  xx2300000564  xx2300000563
2	Refit the screws and washers to the secure the ball screw flange to the outer arm. **Tip** Pre-tighten the screws at 0.5Nm and slide the ball screw up and down for five times. Then tighten the screws at 6 Nm ±3% to secure it.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (5 pcs) Tightening torque: 6 Nm ±3%  xx2300000559

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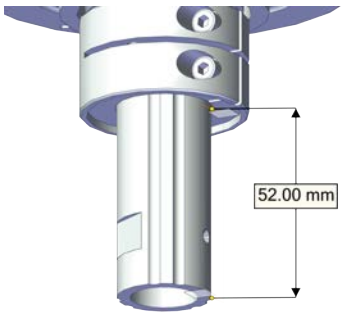
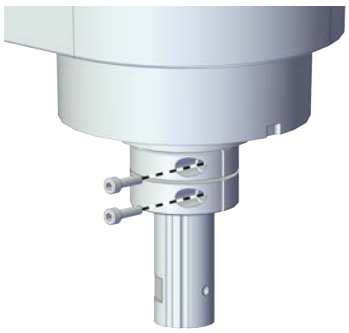
Refitting the mechanical stopper

	Action	Note
1	Refit the mechanical stopper to the ball screw at 52 mm position to the lower of the ball screw. **Tip** Make sure that the limit block opening gap is aligned with the ball screw origin point. **CAUTION** If the ball screw nut or ball screw spline nut go out of the screw shaft, the ball screw is destroyed. Be careful when you do any work that may cause this. **Note** Be careful with the orientation of the mechanical stopper. The flat side is on the upper side.	For robots with protection class IP30  xx2300000561
2	Refit the screws.	Screws: Hex socket head cap screw M4x14 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 6 Nm For robots with protection class IP30  xx2300000556

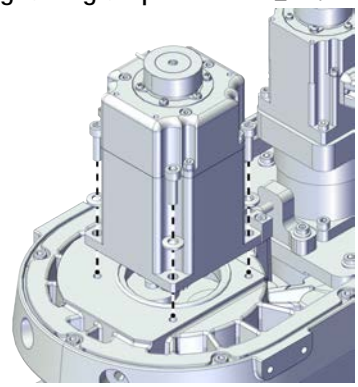
Refitting the axis-2 motor sub-assembly

	Action	Note
1	Replace the o-ring if needed.	

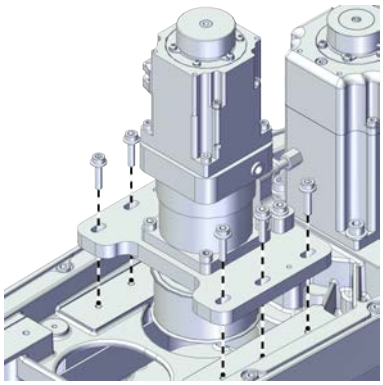
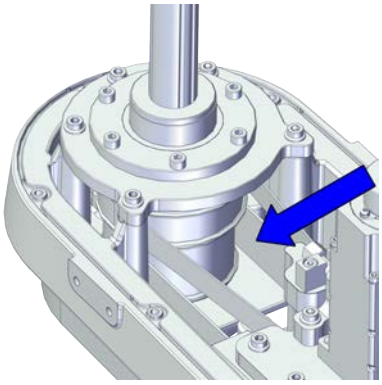
Continues on next page

5.6.8 Replacing the outer arm

Continued

	Action	Note
2	Refit the motor.	Screws: Hex socket head cap screw M6x20 12.9 Gleitmo 603+Geomet 500 (4 pcs) Washers: Spring washer, conical 11x5.3x1.2 Steel (4 pcs) Tightening torque: 2.3 Nm ±10%  xx2300000605
3	Refit the screws and washers.	

Refitting the axis-4 motor sub-assembly

	Action	Note
1	Refit the motor with flange to the outer arm. **Tip** Move the internal harness out of the way.	 xx2300000597
2	Refit the timing belt to the pulley on the ball screw and the motor. Ensure that the belt runs correctly in the grooves.	Timing belt, A4: 3HAC081706-001  xx2300000588

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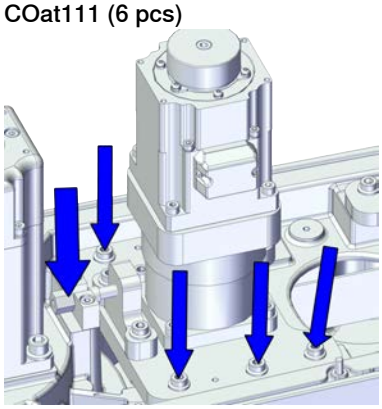
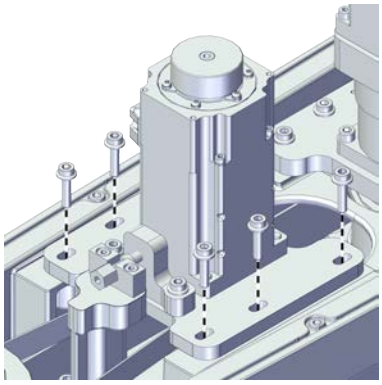
	Action	Note
3	Refit the screws and washers without fully tightened.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (6 pcs)  xx2300000558
4	Use a sonic tension meter to measure the timing belt tension.	Used belt: 312-333 Hz New belt:88.4-92.7 Hz
5	If the timing belt tension does not meet the requirement, readjust the motor with the adjusting screw.	
6	Tighten the motor screws when the timing belt meets the requirement.	Tightening torque: 6 Nm ±10%

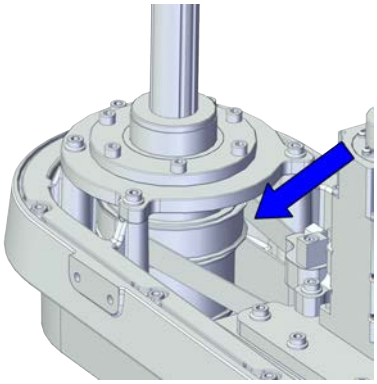
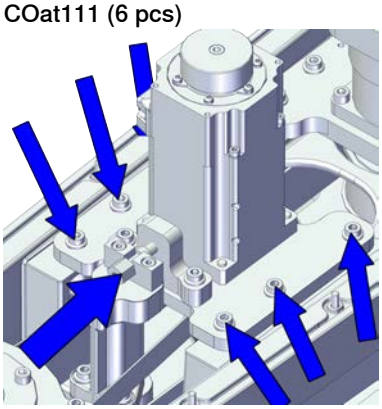
Refitting the axis-3 motor sub-assembly

	Action	Note
	Refit the motor with flange to the outer arm. **Tip** Move the internal harness out of the way.	 xx2300000594

Continues on next page

5.6.8 Replacing the outer arm

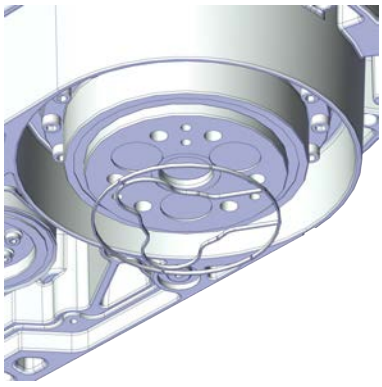
Continued

	Action	Note
1	Refit the timing belt to the pulley on the ball screw and the motor. Ensure that the belt runs correctly in the grooves.	Timing belt, A3: 3HAC081705-001  xx2300000589
2	Refit the screws and washers without fully tightened.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (6 pcs)  xx2300000557
3	Use a sonic tension meter to measure the timing belt tension.	Used belt: 139-149 Hz New belt:109-119 Hz
4	If the timing belt tension does not meet the requirement, readjust the motor with the adjusting screw.	
5	Tighten the motor flange screws when the timing belt meets the requirement.	Tightening torque: 6 Nm ±10%

Refitting the outer arm to the inner arm

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

Continues on next page

	Action	Note
2	Refit the gear gasket to the axis-2 gear unit.	 xx2300000603
3	Refit the outer arm to the inner arm. **Tip** When the gear unit is in the right position, you can hear a clear "Click".	Screws: Hex socket head cap screw M10x25 12.9 Gleitmo 603+Geomet 500 (6 pcs) Tightening torque:55 Nm Screws: Hex socket head cap screw M6x20 12.9 Gleitmo 603+Geomet 500 (3 pcs) Tightening torque:10 Nm
4	Refit the screws. **Note** The two screw holes under the axis-2 belt location are left empty.	 xx2300000517

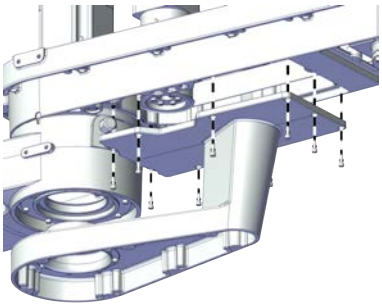
Refitting the cable arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the cable arm to the inner arm and outer arm.	

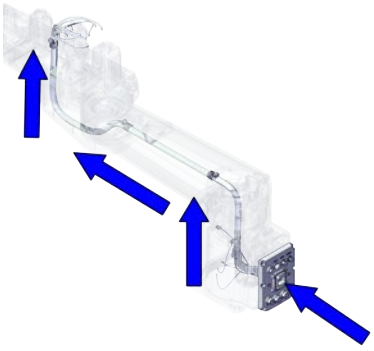
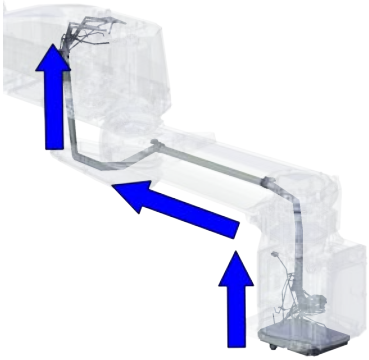
Continues on next page

5.6.8 Replacing the outer arm

Continued

	Action	Note
3	Secure the cable arm to the outer arm with the screws.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque:3.3 Nm2.4 Nm ±3%  xx2300000516

Inserting the main harness through the inner arm position

	Action	Note
1	Secure the cable with the cable ferrule to the two brackets in inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) x 2 Tightening torque: 2.4 Nm ±10%
2	Insert the main harness into the cable arm through the inner arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610

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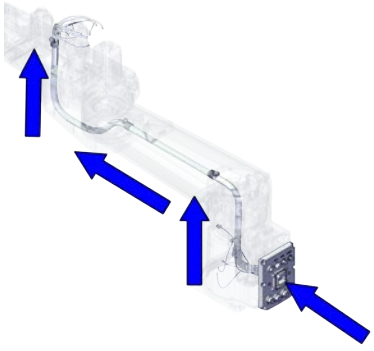
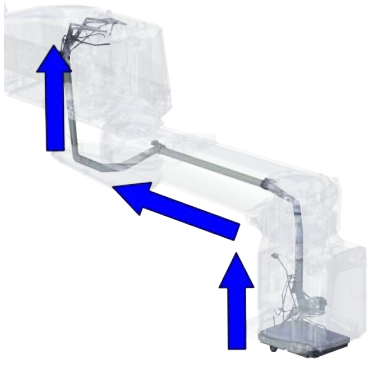
	Action	Note
3	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000508

Inserting the main harness through the cable arm

	Action	Note
1	Insert the main harness into the outer arm through the cable arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610

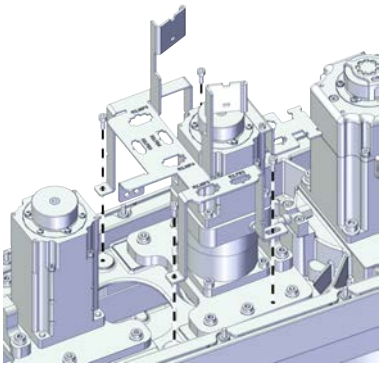
Continues on next page

5.6.8 Replacing the outer arm

Continued

	Action	Note
2	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000506

Refitting the cable ferrule and bracket in the outer arm

	Action	Note
1	Lay the internal harness in a natural state without distortion.	
2	Refit the bracket. **Tip** Do not secure it with the screws before the cable ferrule installed well. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000497

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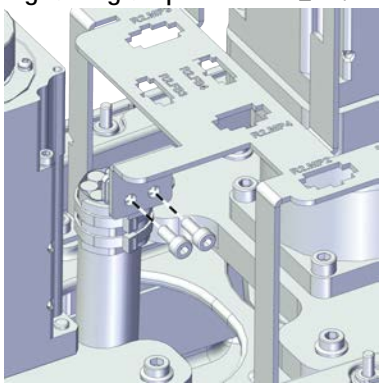
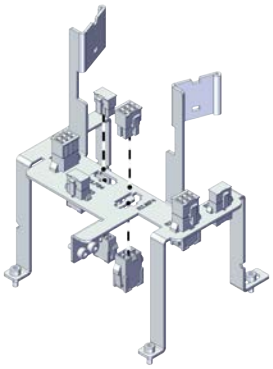
	Action	Note
3	Secure the cable ferrule to the bracket with the screws. **Tip** The air hoses should face the process hub side. **Tip** The position with wrapped tape is the marked position for the cable ferrule. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000496

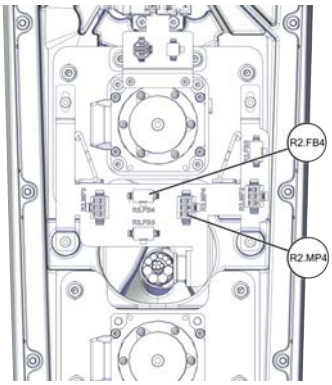
Reconnecting the connectors for axis-4 motor

	Action	Note
	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

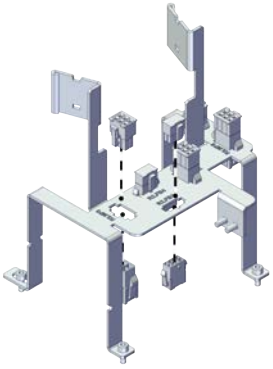
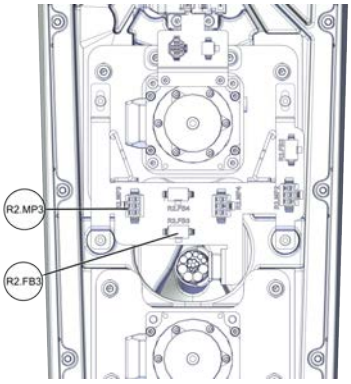
Continues on next page

5.6.8 Replacing the outer arm

Continued

	Action	Note
1	Reconnect the connectors. • R2.MP4 • R2.FB4 **Tip** See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000492
2	Route the cabling on the axis-4 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

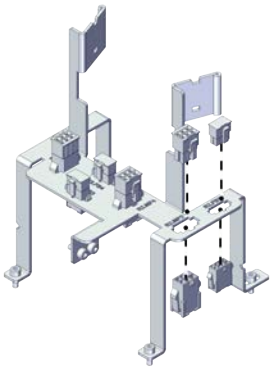
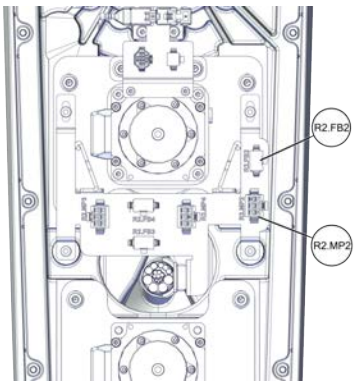
Reconnecting the connectors for axis-3 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494
2	Reconnect the connectors. • R2.MP3 • R2.FB3 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000491

Continues on next page

	Action	Note
3	Route the cabling on the axis-3 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Reconnecting the connectors for axis-2 motor

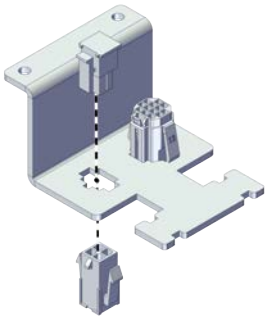
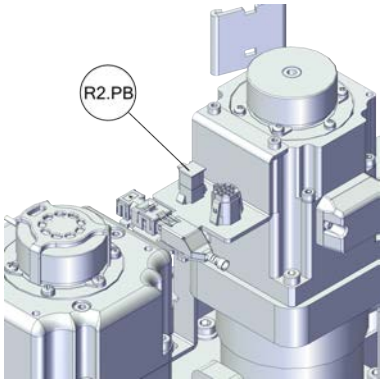
	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.6.8 Replacing the outer arm

Continued

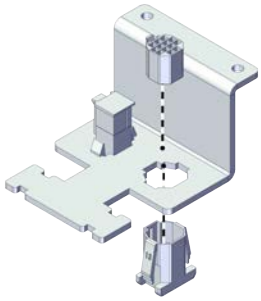
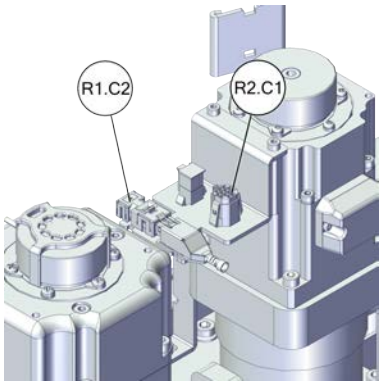
Reconnecting the connector for PB

	Action	Note
1	Insert the female head of the PB connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545
2	Reconnect the connector. • R2.PB **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000543
3	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed incorrectly the cables can be damaged.	

Reconnecting the air hoses, CP/CS cabling and Ethernet cabling (if equipped)

	Action	Note
1	Route the air hoses on the process hub behind the bracket. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

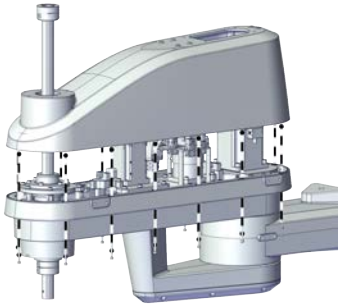
	Action	Note
2	Insert the female head of the C1 cabling connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544
3	**For robots with C1 cabling** Reconnect the connector. • R2.C1 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	 xx2300000542
4	**For robots with C2 cabling** Reconnect the connector. • R1.C2 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	
5	Secure the C2 cabling to the C2 bracket with the cable straps.	
6	Reconnect the air hoses in a cross pattern with the L-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	

Continues on next page

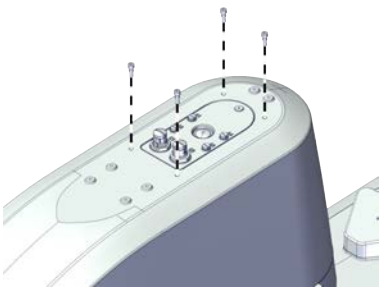
5.6.8 Replacing the outer arm
Continued

	Action	Note
7	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487

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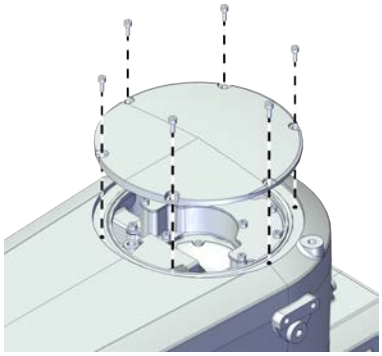
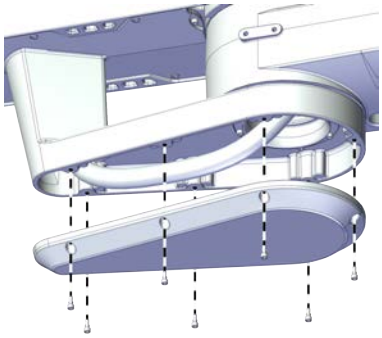
	Action	Note
4	Remove the screw.	

Refitting the axis-1 cover

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.4 Nm ±3% For robots with protection class IP30  xx2300000498
2	Refit the screws.	

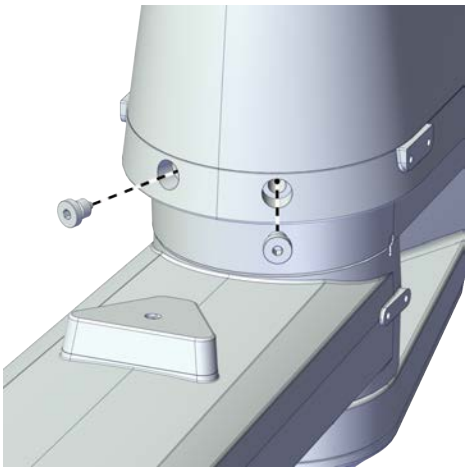
Refitting the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the cover.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (7 pcs) Tightening torque: 6 Nm ±3% For robots with protection class IP30  xx2300000499
3	Refit the screws.	

Continues on next page

5.6.8 Replacing the outer arm
Continued

Refilling oil to axis-2 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	
3	Open the upper oil plug. **Note** The lower oil plug has to be closed; otherwise, the oil may leak before required oil amount is filled.	 xx2300000549
4	**WARNING** 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.	
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained. **CAUTION** Oil filling must be slow to make sure air venting is fluent.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.

Continues on next page

	Action	Note
6	Refit the oil plug.	Tightening torque: 10 Nm
7	**DANGER** Make sure all safety requirements are met when performing the first test run.	

Concluding procedure

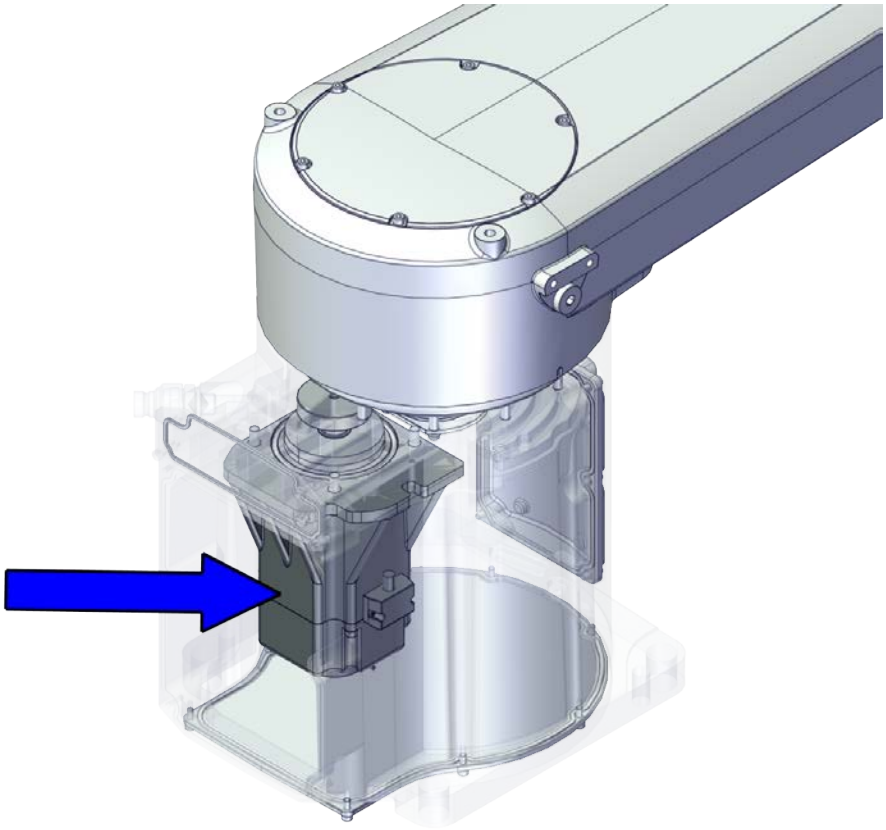
	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 55*.	

5.7 Motors

5.7.1 Replacing the axis-1 motor sub-assembly

Location of the axis-1 motor sub-assembly

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



xx2300000480

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

Spare part	Article number	Note
Axis-1 motor	3HAC087303-001	Includes o-ring 3HAC061327-037.

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Continues on next page

Equipment	Article number	Note
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

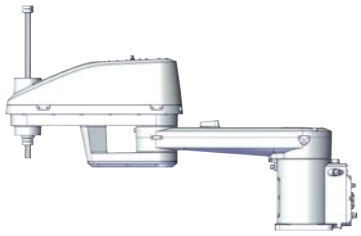
Continues on next page

5.7.1 Replacing the axis-1 motor sub-assembly
Continued

Removing the axis-1 motor sub-assembly

Use these procedures to remove the axis-1 motor sub-assembly.

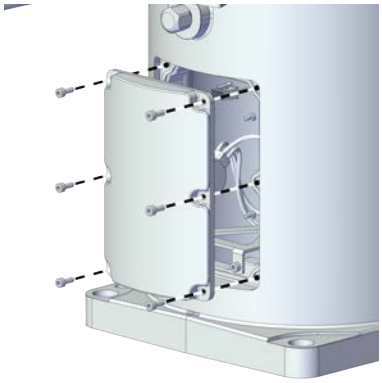
Preparations before removing the axis-1 motor sub-assembly

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	Jog all axes to zero position.	 xx2300000486
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

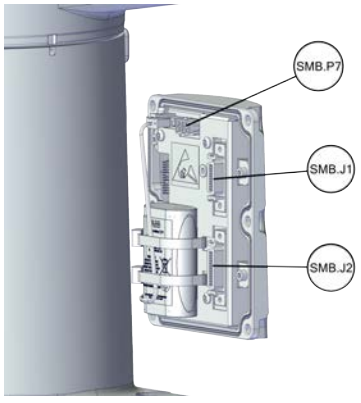
Removing the SMB cover

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

Continues on next page

	Action	Note
2	**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 46*.	
3	Remove the screws on the SMB cover to the base.	For robots with protection class IP30
4	Pull the SMB cover with the SMB unit assembly out together.	 xx2300000489

Disconnecting the SMB cabling

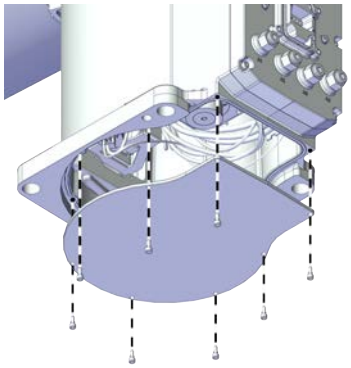
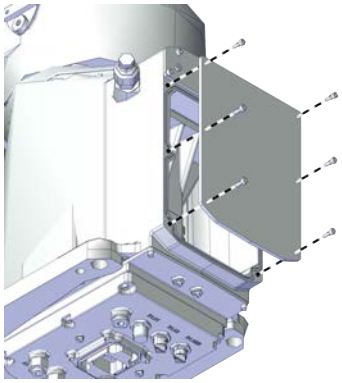
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 46*.	
3	Cut the strips.	
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945

Continues on next page

5.7.1 Replacing the axis-1 motor sub-assembly

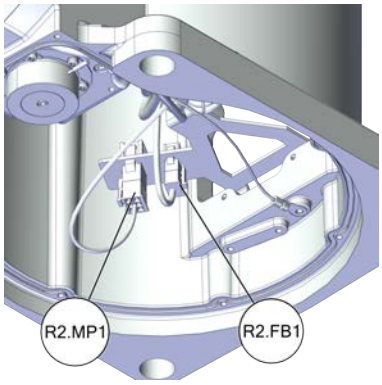
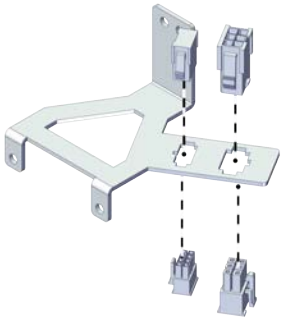
Continued

Removing the base plate/ rear plate

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the base to the ground.	
3	Lay down the robot.	
4	For robot with rear outlet cable version, remove the screws on the base plate.	For rear outlet cable version: For robots with protection class IP30
5	Remove the base plate.	 xx2300000500
6	For robot with underneath outlet cable version, remove the screws on the rear plate.	For underneath outlet cable version: For robots with protection class IP30
7	Remove the rear plate.	 xx2300000608

Continues on next page

Disconnecting the connectors for axis-1 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP1 • R2.FB1	 xx2300000504
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000505

Removing the base bracket

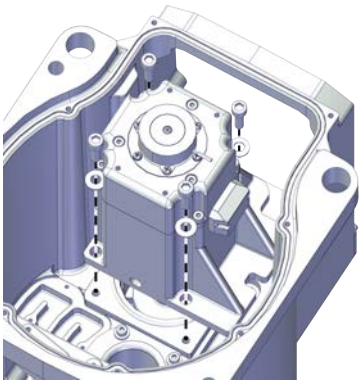
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	

Continues on next page

5.7.1 Replacing the axis-1 motor sub-assembly
Continued

	Action	Note
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000503
3	Remove the screws on the base bracket to the base from the SMB side.	

Removing the axis-1 motor sub-assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and washers.	 xx2300000512
3	Remove the motor.	

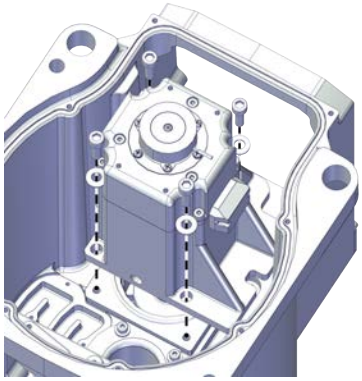
Refitting the axis-1 motor sub-assembly

Use these procedures to refit the axis-1 motor sub-assembly.

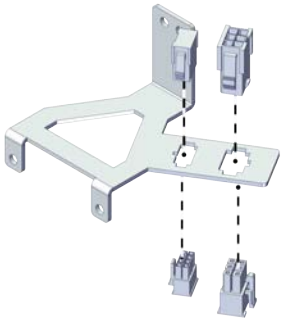
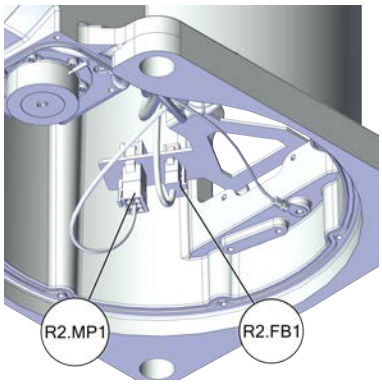
Refitting the axis-1 motor sub-assembly

	Action	Note
1	Replace the o-ring if needed.	
2	Put the timing belt into the pulley on the gear.	

Continues on next page

	Action	Note
3	Refit the motor and refit the timing belt to the motor. Ensure that the belt runs correctly in the grooves.	Screws: Hex socket head cap screw M6x20 12.9 Gleitmo 603+Geomet 500 (4 pcs) Washers: Spring washer, conical 11x5.3x1.2 Steel (4 pcs) Tightening torque: 10 Nm ±10%
4	Refit the screws and washers without fully tightened.	 xx2300000512

Reconnecting the connectors for axis-1 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000505
2	Reconnect the connectors. • R2.MP1 • R2.FB1 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000504

Continues on next page

5.7.1 Replacing the axis-1 motor sub-assembly
Continued

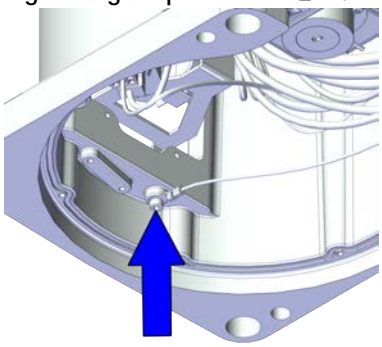
	Action	Note
3	Route the cabling behind the axis-1 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the base bracket

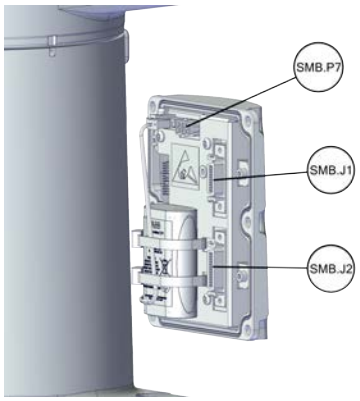
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Lay the main harness in a natural state without distortion.	
	Refit the cable ferrule to the bracket. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000503
3	Refit the base bracket to the base and secure with the screws.	

Continues on next page

Reconnecting the grounding cable connector

	Action	Note
1	Secure the grounding cable to the bracket with the screw.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (1 pcs) Tightening torque: 1.2 Nm ±10%  xx2300000502
2	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

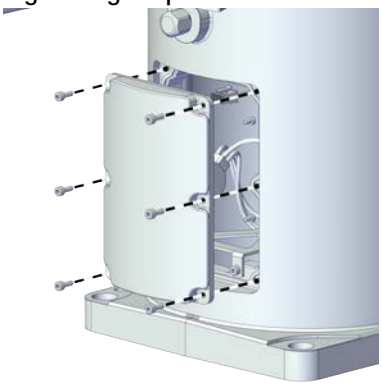
Refitting the SMB cover

	Action	Note
1	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945

Continues on next page

5.7.1 Replacing the axis-1 motor sub-assembly

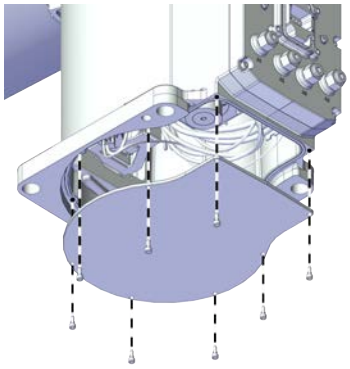
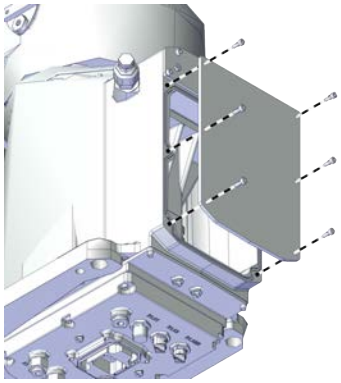
Continued

	Action	Note
2	Refit the SMB cover assembly.	For robots with protection class IP30 Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.6 Nm  xx2300000489
3	Secure the SMB cover to the base with the screws.	

Refitting the base plate/ rear plate

	Action	Note
1	Apply grease to the internal harness, cover all moving area of the harness.	

Continues on next page

	Action	Note
2	For rear outlet cable version, refit the base plate to the base. For underneath outlet cable version, refit the rear plate to the base.	Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm ±10%
3	Secure the base plate/ rear plate to the base with the screws.	For rear outlet cable version: For robots with protection class IP30  xx2300000500 For underneath outlet cable version: For robots with protection class IP30  xx2300000608
4	Refit the robot back to the ground.	
5	Secure with the screws.	Screws: Hex socket head cap screw M12x35 12.9 Gleitmo 603+Geomet 500 (4 pcs) Steel Washers: 24 mm x 13 mm x 2.5 mm (4 pcs) Tightening torque: 56 Nm ±10%

Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.

Continues on next page

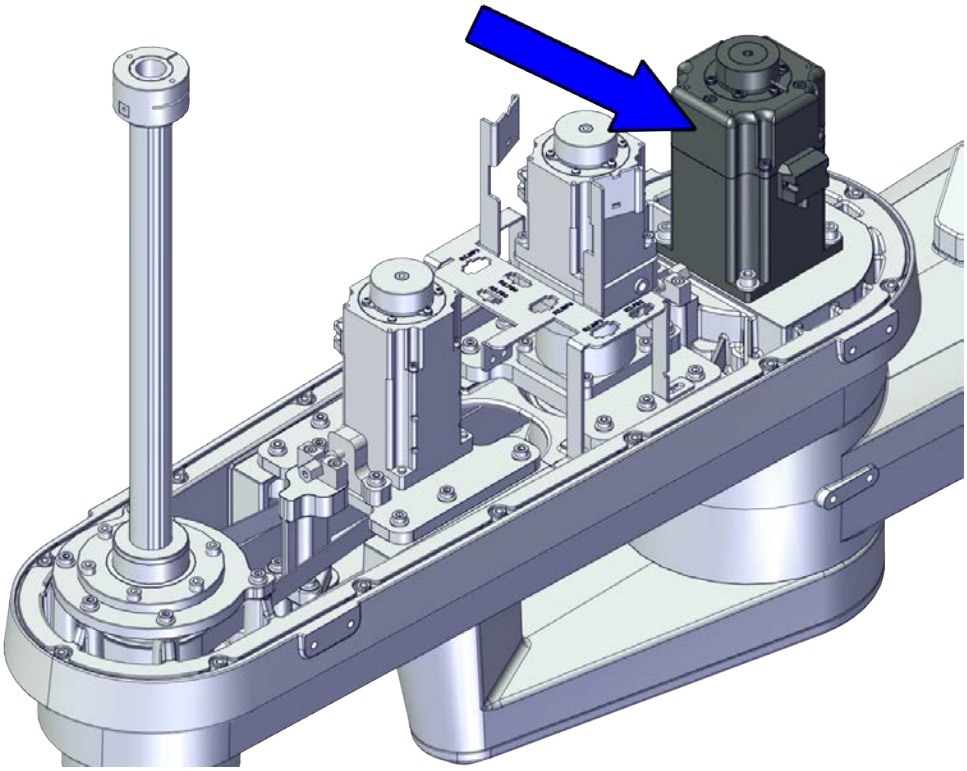
5.7.1 Replacing the axis-1 motor sub-assembly
Continued

	Action	Note
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 55*.	

5.7.2 Replacing the axis-2 motor sub-assembly

Location of the axis-2 motor sub-assembly

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



xx2300000481

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

Spare part	Article number	Note
Axis-2 motor	3HAC087311-001	
Resolver cover	3HAC060261-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Continues on next page

5.7.2 Replacing the axis-2 motor sub-assembly
Continued

Equipment	Article number	Note
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

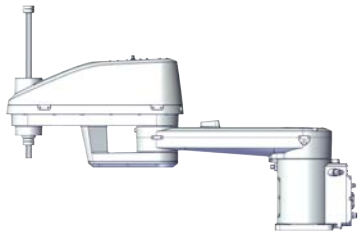
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removing the axis-2 motor sub-assembly

Use these procedures to remove the axis-2 motor sub-assembly.

Preparations before removing the axis-2 motor sub-assembly

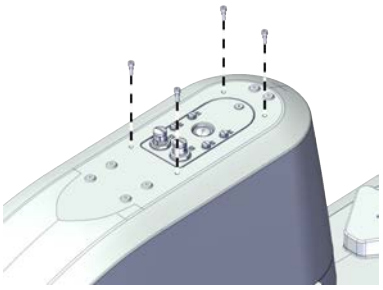
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	Jog all axes to zero position.	 xx2300000486
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the process hub screws

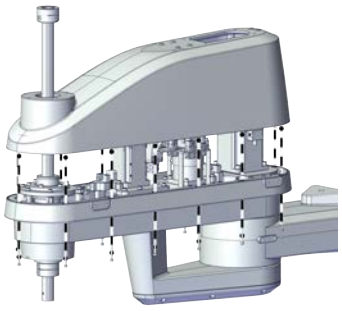
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	

Continues on next page

5.7.2 Replacing the axis-2 motor sub-assembly
Continued

	Action	Note
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

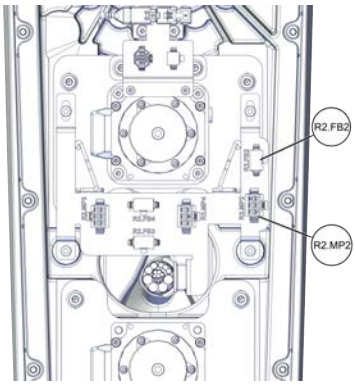
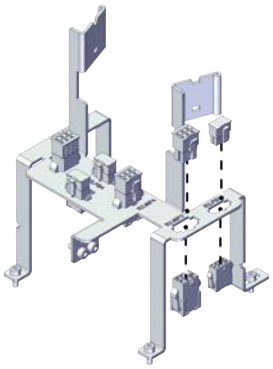
Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

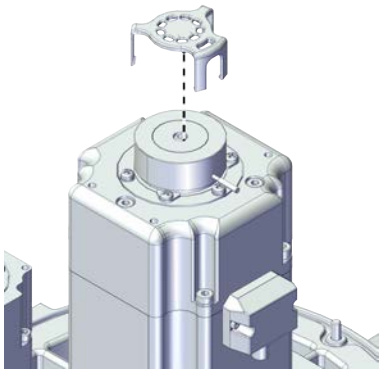
Disconnecting the connectors for axis-2 motor

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

Continues on next page

	Action	Note
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

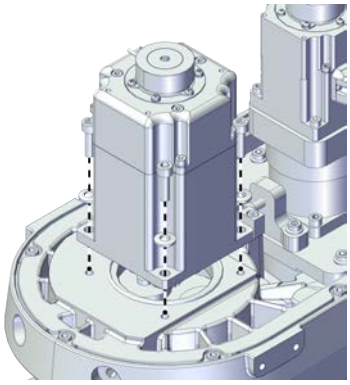
Removing the axis-2 motor protection cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the protection cover on the motor.	 xx2300000550

Continues on next page

5.7.2 Replacing the axis-2 motor sub-assembly
Continued

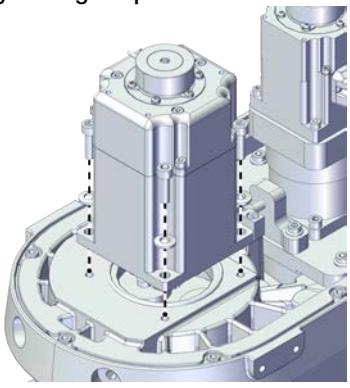
Removing the axis-2 motor sub-assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and washers.	 xx2300000605
3	Remove the motor. **Tip** Move the internal harness out of the way.	

Refitting the axis-2 motor sub-assembly

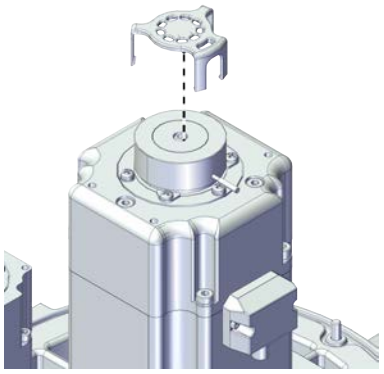
Use these procedures to refit the axis-2 motor sub-assembly.

Refitting the axis-2 motor sub-assembly

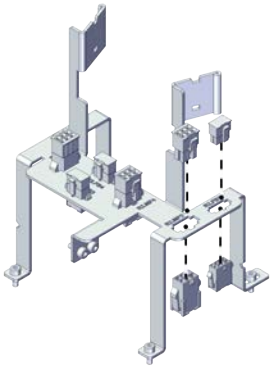
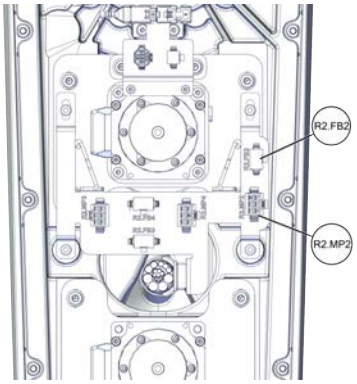
	Action	Note
1	Replace the o-ring if needed.	
2	Refit the motor.	Screws: Hex socket head cap screw M6x20 12.9 Gleitmo 603+Geomet 500 (4 pcs) Washers: Spring washer, conical 11x5.3x1.2 Steel (4 pcs) Tightening torque: 2.3 Nm ±10%  xx2300000605
3	Refit the screws and washers.	

Continues on next page

Refitting the axis-2 motor pulley protection cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the protection cover back to the motor.	 xx2300000550

Reconnecting the connectors for axis-2 motor

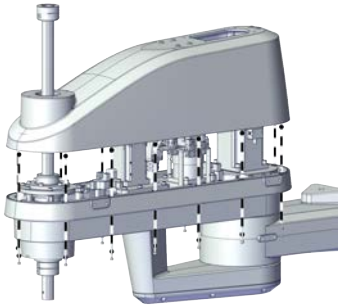
	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490

Continues on next page

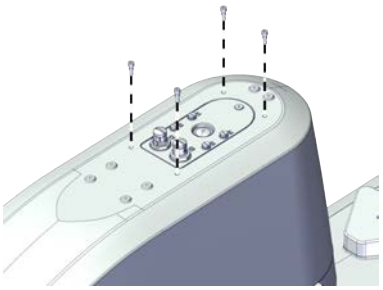
5.7.2 Replacing the axis-2 motor sub-assembly
Continued

	Action	Note
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487

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	Action	Note
4	Remove the screw.	

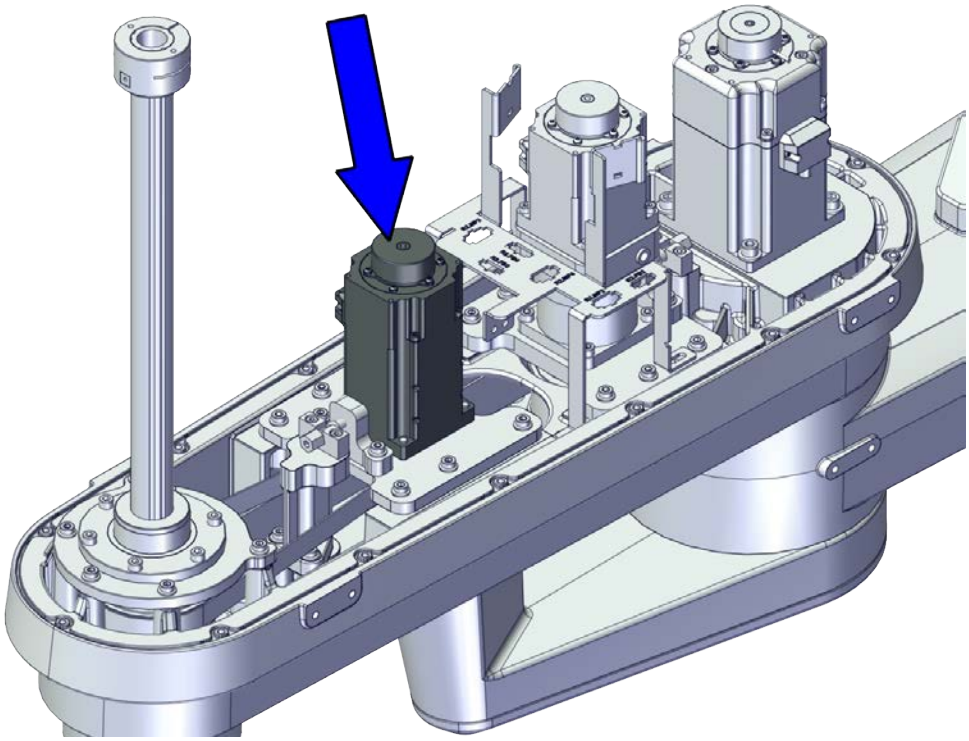
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
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 55*.	

5.7.3 Replacing the axis-3 motor sub-assembly

Location of the axis-3 motor sub-assembly

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



xx2300000482

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

Spare part	Article number	Note
Axis-3 motor with pulley A3	3HAC087312-001	
Timing belt, A3	3HAC081705-001	
Hex socket head cap flange	3HAB3412-520	Used for axis-3/axis-4 motor flange and adjusting block/screw nut adaptor.

Continues on next page

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

5.7.3 Replacing the axis-3 motor sub-assembly
Continued

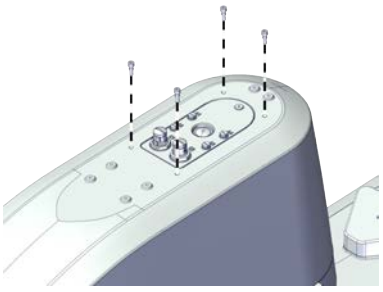
Removing the axis-3 motor sub-assembly

Use these procedures to remove the axis-3 motor sub-assembly.

Preparations before removing the axis-3 motor sub-assembly

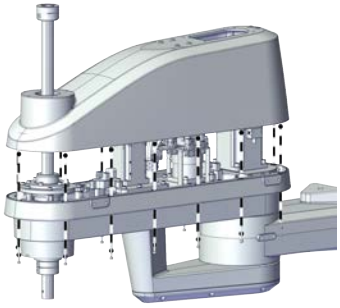
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the process hub screws

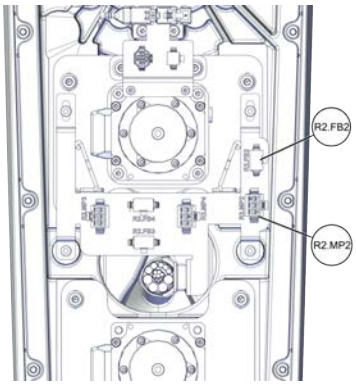
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

Continues on next page

Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

Disconnecting the connectors for axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490

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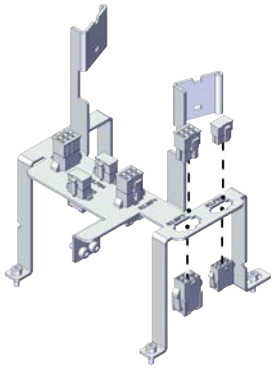
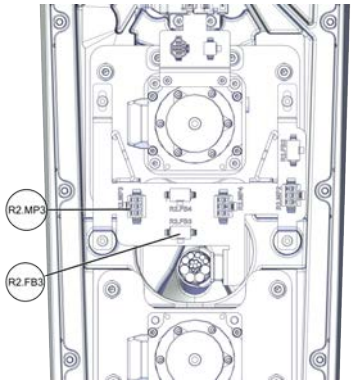
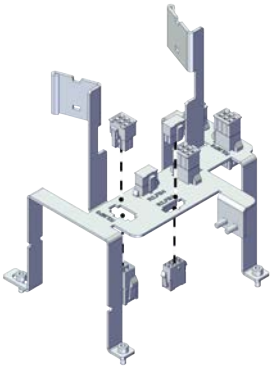
5.7.3 Replacing the axis-3 motor sub-assembly

Continued

	Action	Note
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

Disconnecting the connectors for axis-3 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP3 • R2.FB3	 xx2300000491
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494

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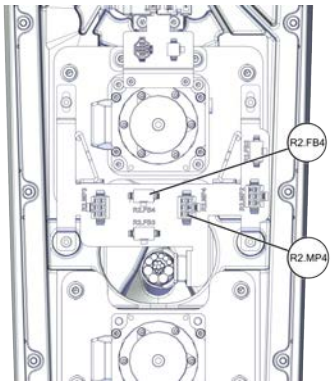
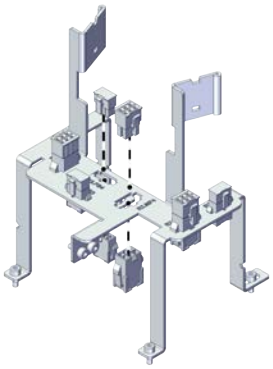
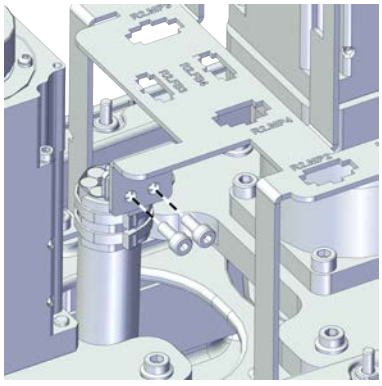
Disconnecting the connectors for axis-4 motor

	Action	Note
1	Disconnect the axis-4 motor connectors. • R2.MP4 • R2.FB4	 xx2300000492
2	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

Removing the outer arm cable ferrule and bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000496

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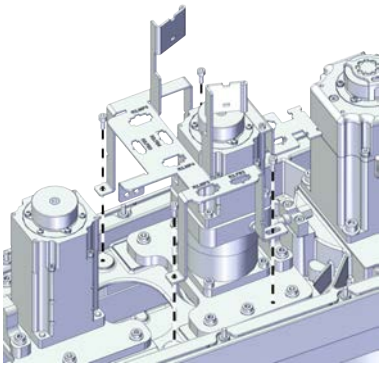
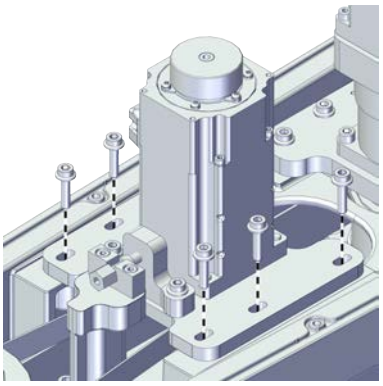
5.7.3 Replacing the axis-3 motor sub-assembly

Continued

	Action	Note
3	Remove the screws on the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000497

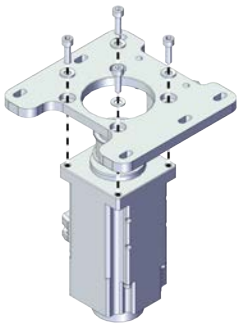
Removing the axis-3 motor sub-assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	
3	Remove the screws.	 xx2300000594
4	Remove the axis-3 motor sub-assembly.	

Separating the flange from axis-3 motor sub-assembly

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

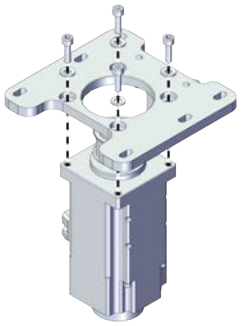
Continues on next page

	Action	Note
2	Remove the screws and washers.	 xx2300000607
3	Remove the motor.	

Refitting the axis-3 motor sub-assembly

Use these procedures to refit the axis-3 motor sub-assembly.

Refitting the flange to the axis-3 motor sub-assembly

	Action	Note
1	Install the flange to the motor and secure with screws.	Screws: Hex socket head cap screw M5x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Washers: Plain washer 11x5.3x1.2 Steel (4 pcs) Tightening torque: 2.3 Nm ±10% 3HAB3409-212  xx2300000607

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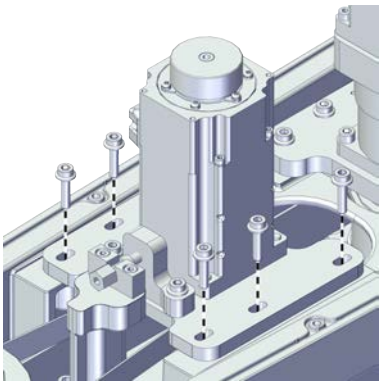
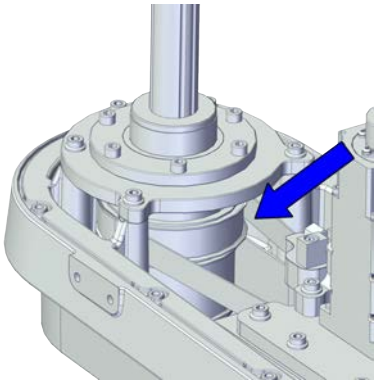
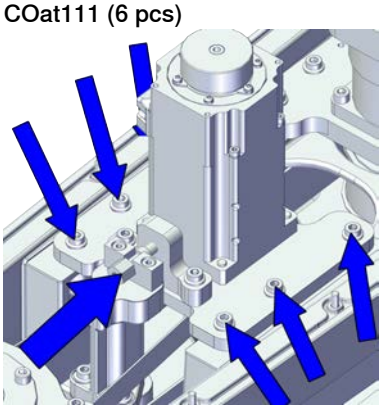
5.7.3 Replacing the axis-3 motor sub-assembly
Continued

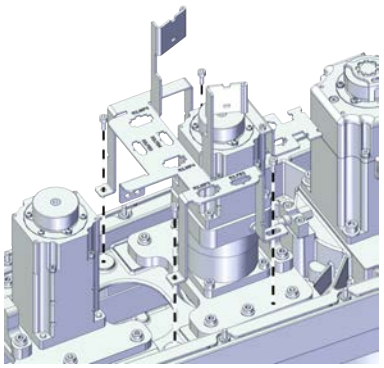
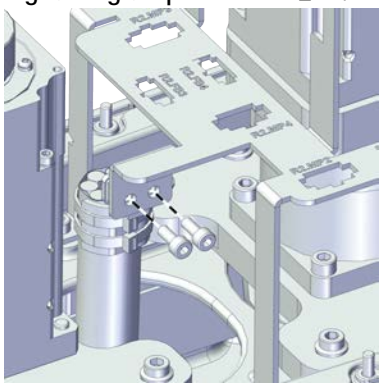
Refitting the axis-3 motor sub-assembly

	Action	Note
	Refit the motor with flange to the outer arm. **Tip** Move the internal harness out of the way.	 xx2300000594
1	Refit the timing belt to the pulley on the ball screw and the motor. Ensure that the belt runs correctly in the grooves.	Timing belt, A3: 3HAC081705-001  xx2300000589
2	Refit the screws and washers without fully tightened.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (6 pcs)  xx2300000557
3	Use a sonic tension meter to measure the timing belt tension.	Used belt: 139-149 Hz New belt:109-119 Hz
4	If the timing belt tension does not meet the requirement, readjust the motor with the adjusting screw.	

Continues on next page

	Action	Note
5	Tighten the motor flange screws when the timing belt meets the requirement.	Tightening torque: 6 Nm ±10%

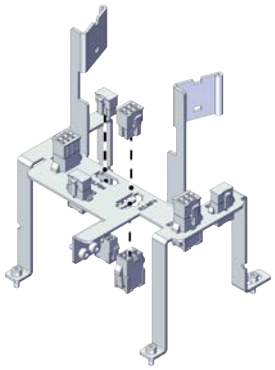
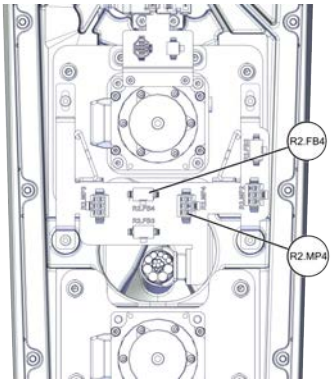
Refitting the cable ferrule and bracket in the outer arm

	Action	Note
1	Lay the internal harness in a natural state without distortion.	
2	Refit the bracket. **Tip** Do not secure it with the screws before the cable ferrule installed well. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000497
3	Secure the cable ferrule to the bracket with the screws. **Tip** The air hoses should face the process hub side. **Tip** The position with wrapped tape is the marked position for the cable ferrule. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000496

Continues on next page

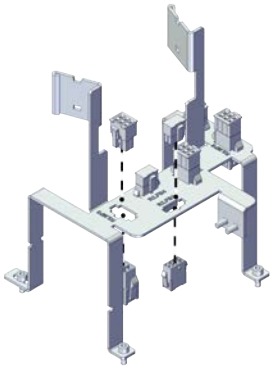
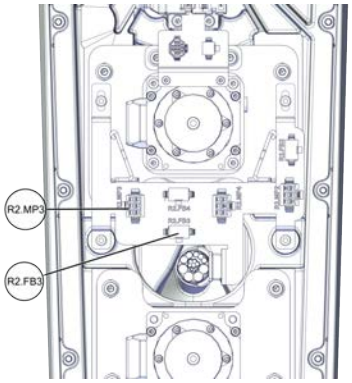
5.7.3 Replacing the axis-3 motor sub-assembly
Continued

Reconnecting the connectors for axis-4 motor

	Action	Note
	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495
1	Reconnect the connectors. • R2.MP4 • R2.FB4 **Tip** See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000492
2	Route the cabling on the axis-4 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Reconnecting the connectors for axis-3 motor

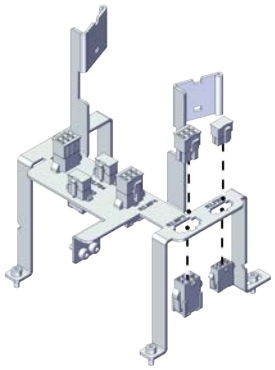
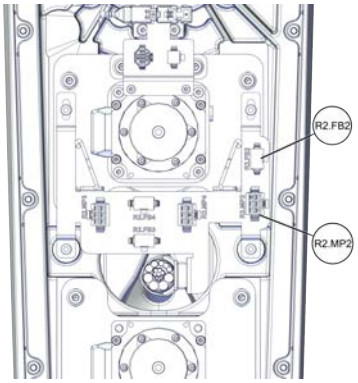
	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494
2	Reconnect the connectors. • R2.MP3 • R2.FB3 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000491
3	Route the cabling on the axis-3 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.7.3 Replacing the axis-3 motor sub-assembly

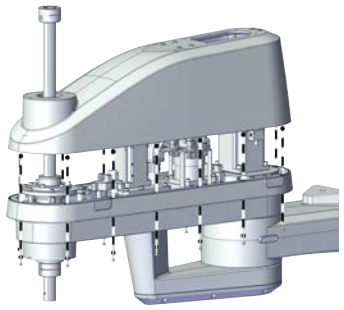
Continued

Reconnecting the connectors for axis-2 motor

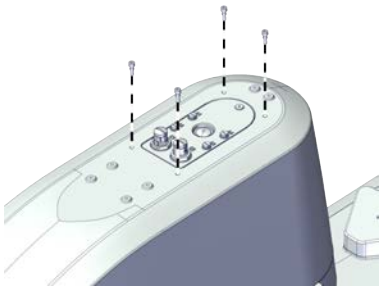
	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487
4	Remove the screw.	

Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.

Continues on next page

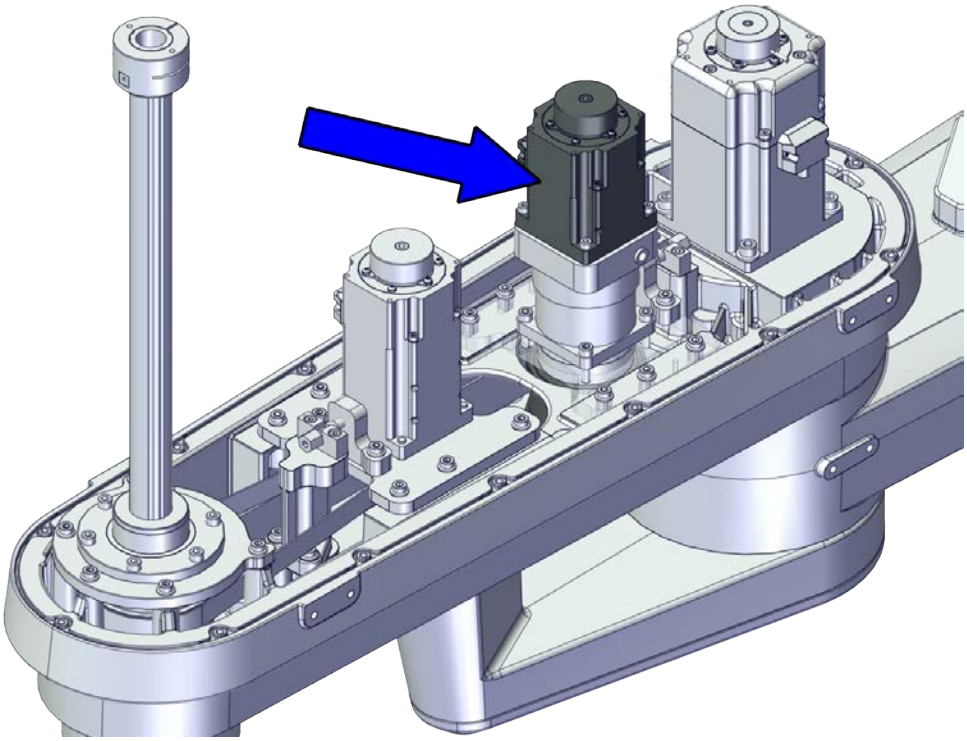
5.7.3 Replacing the axis-3 motor sub-assembly
Continued

	Action	Note
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 55*.	

5.7.4 Replacing the axis-4 motor sub-assembly

Location of the axis-4 motor sub-assembly

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



xx2300000483

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

Spare part	Article number	Note
Axis-4 motor	3HAC060157-001	PMSM, MT45.1
Timing belt, A4	3HAC081706-001	
CPCS bracket	3HAC081795-001	
Hex socket head cap flange	3HAB3412-520	Used for axis-3/axis-4 motor flange and adjusting block/screw nut adaptor.
Hex socket head cap flange	3HAB3412-435	Used for axis-4 pulley.

Continues on next page

5.7.4 Replacing the axis-4 motor sub-assembly
Continued

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

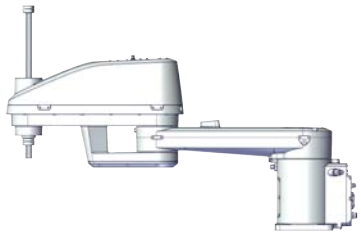
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removing the axis-4 motor sub-assembly

Use these procedures to remove the axis-4 motor sub-assembly.

Preparations before removing the axis-4 motor sub-assembly

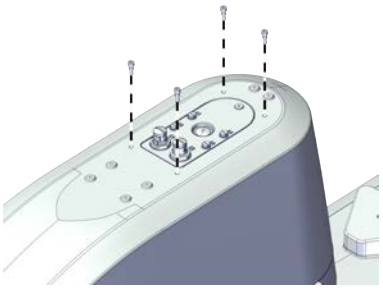
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	Jog all axes to zero position.	 xx2300000486
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the process hub screws

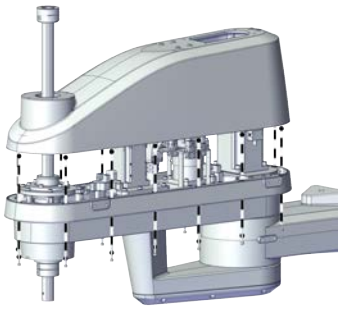
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	

Continues on next page

5.7.4 Replacing the axis-4 motor sub-assembly
Continued

	Action	Note
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

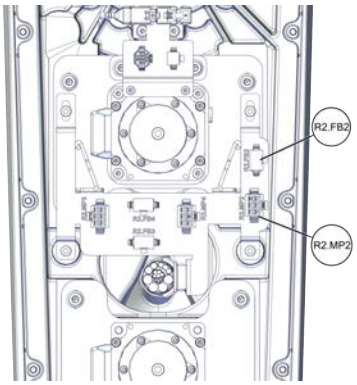
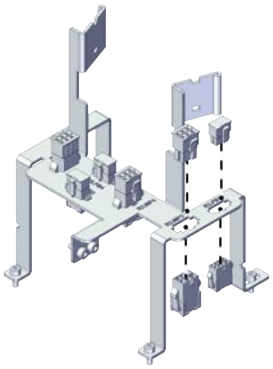
Removing the cover of the outer arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

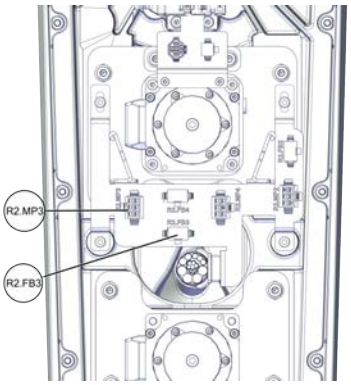
Disconnecting the connectors for axis-2 motor

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

Continues on next page

	Action	Note
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

Disconnecting the connectors for axis-3 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP3 • R2.FB3	 xx2300000491

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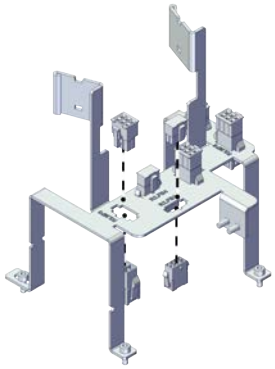
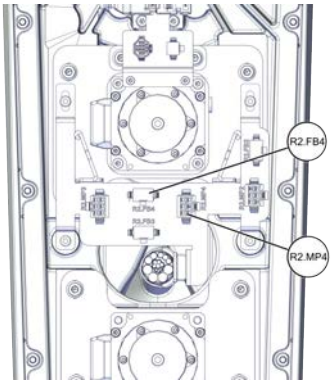
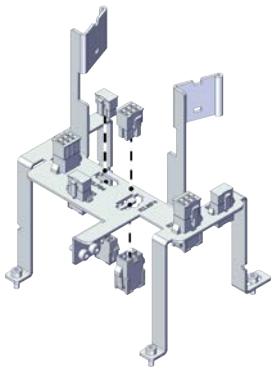
5.7.4 Replacing the axis-4 motor sub-assembly

Continued

	Action	Note
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494

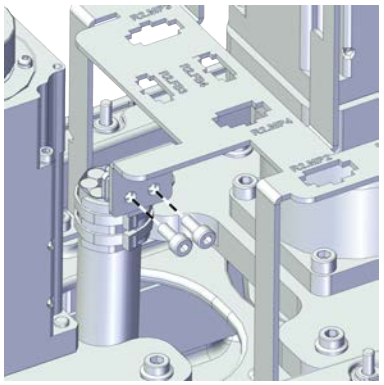
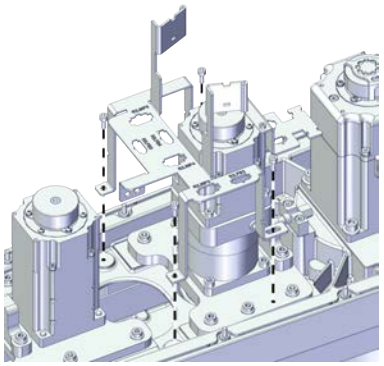
Disconnecting the connectors for axis-4 motor

	Action	Note
1	Disconnect the axis-4 motor connectors. • R2.MP4 • R2.FB4	 xx2300000492
2	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

Removing the outer arm cable ferrule and bracket

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

Continues on next page

	Action	Note
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000496
3	Remove the screws on the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000497

Removing the axis-4 motor sub-assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**DANGER** Make sure that the ball screw is supported with something. The sudden drop of the ball screw due the lost of the axis-3 motor may cause danger.	

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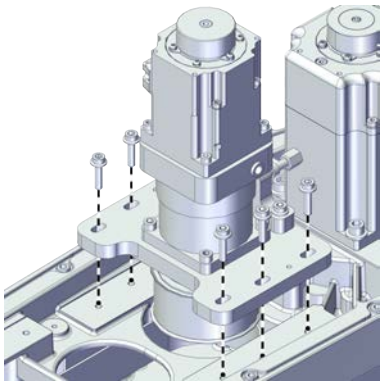
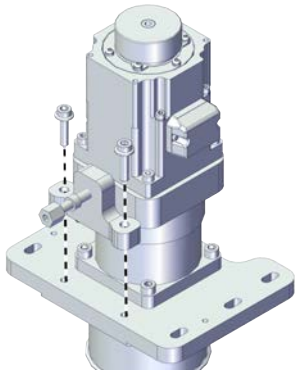
5.7.4 Replacing the axis-4 motor sub-assembly

Continued

	Action	Note
3	Remove the screws.	 xx2300000597
4	Remove the axis-4 motor sub-assembly.	

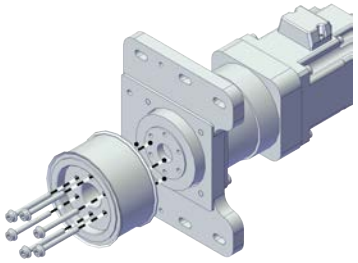
Removing the adjusting block from axis-4 motor sub-assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the bracket on the motor.	
3	Remove the screws.	 xx2300000598
4	Remove the adjusting block.	

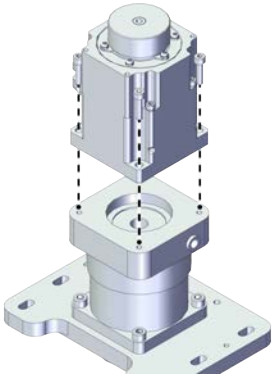
Removing the pulley from axis-4 motor sub-assembly

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

Continues on next page

	Action	Note
2	Remove the screws.	 xx2300000599
3	Remove the pulley.	

Separating the gearhead from axis-4 motor sub-assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	 xx2300000600
3	Separate the gearhead and motor.	

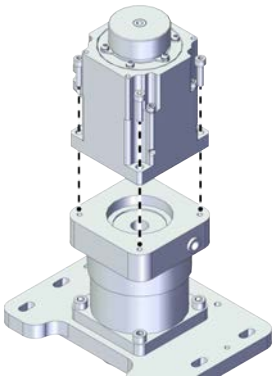
Continues on next page

5.7.4 Replacing the axis-4 motor sub-assembly
Continued

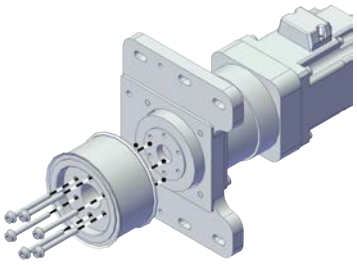
Refitting the axis-4 motor sub-assembly

Use these procedures to refit the axis-4 motor sub-assembly.

Refitting the gearhead to the axis-4 motor sub-assembly

	Action	Note
1	Refit the gearhead to the axis-4 motor sub-assembly and secure with screws.	Screws: Hex socket head cap screw M4x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.8 Nm ±3%  xx2300000600

Refitting the pulley to the axis-4 motor sub-assembly

	Action	Note
1	Refit the pulley to the axis-4 motor sub-assembly and secure with screws.	Screws: Hex socket head cap flange screw 3HAB3412-435 M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (6 pcs) Tightening torque: 4.3 Nm ±10%  xx2300000599

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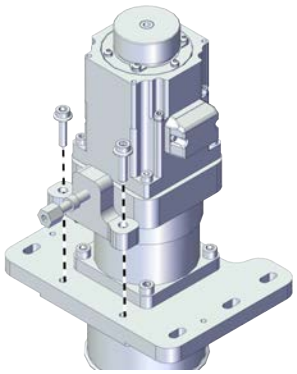
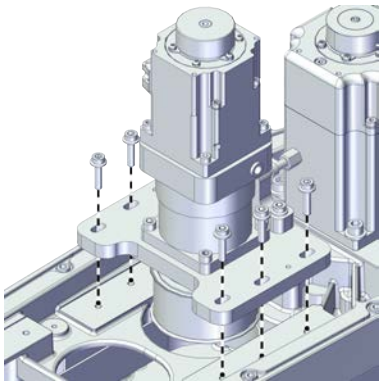
Refitting the adjusting block to the axis-4 motor sub-assembly

	Action	Note
1	Refit the adjusting block to the axis-4 motor sub-assembly and secure with screws.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (2 pcs) Tightening torque: 6 Nm ±10%  xx2300000598
2	Refit the bracket to the motor assembly.	Screws: Hex socket head cap screw M3x5 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 1.2 Nm ±10%

Refitting the axis-4 motor sub-assembly

	Action	Note
1	Refit the motor with flange to the outer arm. **Tip** Move the internal harness out of the way.	 xx2300000597

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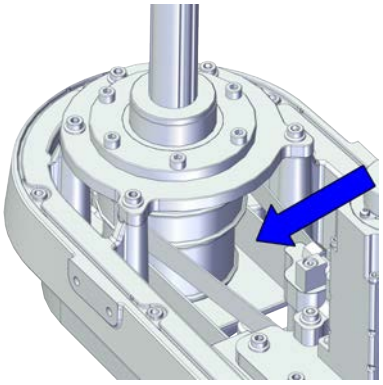
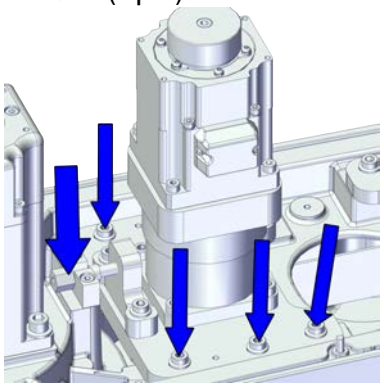
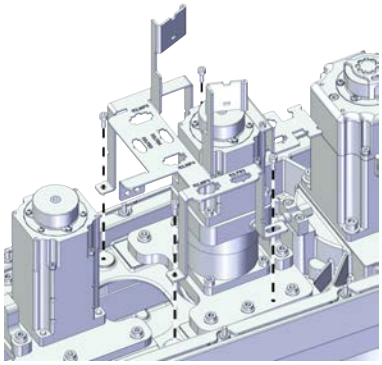
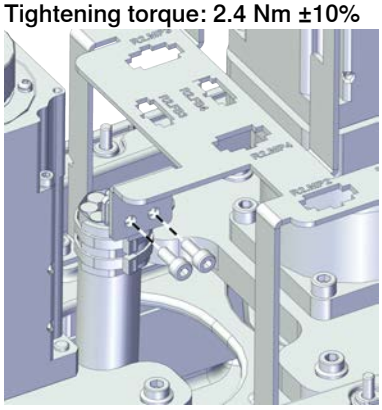
5.7.4 Replacing the axis-4 motor sub-assembly
Continued

	Action	Note
2	Refit the timing belt to the pulley on the ball screw and the motor. Ensure that the belt runs correctly in the grooves.	Timing belt, A4: 3HAC081706-001  xx2300000588
3	Refit the screws and washers without fully tightened.	Screws: Hex socket head cap flange screw 3HAB3412-520 M5x16 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (6 pcs)  xx2300000558
4	Use a sonic tension meter to measure the timing belt tension.	Used belt: 312-333 Hz New belt:88.4-92.7 Hz
5	If the timing belt tension does not meet the requirement, readjust the motor with the adjusting screw.	
6	Tighten the motor screws when the timing belt meets the requirement.	Tightening torque: 6 Nm ±10%

Refitting the cable ferrule and bracket in the outer arm

	Action	Note
1	Lay the internal harness in a natural state without distortion.	

Continues on next page

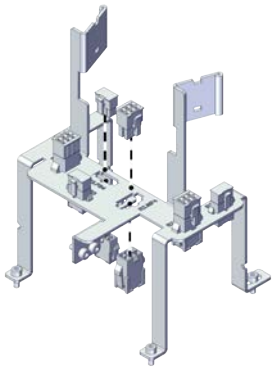
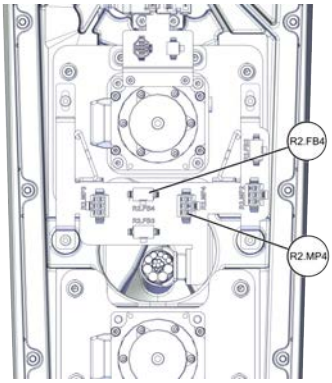
	Action	Note
2	Refit the bracket. **Tip** Do not secure it with the screws before the cable ferrule installed well. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000497
3	Secure the cable ferrule to the bracket with the screws. **Tip** The air hoses should face the process hub side. **Tip** The position with wrapped tape is the marked position for the cable ferrule. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000496

Continues on next page

5.7.4 Replacing the axis-4 motor sub-assembly

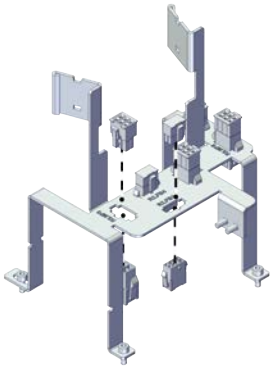
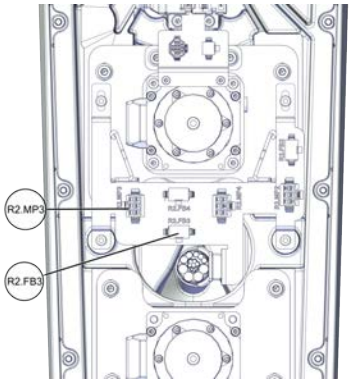
Continued

Reconnecting the connectors for axis-4 motor

	Action	Note
	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495
1	Reconnect the connectors. • R2.MP4 • R2.FB4 **Tip** See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000492
2	Route the cabling on the axis-4 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Reconnecting the connectors for axis-3 motor

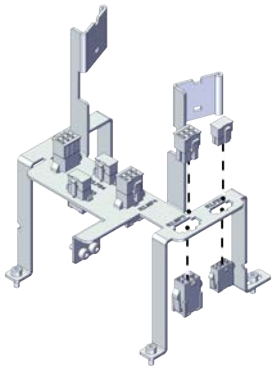
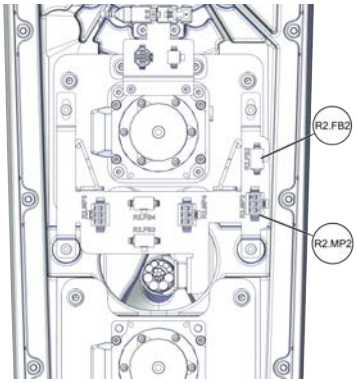
	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494
2	Reconnect the connectors. • R2.MP3 • R2.FB3 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000491
3	Route the cabling on the axis-3 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

5.7.4 Replacing the axis-4 motor sub-assembly

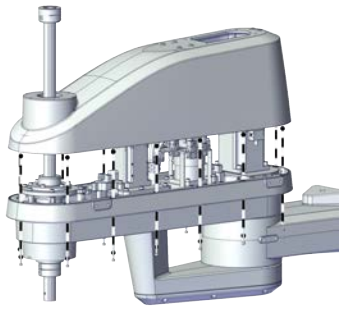
Continued

Reconnecting the connectors for axis-2 motor

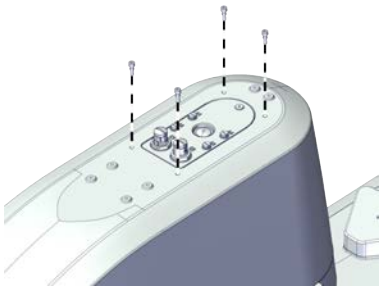
	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487
4	Remove the screw.	

Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.

Continues on next page

5.7.4 Replacing the axis-4 motor sub-assembly
Continued

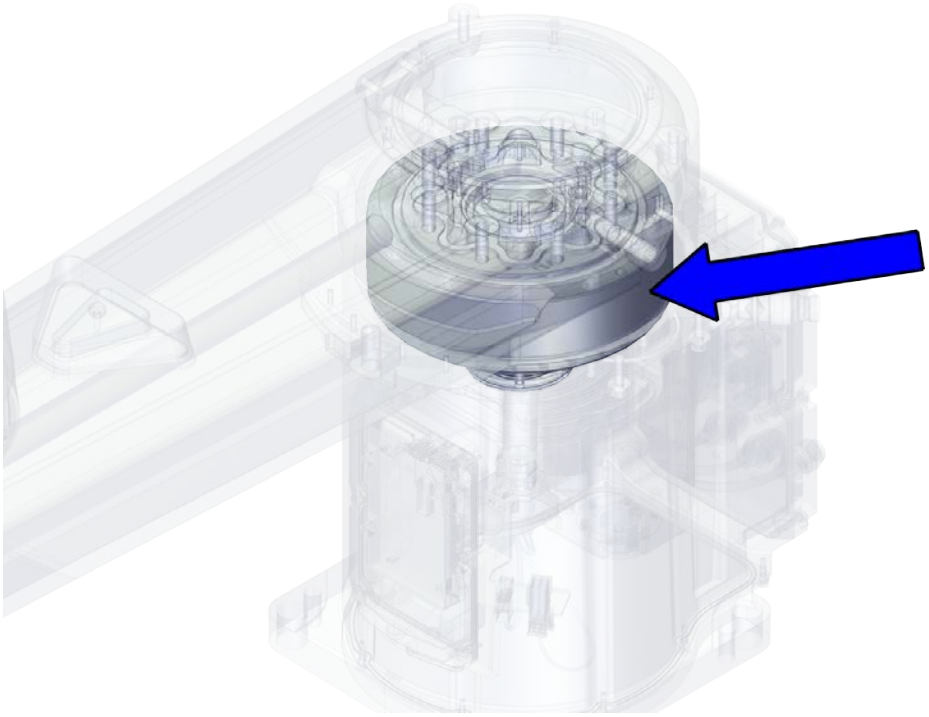
	Action	Note
2	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 55*.	

5.8 Gearboxes

5.8.1 Replacing the axis-1 gear unit sub-assembly

Location of the axis-1 gear unit sub-assembly

The axis-1 gear unit sub-assembly is located as shown in the figure.



xx2300000484

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

Spare part	Article number	Note
Axis-1 gear unit sub-assembly	3HAC081648-001	Without tube&bolt; flange screw. Gearbox NTS RV-27C-36.57

Continues on next page

5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Belt tension adjustment tool set, axis 1&2	-	Included in the special toolkit 3HAC073070-001. Used to adjust the tension of axis-1&2 timing belts. Special tool for L2
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

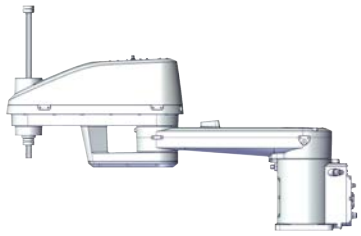
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removing the axis-1 gear unit sub-assembly

Use these procedures to remove the axis-1 gear unit sub-assembly.

Preparations before removing the axis-1 gear unit sub-assembly

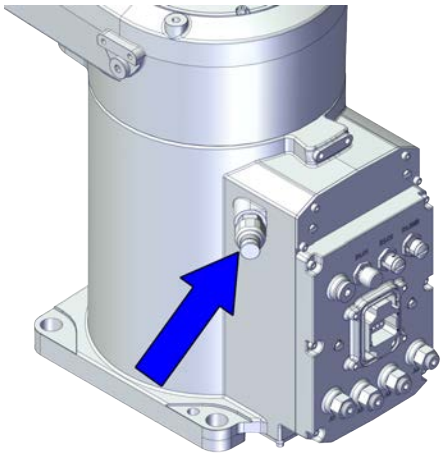
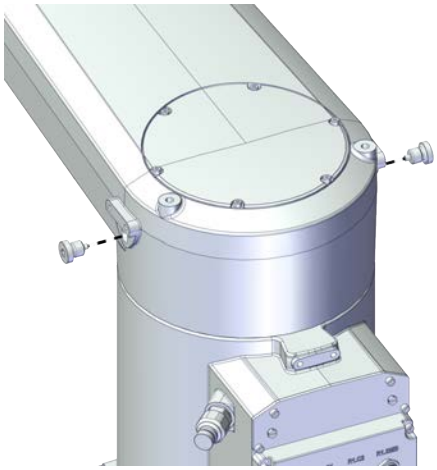
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	Jog all axes to zero position.	 xx2300000486
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Draining oil of axis-1 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	

Continues on next page

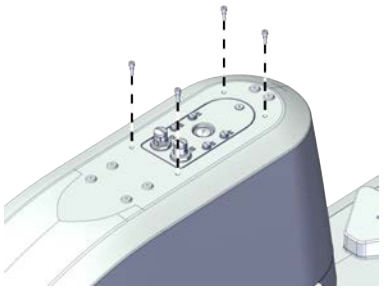
5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

	Action	Note
2	**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.	
3	Lay down the robot to let the quick coupling facing the ground if needed.	
4	Place the oil collecting vessel underneath the quick coupling.	 xx2300000546
5	Remove the oil plugs and keep them opened to speed up the drainage.	 xx2300000547
6	Plug a G3/8 quick coupling connector with pipe to the quick coupling on base.	
7	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 605* for more information.	

Continues on next page

	Action	Note
8	Drain the gearbox oil.	**Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
9	Remove the quick coupling connector and clean the pipe after the oil is drained. **Note** There will be some oil left in the gearbox after draining.	
10	Refit oil plugs.	Tightening torque: 10 Nm

Removing the process hub screws

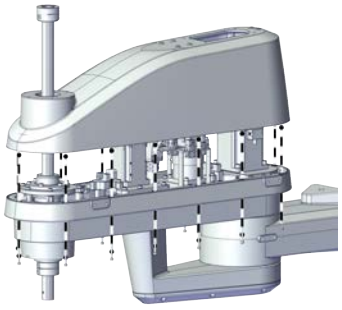
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

Removing the cover of the outer arm

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

Continues on next page

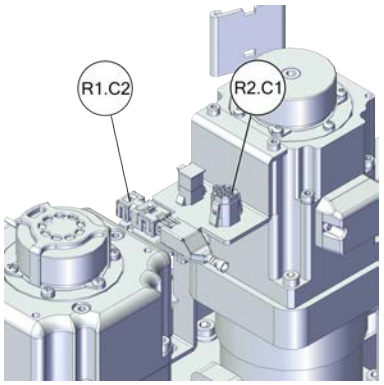
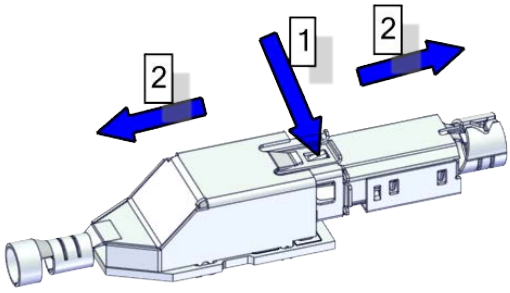
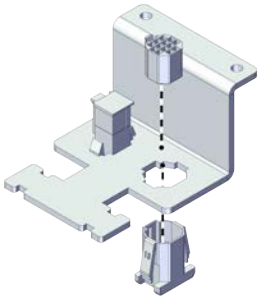
5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

	Action	Note
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

Disconnecting the air hoses, C1 cabling and C2 cabling (if equipped)

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the air hoses from the L-shaped connectors.	

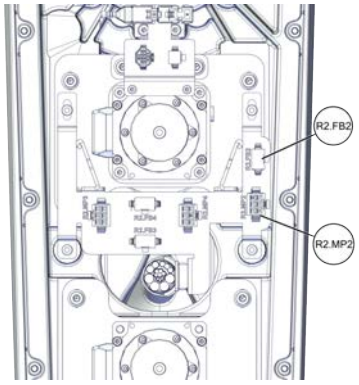
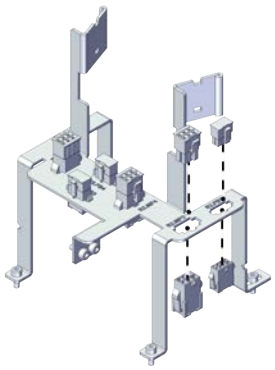
Continues on next page

	Action	Note
3	**For robots with C1 cabling** Disconnect the connector. • R2.C1	 xx2300000542
4	**For robots with C2 cabling** Disconnect the connector. • R1.C2 **Tip** Cut the cable straps for the R1.C2 at the same time. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the R1.C2 (for C2 cabling).  xx1800002943	
5	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544

Continues on next page

5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

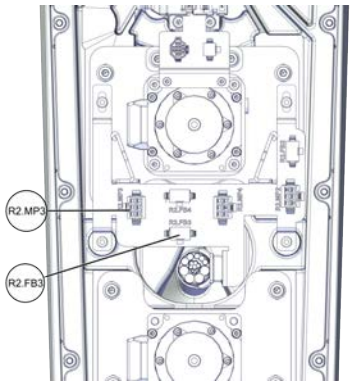
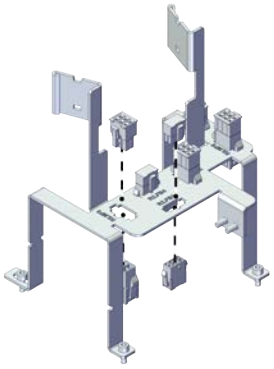
Disconnecting the connectors for axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

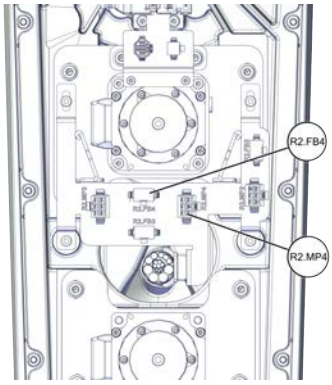
Disconnecting the connectors for axis-3 motor

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

Continues on next page

	Action	Note
2	Disconnect the connectors. • R2.MP3 • R2.FB3	 xx2300000491
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494

Disconnecting the connectors for axis-4 motor

	Action	Note
1	Disconnect the axis-4 motor connectors. • R2.MP4 • R2.FB4	 xx2300000492

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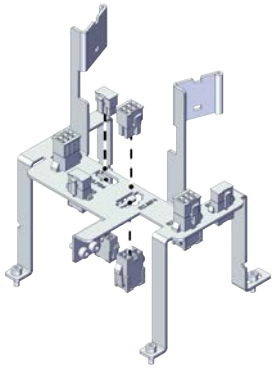
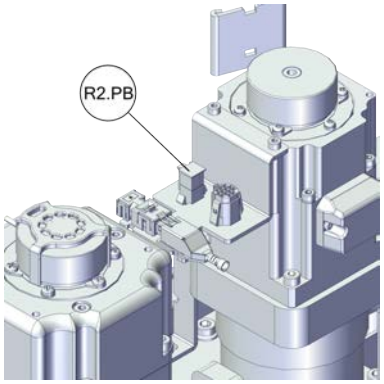
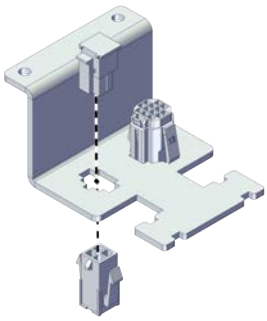
5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

	Action	Note
2	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

Disconnecting the connector for PB

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connector. • R2.PB	 xx2300000543
3	Snap loose and remove the female head of the connector from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545

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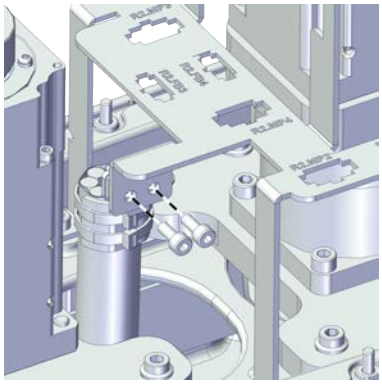
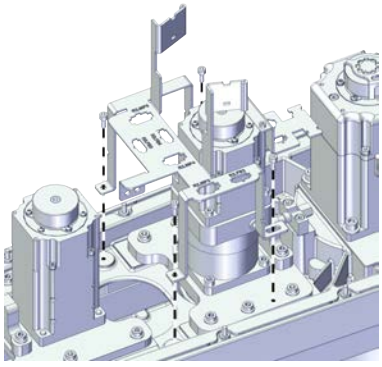
Removing the process hub

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Take out the process hub. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	

Removing the outer arm cable ferrule and bracket

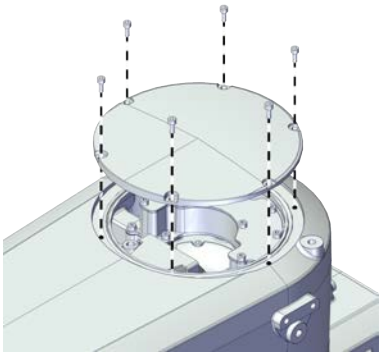
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000496
3	Remove the screws on the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000497

Continues on next page

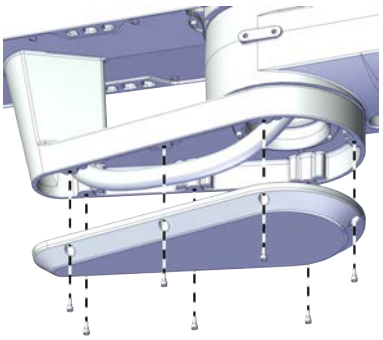
5.8.1 Replacing the axis-1 gear unit sub-assembly

Continued

Removing the axis-1 cover

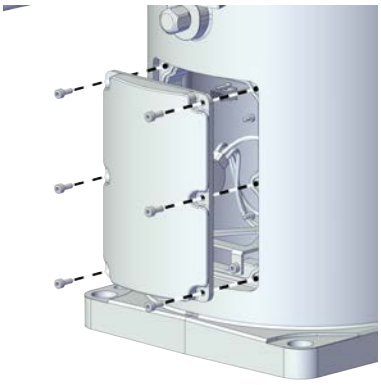
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000498
3	Remove the cover.	

Removing the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000499
3	Remove the cover.	

Continues on next page

Removing the SMB cover

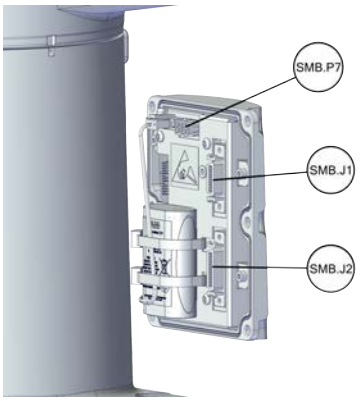
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 46*.	
3	Remove the screws on the SMB cover to the base.	For robots with protection class IP30
4	Pull the SMB cover with the SMB unit assembly out together.	 xx2300000489

Disconnecting the SMB cabling

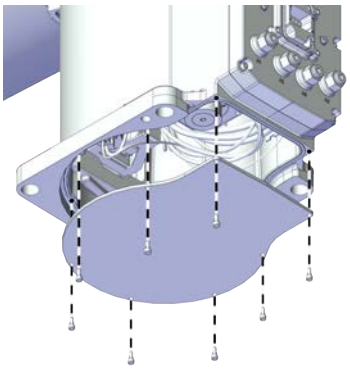
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 46*.	
3	Cut the strips.	

Continues on next page

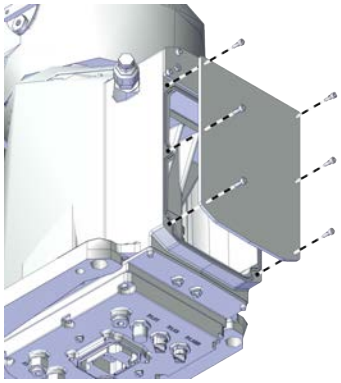
5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

	Action	Note
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945

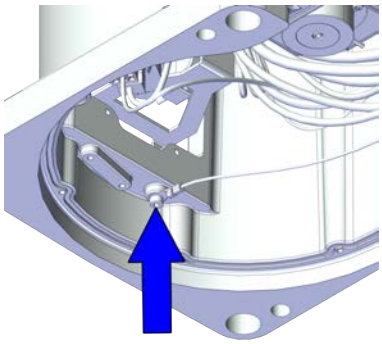
Removing the base plate/ rear plate

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the base to the ground.	
3	Lay down the robot.	
4	For robot with rear outlet cable version, remove the screws on the base plate.	For rear outlet cable version: For robots with protection class IP30  xx2300000500
5	Remove the base plate.	

Continues on next page

	Action	Note
6	For robot with underneath outlet cable version, remove the screws on the rear plate.	For underneath outlet cable version:
7	Remove the rear plate.	For robots with protection class IP30  xx2300000608

Disconnecting the grounding cable connector

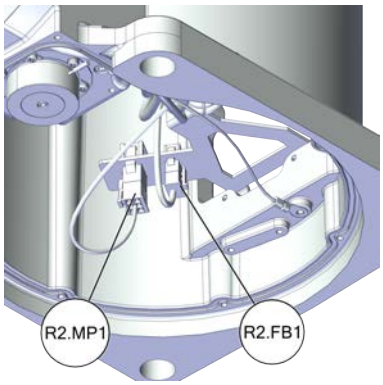
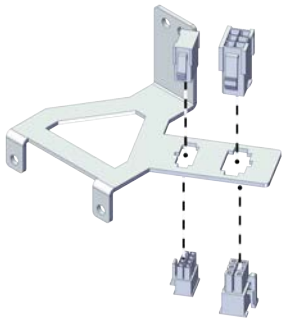
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the grounding cable from the base by unscrew the screw.	 xx2300000502

Disconnecting the connectors for axis-1 motor

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

Continues on next page

5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

	Action	Note
2	Disconnect the connectors. • R2.MP1 • R2.FB1	 xx2300000504
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000505

Removing the base bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000503
3	Remove the screws on the base bracket to the base from the SMB side.	

Continues on next page

Removing the bracket of the cable arm

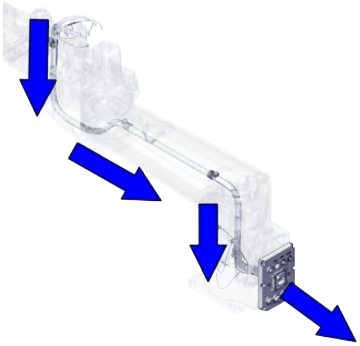
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the bracket from the cable arm to release the cable.	 xx2300000506

Removing the main harness from the cable arm position

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

Continues on next page

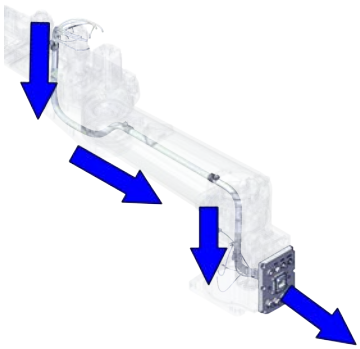
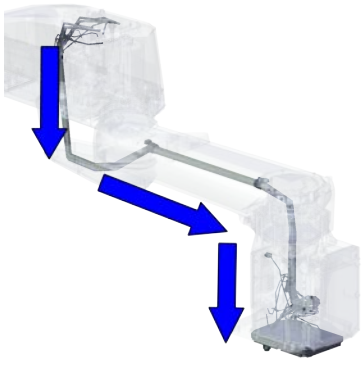
5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

	Action	Note
2	Pull the main harness out of the outer arm from lower of the cable arm. **Tip** Wrap the connectors with the masking tape. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	For rear outlet cable version:  xx2300000507 For underneath outlet cable version:  xx2300000612
3	Pull the main harness out of the cable arm from the inner arm.	

Removing the main harness from the axis -1 gearbox position

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

Continues on next page

	Action	Note
2	Remove the bracket from the inner arm to release the cable.	 xx2300000508
3	Remove the screws on the cable ferrule to the bracket and take the bracket out.	
4	Pull the main harness out of the inner arm from the sleeve of the axis-1 gearbox. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000507 For underneath outlet cable version:  xx2300000612

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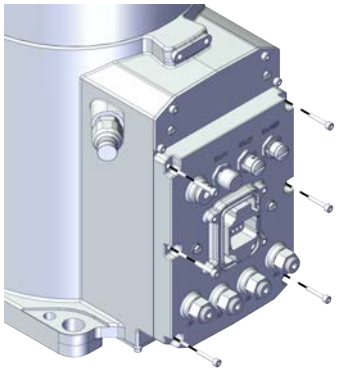
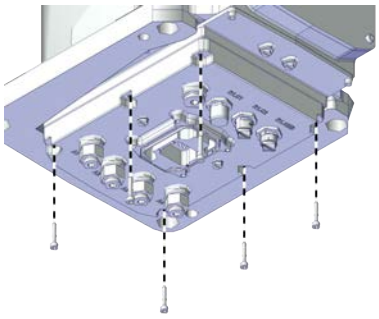
5.8.1 Replacing the axis-1 gear unit sub-assembly

Continued

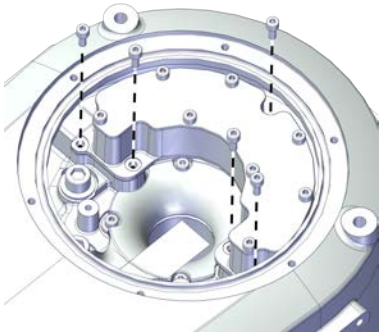
Removing the main harness

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	For robot with rear outlet cable version, remove the screws on the main harness to the base.	For rear outlet cable version: For robots with protection class IP30  xx2300000509
3	Remove the main harness.	
4	For robot with underneath outlet cable version, remove the screws on the main harness assembly.	For underneath outlet cable version: For robots with protection class IP30  xx2300000609
5	Remove the main harness assembly. **Note** Remove the bottom plate from the main harness if needed.	

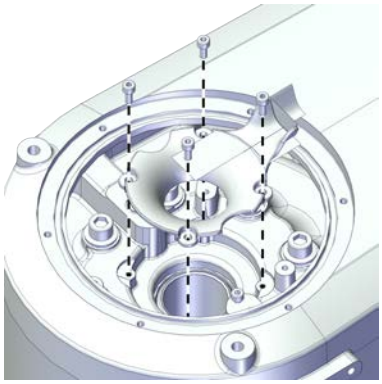
Removing the oil tank

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

Continues on next page

	Action	Note
2	Remove the screws on the oil tank to the inner arm.	 xx2300000511
3	Remove the oil tank.	

Removing the protection tube

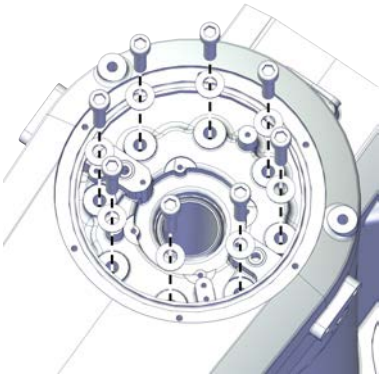
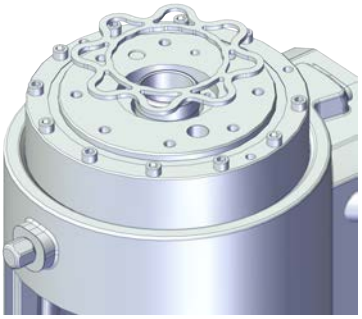
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the protection tube to the inner arm.	 xx2300000513
3	Remove the protection tube.	

Removing the base from inner arm

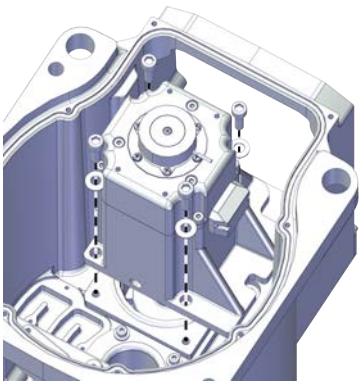
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	

Continues on next page

5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

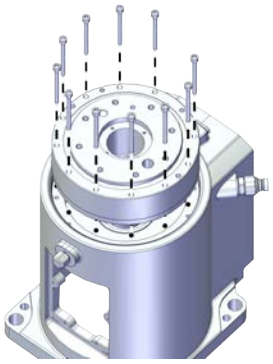
	Action	Note
2	Remove the screws and washers on the inner to the axis-1 gear unit.	 xx2300000514
3	Disconnect the axis-1 gear to the inner arm.	
4	Remove the BassSwing gasket on the axis-1 gear unit.	 xx2300000602

Removing the axis-1 motor sub-assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and washers.	 xx2300000512
3	Remove the motor.	

Continues on next page

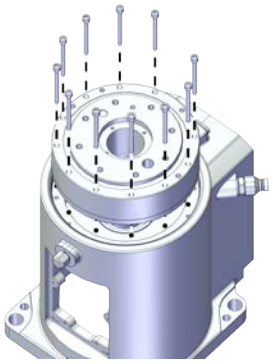
Removing the axis-1 gear unit sub-assembly

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the gear to the base.	For robots with protection class IP30 (option 3350-300)
3	Remove the gear unit. **Tip** Wrap the connectors with the masking tape.	 xx2300000515

Refitting the axis-1 gear unit sub-assembly

Use these procedures to refit the axis-1 gear unit sub-assembly.

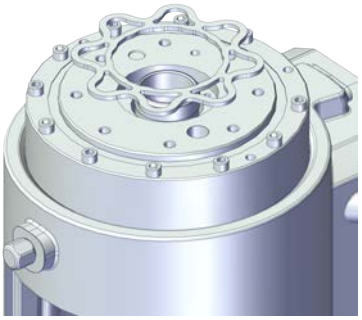
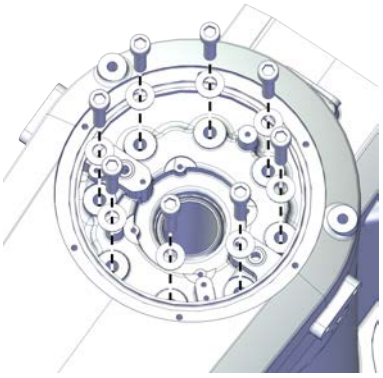
Refitting the base to the axis-1 gear unit sub-assembly

	Action	Note
1	Refit the base to the axis-1 gearbox as the illustration.	Screws: Hex socket head cap screw M6x65 12.9 Gleitmo 603+Geomet 500 (11 pcs) Tightening torque: 10 Nm ±10%
2	Refit the screws.	 xx2300000515

Continues on next page

5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

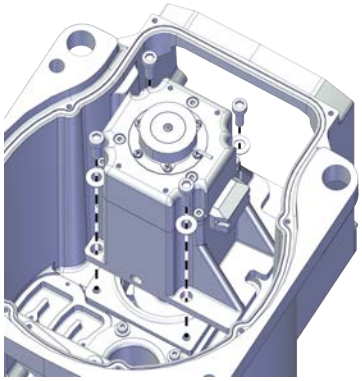
Refitting the base to the inner arm

	Action	Note
1	Refit the BassSwing gasket to the axis-1 gearbox.	 xx2300000602
2	Refit the inner arm to the axis-1 gearbox as the illustration.	Screws: Hex socket head cap screw M8x40 12.9 Gleitmo 603+Geomet 500 (8 pcs) Washers: Spring washer, conical 9ADA334-7 18x4x2 Steel (8 pcs) Tightening torque: 25 Nm ±3%  xx2300000514
3	Refit the screws.	

Refitting the axis-1 motor sub-assembly

	Action	Note
1	Replace the o-ring if needed.	
2	Put the timing belt into the pulley on the gear.	

Continues on next page

	Action	Note
3	Refit the motor and refit the timing belt to the motor. Ensure that the belt runs correctly in the grooves.	Screws: Hex socket head cap screw M6x20 12.9 Gleitmo 603+Geomet 500 (4 pcs) Washers: Spring washer, conical 11x5.3x1.2 Steel (4 pcs) Tightening torque: 10 Nm ±10%  xx2300000512
4	Refit the screws and washers without fully tightened.	

Refitting the protection tube

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the protection tube.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1 Nm  xx2300000513
3	Secure the screws on the protection tube to the inner arm.	

Continues on next page

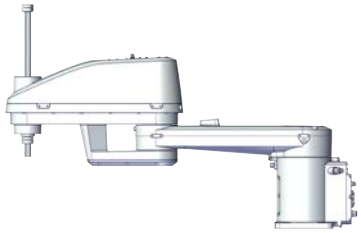
5.8.1 Replacing the axis-1 gear unit sub-assembly

Continued

Refitting the oil tank

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the oil tank.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (5 pcs) Tightening torque: 2.4 Nm ±3%  xx2300000511
3	Secure the screws on the oil tank to the inner arm.	

Inserting the main harness through the axis -1 gearbox position

	Action	Note
1	Make sure that the robot is at zero position.	 xx2300000486

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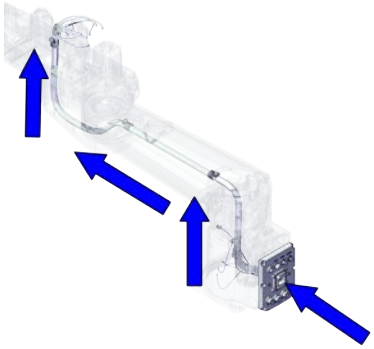
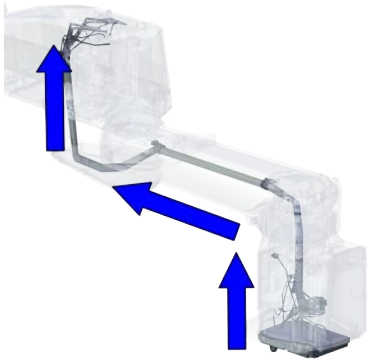
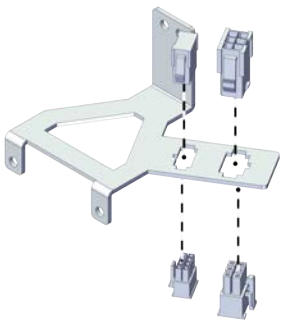
	Action	Note
2	Insert the main harness into the inner arm through the protection tube of the axis-1 gearbox from the base. **Tip** Wrap the connectors with the masking tape. **Tip** The air hoses should face the axis-1 motor. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610

Reconnecting the connectors for axis-1 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000505

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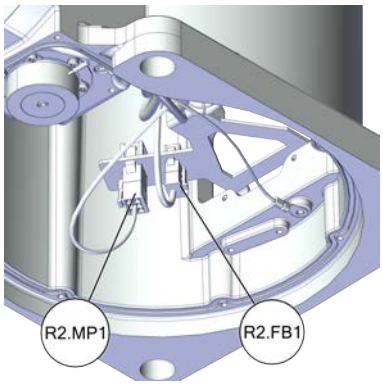
5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

	Action	Note
2	Reconnect the connectors. • R2.MP1 • R2.FB1 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000504
3	Route the cabling behind the axis-1 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the base bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Lay the main harness in a natural state without distortion.	
	Refit the cable ferrule to the bracket. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000503
3	Refit the base bracket to the base and secure with the screws.	

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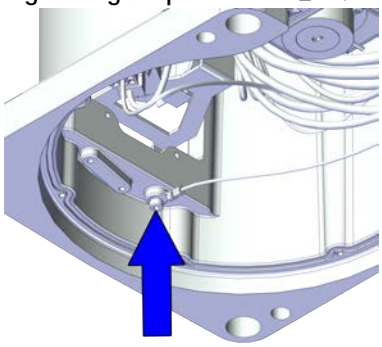
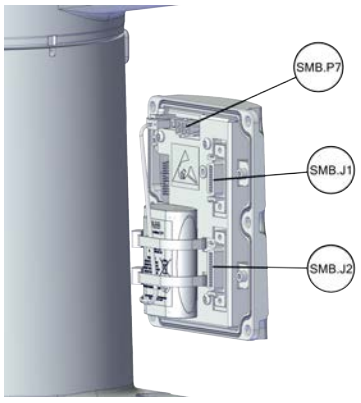
Reconnecting the grounding cable connector

	Action	Note
1	Secure the grounding cable to the bracket with the screw.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (1 pcs) Tightening torque: 1.2 Nm ±10%  xx2300000502
2	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the SMB cover

	Action	Note
1	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx2100000945

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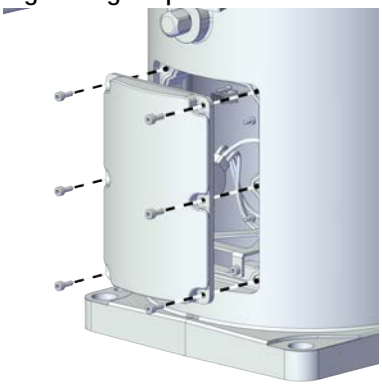
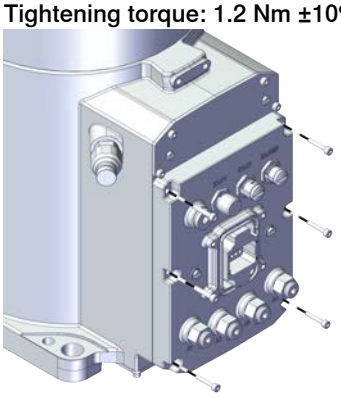
5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

	Action	Note
2	Refit the SMB cover assembly.	For robots with protection class IP30 Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.6 Nm  xx2300000489
3	Secure the SMB cover to the base with the screws.	

Refitting the main harness

	Action	Note
1	For rear outlet cable version, refit the main harness to the base.	For rear outlet cable version: For robots with protection class IP30 Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm ±10%  xx2300000509
2	Secure with the screws.	

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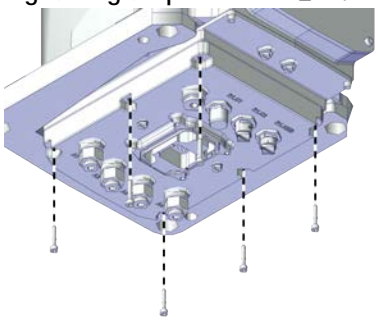
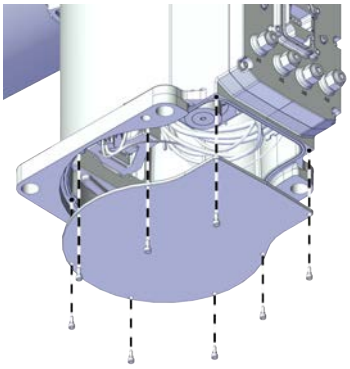
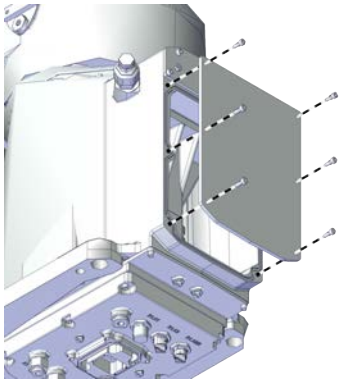
	Action	Note
3	For underneath outlet cable version, refit the main harness assembly to the base. **Note** Refit the bottom plate to the main harness if needed.	For underneath outlet cable version: For robots with protection class IP30 Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.2 Nm ±10%
4	Secure with the screws.	 xx2300000609

Refitting the base plate/ rear plate

	Action	Note
1	Apply grease to the internal harness, cover all moving area of the harness.	

Continues on next page

5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

	Action	Note
2	For rear outlet cable version, refit the base plate to the base. For underneath outlet cable version, refit the rear plate to the base.	Screws: Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm ±10%
3	Secure the base plate/ rear plate to the base with the screws.	For rear outlet cable version: For robots with protection class IP30  xx2300000500 For underneath outlet cable version: For robots with protection class IP30  xx2300000608
4	Refit the robot back to the ground.	
5	Secure with the screws.	Screws: Hex socket head cap screw M12x35 12.9 Gleitmo 603+Geomet 500 (4 pcs) Steel Washers: 24 mm x 13 mm x 2.5 mm (4 pcs) Tightening torque: 56 Nm ±10%

Inserting the main harness through the inner arm position

	Action	Note
1	Secure the cable with the cable ferrule to the two brackets in inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) x 2 Tightening torque: 2.4 Nm ±10%

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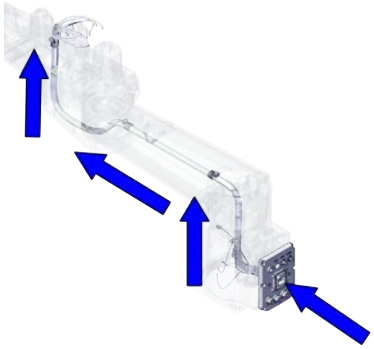
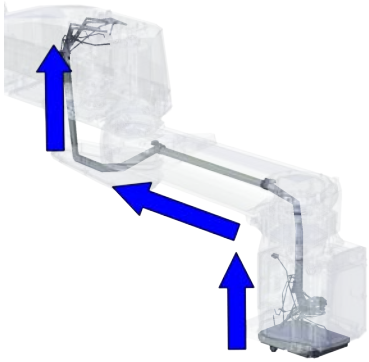
	Action	Note
2	Insert the main harness into the cable arm through the inner arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
3	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000508

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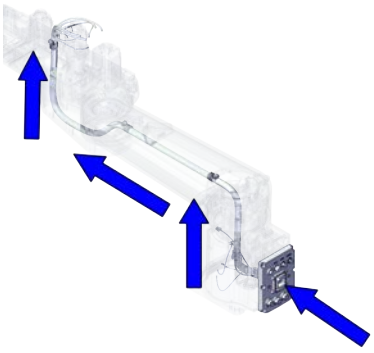
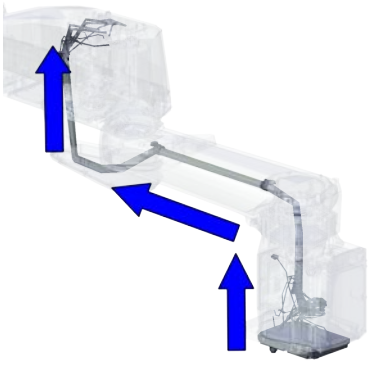
5.8.1 Replacing the axis-1 gear unit sub-assembly

Continued

Inserting the main harness through the cable arm

	Action	Note
1	Insert the main harness into the outer arm through the cable arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
2	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000506

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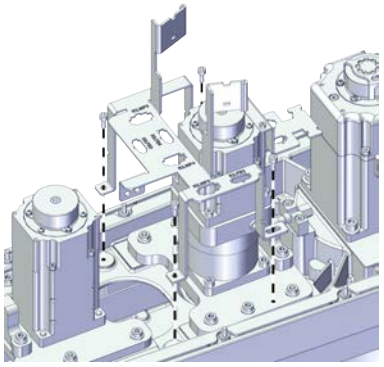
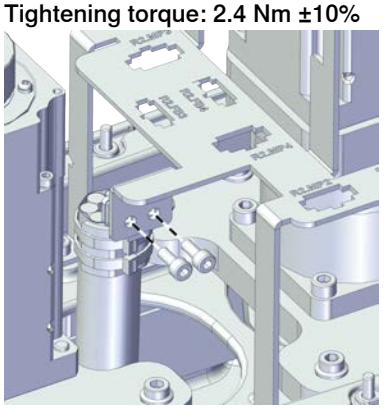
Refitting the cable ferrule and bracket in the outer arm

	Action	Note
1	Lay the internal harness in a natural state without distortion.	
2	Refit the bracket. **Tip** Do not secure it with the screws before the cable ferrule installed well. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000497
3	Secure the cable ferrule to the bracket with the screws. **Tip** The air hoses should face the process hub side. **Tip** The position with wrapped tape is the marked position for the cable ferrule. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000496

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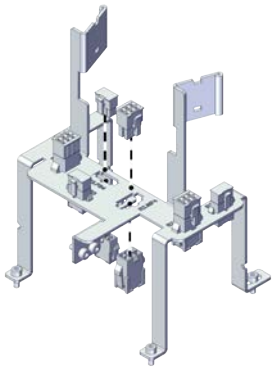
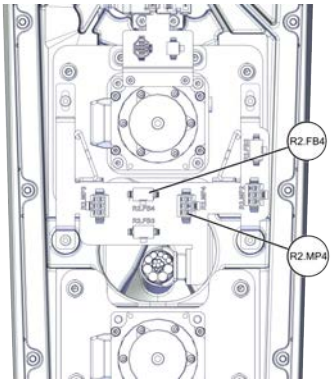
5.8.1 Replacing the axis-1 gear unit sub-assembly

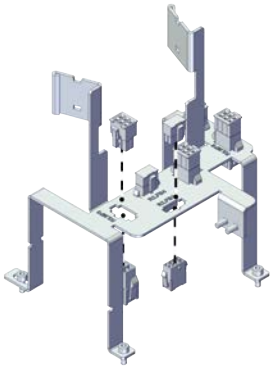
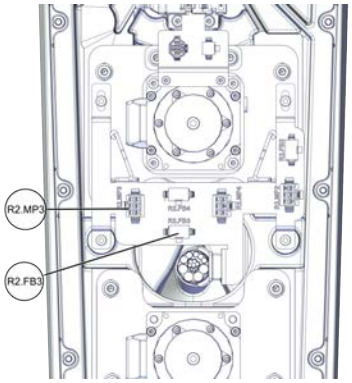
Continued

Reconnecting the connectors for axis-4 motor

	Action	Note
	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495
1	Reconnect the connectors. • R2.MP4 • R2.FB4 **Tip** See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000492
2	Route the cabling on the axis-4 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

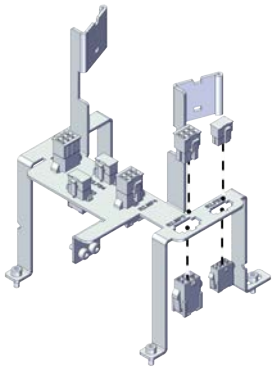
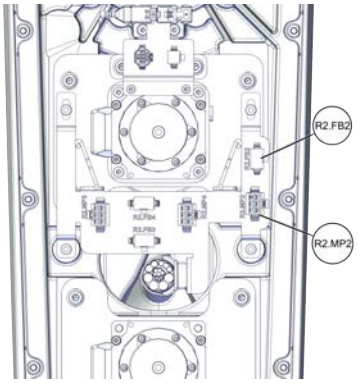
Reconnecting the connectors for axis-3 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494
2	Reconnect the connectors. • R2.MP3 • R2.FB3 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000491
3	Route the cabling on the axis-3 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

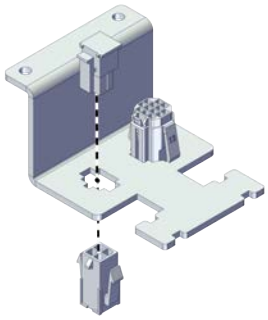
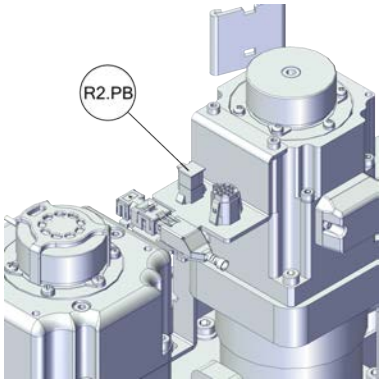
5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

Reconnecting the connectors for axis-2 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Reconnecting the connector for PB

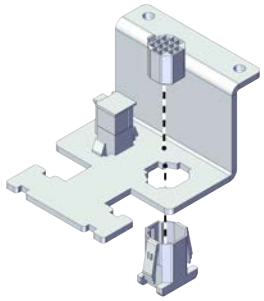
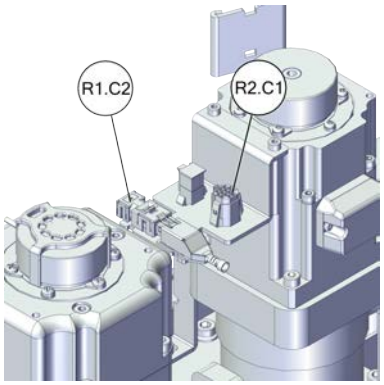
	Action	Note
1	Insert the female head of the PB connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545
2	Reconnect the connector. • R2.PB **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000543
3	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed incorrectly the cables can be damaged.	

Reconnecting the air hoses, CP/CS cabling and Ethernet cabling (if equipped)

	Action	Note
1	Route the air hoses on the process hub behind the bracket. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

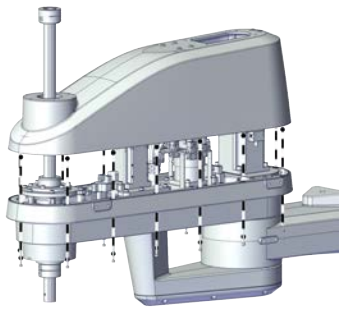
5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

	Action	Note
2	Insert the female head of the C1 cabling connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544
3	**For robots with C1 cabling** Reconnect the connector. • R2.C1 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	 xx2300000542
4	**For robots with C2 cabling** Reconnect the connector. • R1.C2 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	
5	Secure the C2 cabling to the C2 bracket with the cable straps.	
6	Reconnect the air hoses in a cross pattern with the L-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	

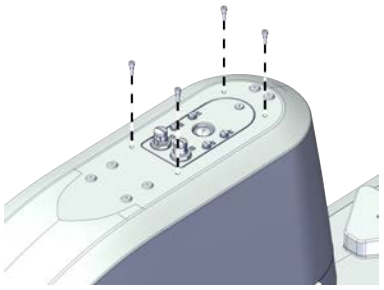
Continues on next page

	Action	Note
7	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

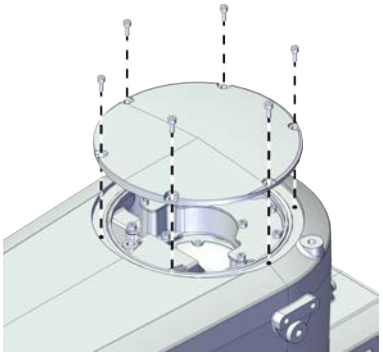
	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487

Continues on next page

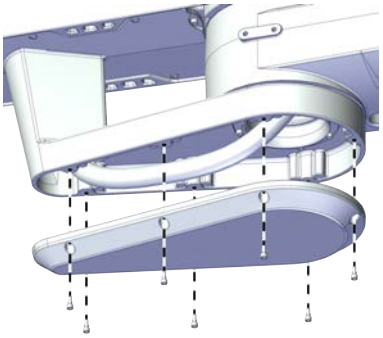
5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

	Action	Note
4	Remove the screw.	

Refitting the axis-1 cover

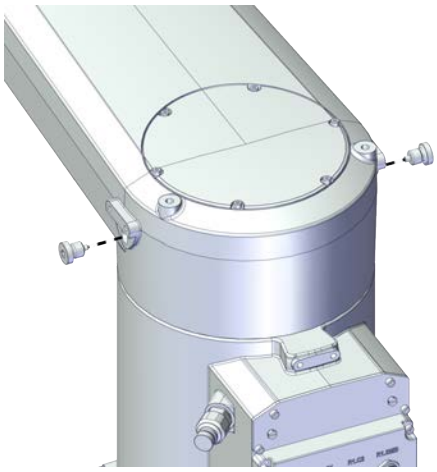
	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.4 Nm ±3% For robots with protection class IP30  xx2300000498
2	Refit the screws.	

Refitting the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the cover.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (7 pcs) Tightening torque: 6 Nm ±3% For robots with protection class IP30  xx2300000499
3	Refit the screws.	

Continues on next page

Refilling oil to axis-1 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	
3	Open the oil plugs, one for filling and the other for venting.	 xx2300000547
4	**WARNING** 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.	
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.
6	Refit the oil plugs.	Tightening torque: 10 Nm

Continues on next page

5.8.1 Replacing the axis-1 gear unit sub-assembly
Continued

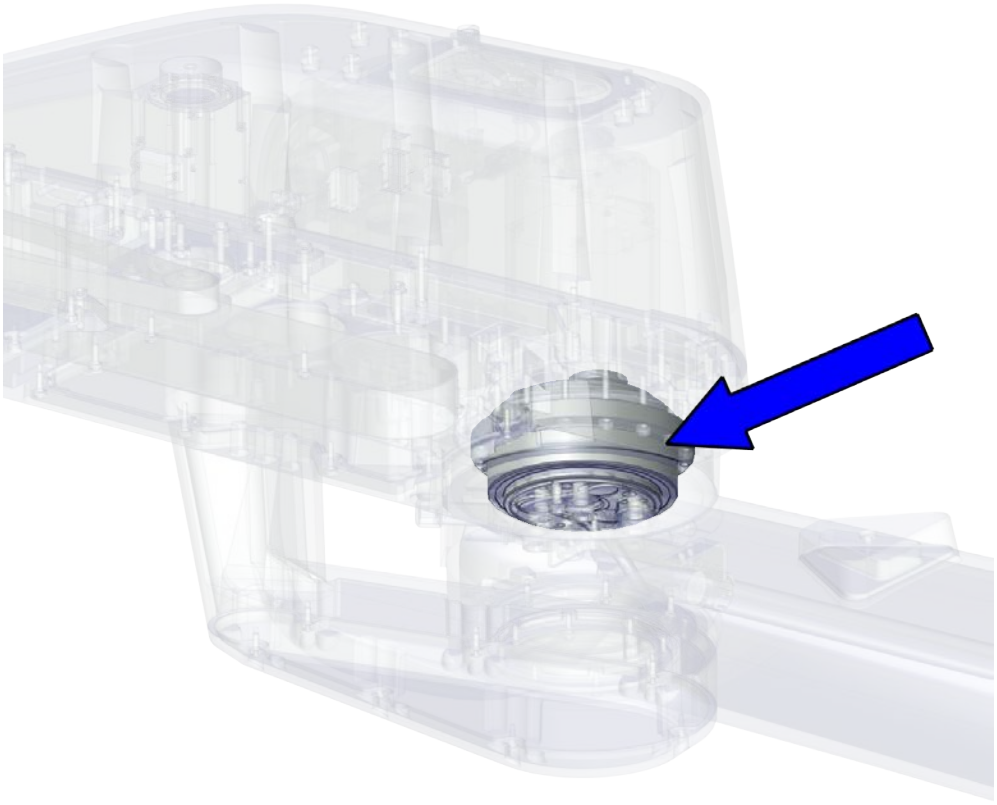
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
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 55*.	

5.8.2 Replacing the axis-2 gear unit sub-assembly

Location of the axis-2 gear unit sub-assembly

The axis-2 gear unit sub-assembly is located as shown in the figure.



xx2300000485

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

Spare part	Article number	Note
Axis-2 gear unit sub-assembly	3HAC081649-001	Without tube&bolt; flange screw. Gearbox NTS RV-25N-63
A2 Ring	3HAC089333-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 616*.

Continues on next page

5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

Equipment	Article number	Note
Calibration toolbox, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Sonic tension meter	-	Used for measuring the timing belt tension.
Handheld dynamometer	-	Used for measuring the timing belt tension.
A2 Sealing ring assembling tool	3HAC090314-001	Used to install the A2 sealing ring. Special tool for L2.
A2 Sealing ring disassembling tool	3HAC090315-001	Used to uninstall the A2 sealing ring. Special tool for L2.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222

Deciding calibration routine

Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

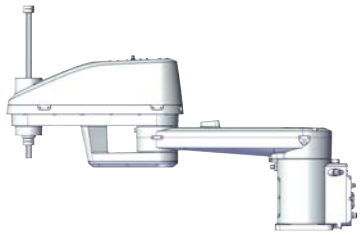
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 573*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removing the axis-2 gear unit sub-assembly

Use these procedures to remove the axis-2 gear unit sub-assembly.

Preparations before removing the axis-2 gear unit sub-assembly

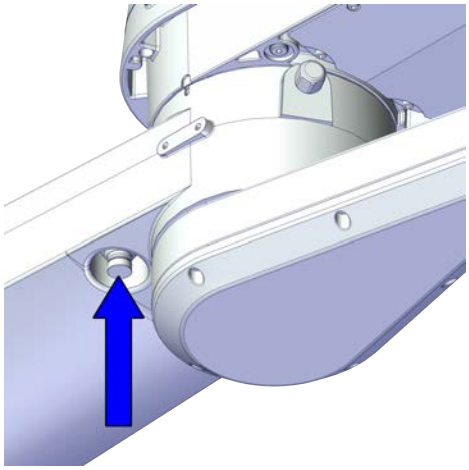
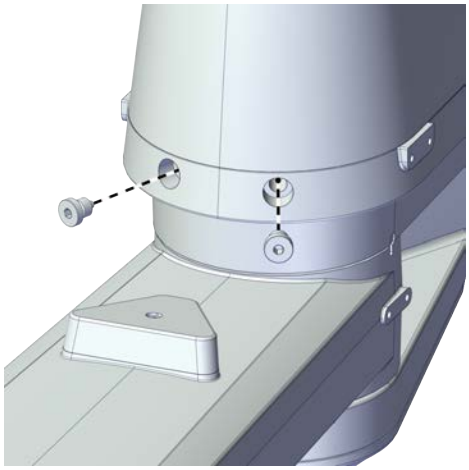
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	If there is no enough space for the maintenance work, remove the robot from the wall and place it on the maintenance bracket. **CAUTION** Do not lay down the robot during the transportation, always keep it straight. If the robot lay down in any situation, the grease may come out from gearbox.	
3	Jog all axes to zero position.	 xx2300000486
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Draining oil of axis-2 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	

Continues on next page

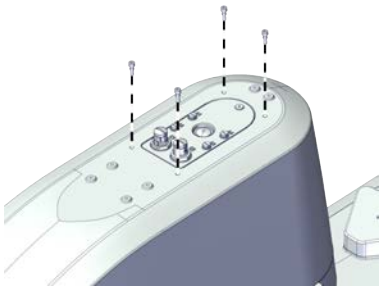
5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

	Action	Note
2	**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.	
3	Place the oil collecting vessel underneath the oil plug, draining.	 xx2300000548
4	Plug a clean pipe to the oil plug, draining, with the other end to the oil collecting vessel.	
5	Remove the oil plug, draining.	 xx2300000549
6	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 605* for more information.	

Continues on next page

	Action	Note
7	Drain the gearbox oil.	**Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
8	Remove and clean the pipe after the oil is drained. **Note** There will be some oil left in the gearbox after draining.	
9	Refit oil plugs.	Tightening torque: 10 Nm

Removing the process hub screws

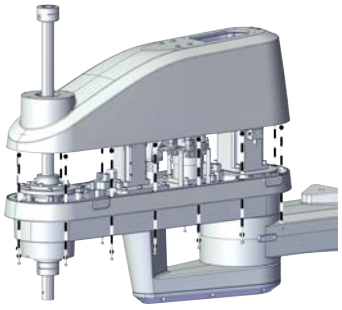
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the process hub.	For robots with protection class IP30  xx2300000487
3	Push the process hub to the outer arm.	

Removing the cover of the outer arm

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

Continues on next page

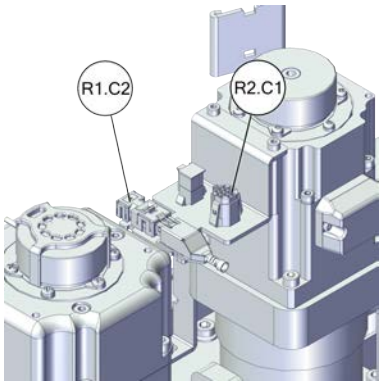
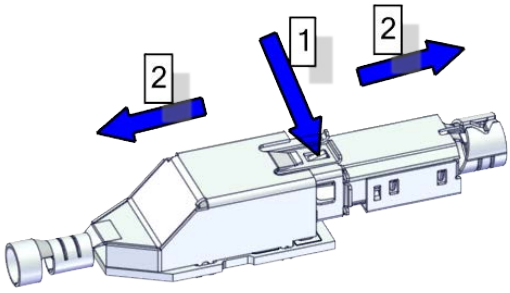
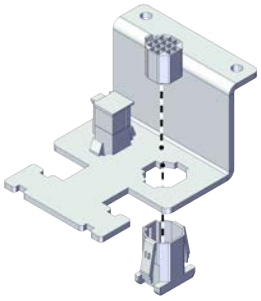
5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

	Action	Note
2	Remove the screws on the cover of the outer arm and remove the cover.	For robots with protection class IP30  xx2300000488

Disconnecting the air hoses, C1 cabling and C2 cabling (if equipped)

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the air hoses from the L-shaped connectors.	

Continues on next page

	Action	Note
3	**For robots with C1 cabling** Disconnect the connector. • R2.C1	 xx2300000542
4	**For robots with C2 cabling** Disconnect the connector. • R1.C2 **Tip** Cut the cable straps for the R1.C2 at the same time. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the R1.C2 (for C2 cabling).  xx1800002943	
5	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544

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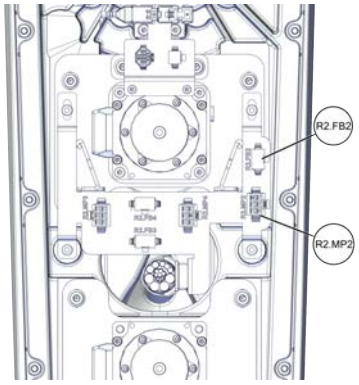
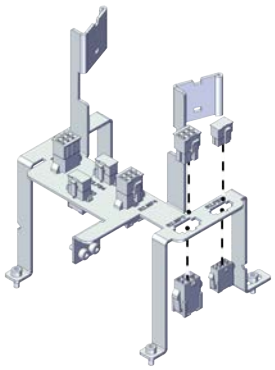
5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

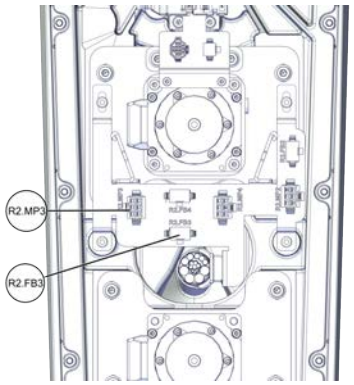
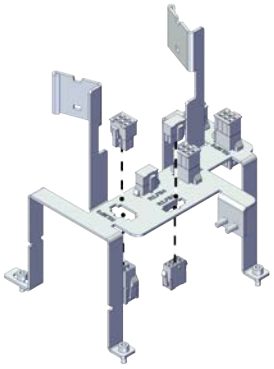
Disconnecting the connectors for axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • R2.MP2 • R2.FB2	 xx2300000490
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493

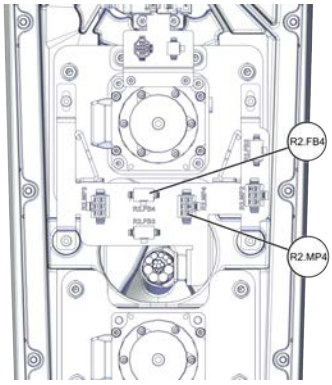
Disconnecting the connectors for axis-3 motor

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

Continues on next page

	Action	Note
2	Disconnect the connectors. • R2.MP3 • R2.FB3	 xx2300000491
3	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494

Disconnecting the connectors for axis-4 motor

	Action	Note
1	Disconnect the axis-4 motor connectors. • R2.MP4 • R2.FB4	 xx2300000492

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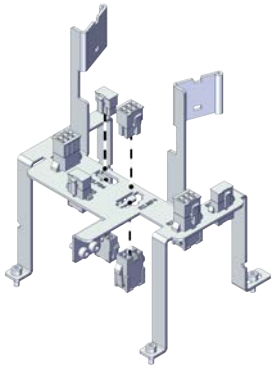
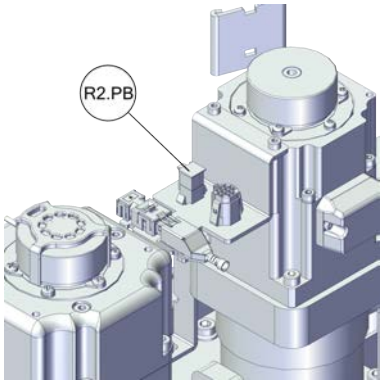
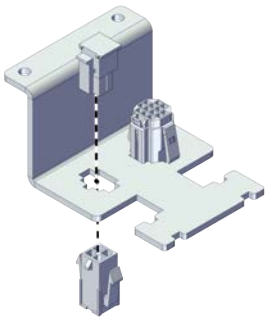
5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

	Action	Note
2	Snap loose and remove the female head of the connectors from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495

Disconnecting the connector for PB

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connector. • R2.PB	 xx2300000543
3	Snap loose and remove the female head of the connector from the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545

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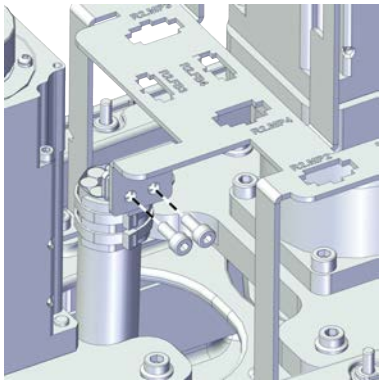
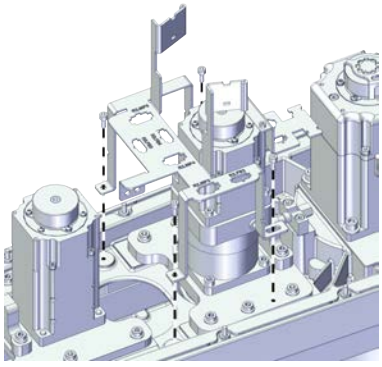
Removing the process hub

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Take out the process hub. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	

Removing the outer arm cable ferrule and bracket

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the bracket to the cable ferrule to release the cable ferrule with cable. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000496
3	Remove the screws on the bracket. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000497

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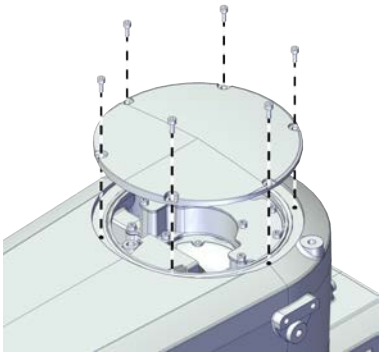
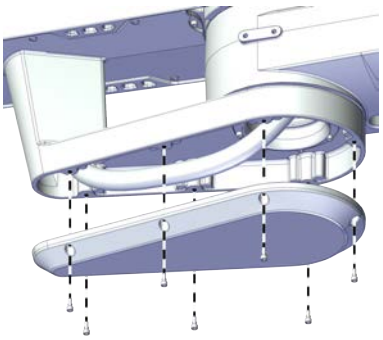
5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

Removing the axis-1 cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000498
3	Remove the cover.	

Removing the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.	For robots with protection class IP30  xx2300000499
3	Remove the cover.	

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Removing the bracket of the cable arm

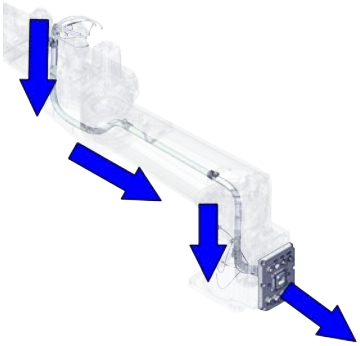
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the bracket from the cable arm to release the cable.	 xx2300000506

Removing the main harness from the cable arm position

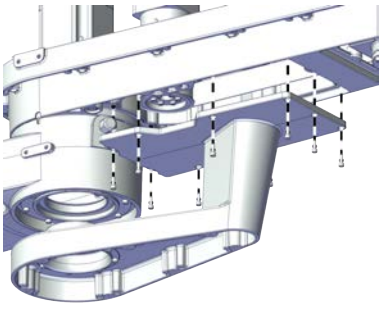
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	

Continues on next page

5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

	Action	Note
2	Pull the main harness out of the outer arm from lower of the cable arm. **Tip** Wrap the connectors with the masking tape. **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	For rear outlet cable version:  xx2300000507 For underneath outlet cable version:  xx2300000612
3	Pull the main harness out of the cable arm from the inner arm.	

Removing the cable arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws locking the cable arm to the outer arm.	 xx2300000516
3	Remove the cable arm by pulling out from the inner arm bearing.	

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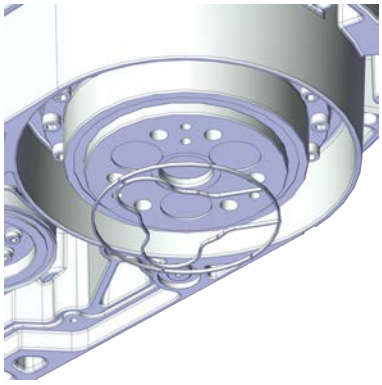
Removing the outer arm assembly

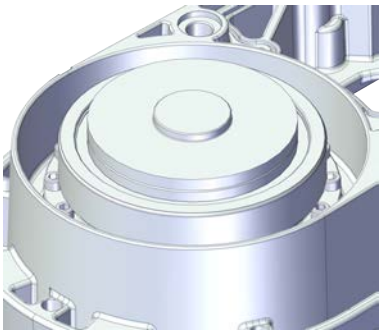
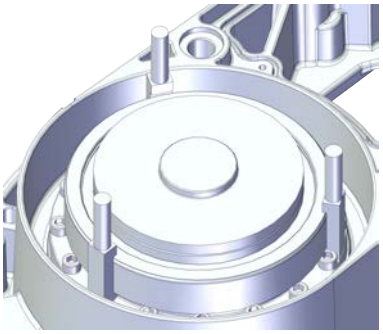
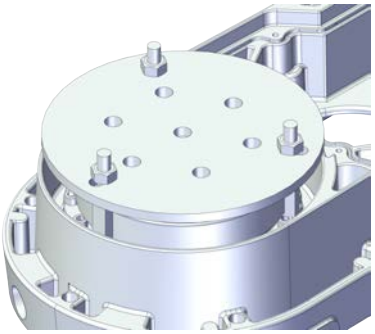
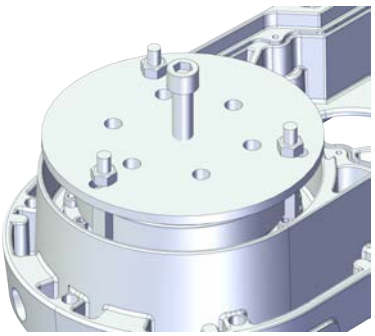
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws on the axis -2 gear inside the inner arm.	For robots with protection class IP30
3	Remove the outer arm assembly slightly.	 xx2300000517
4	Remove the gear gasket on the axis-2 gear unit.	 xx2300000603

Removing the axis-2 gear unit sub-assembly from the outer arm

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

Continues on next page

5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

	Action	Note
2	Install the supporting plate of the sealing ring disassembling tool (3HAC090315-001) to the axis-2 gear.	A2 Sealing ring disassembling tool:3HAC090315-001  xx2300001904
3	Hook the A2 sealing ring with three pulling sticks (M8) of the sealing ring disassembling tool.	 xx2300001905
4	Thread the upper part of the pulling sticks through the pulling plate and lock with nuts.	 xx2300001906
5	Tighten the nuts to pull out the A2 sealing ring.	 xx2300001907

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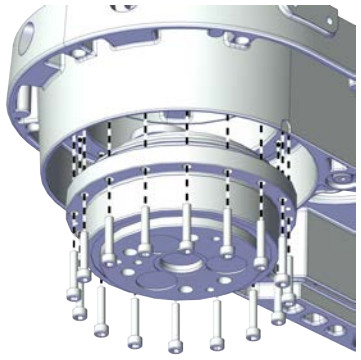
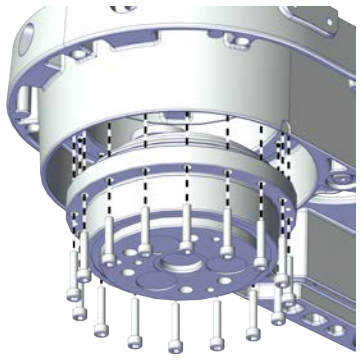
	Action	Note
6	Take out the A2 sealing ring with the sealing ring disassembling tool. **Tip** Clean the glue on the ring if need to be reused.	
7	Remove the screws on the gear to the outer arm.	For robots with protection class IP30  xx2300000606
8	Remove the gear unit.	

Refitting the axis-2 gear unit sub-assembly

Use these procedures to refit the axis-2 gear unit sub-assembly.

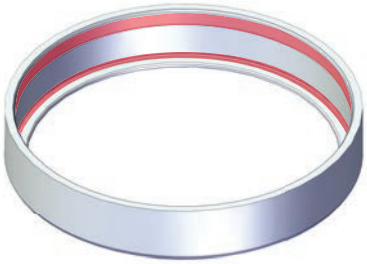
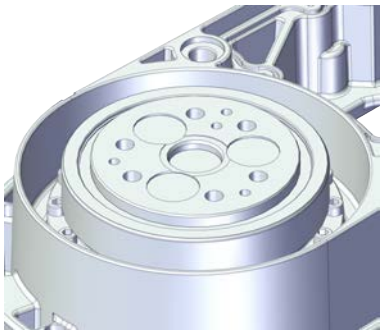
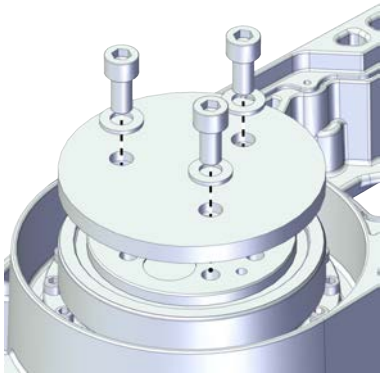
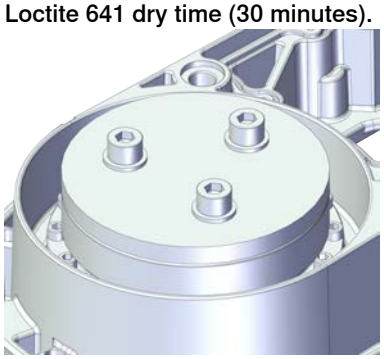
Refitting the axis-2 gear unit sub-assembly to the outer arm

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
2	Refit the gear unit according to the location screws. **Tip** When the gear unit is in the right position, you can hear a clear "Click".	Screws: Hex socket head cap screw M5x25 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 7 Nm ±3% For robots with protection class IP30  xx2300000606
3	Refit the screws.	

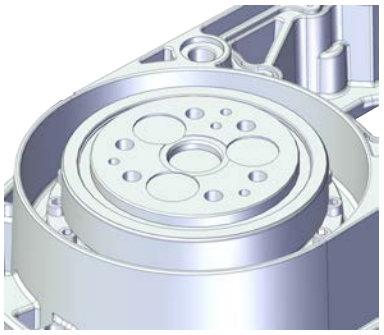
Continues on next page

5.8.2 Replacing the axis-2 gear unit sub-assembly

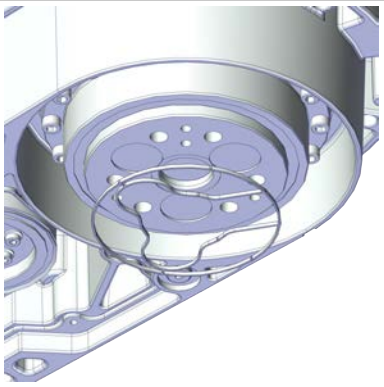
Continued

	Action	Note
4	Apply the glue (Loctite 641) to the inner side of the A2 sealing ring as illustrated.	 xx2300001899
5	Install the A2 sealing ring to the gearbox.	 xx2300001900
6	Install the pressing plate of the sealing ring assembling tool and lock with the screws (M10) to press the A2 sealing ring.	A2 Sealing ring assembling tool:3HAC090314-001  xx2300001901
7	Wait for 30 minutes.	Loctite 641 dry time (30 minutes).  xx2300001902

Continues on next page

	Action	Note
8	Remove the sealing ring assembling tool and the check that the A2 sealing ring is glued to the gearbox.	 xx2300001903

Refitting the outer arm to the inner arm

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
2	Refit the gear gasket to the axis-2 gear unit.	 xx2300000603

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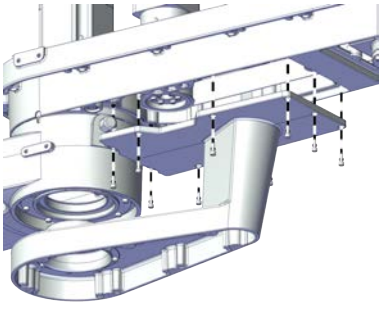
5.8.2 Replacing the axis-2 gear unit sub-assembly

Continued

	Action	Note
3	Refit the outer arm to the inner arm. **Tip** When the gear unit is in the right position, you can hear a clear "Click".	Screws: Hex socket head cap screw M10x25 12.9 Gleitmo 603+Geomet 500 (6 pcs) Tightening torque:55 Nm Screws: Hex socket head cap screw M6x20 12.9 Gleitmo 603+Geomet 500 (3 pcs) Tightening torque:10 Nm  xx2300000517
4	Refit the screws. **Note** The two screw holes under the axis-2 belt location are left empty.	

Refitting the cable arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the cable arm to the inner arm and outer arm.	
3	Secure the cable arm to the outer arm with the screws.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque:3.3 Nm2.4 Nm ±3%  xx2300000516

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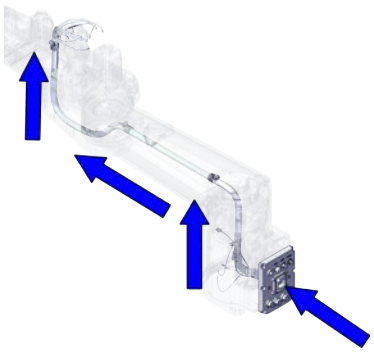
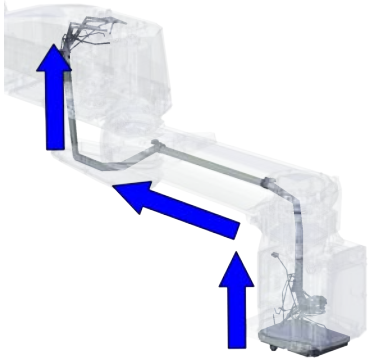
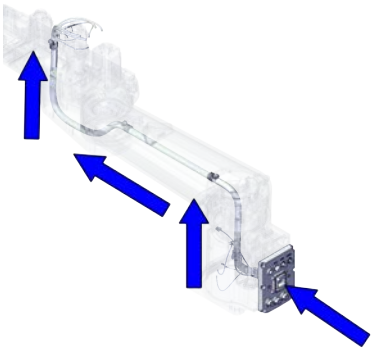
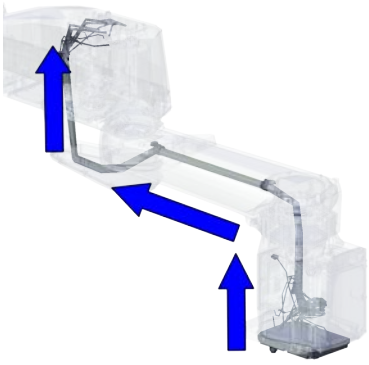
Inserting the main harness through the inner arm position

	Action	Note
1	Secure the cable with the cable ferrule to the two brackets in inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) x 2 Tightening torque: 2.4 Nm ±10%
2	Insert the main harness into the cable arm through the inner arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
3	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000508

Continues on next page

5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

Inserting the main harness through the cable arm

	Action	Note
1	Insert the main harness into the outer arm through the cable arm. **Tip** Wrap the connectors with the masking tape.	For rear outlet cable version:  xx2300000510 For underneath outlet cable version:  xx2300000610
2	Secure the bracket to the inner arm.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000506

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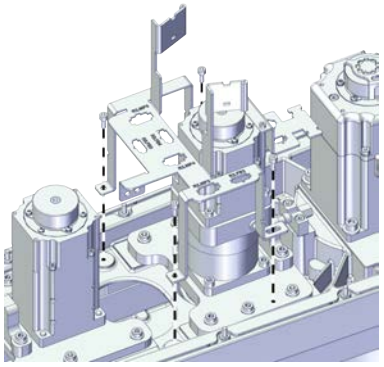
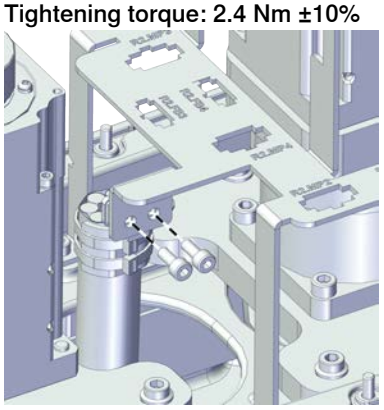
Refitting the cable ferrule and bracket in the outer arm

	Action	Note
1	Lay the internal harness in a natural state without distortion.	
2	Refit the bracket. **Tip** Do not secure it with the screws before the cable ferrule installed well. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000497
3	Secure the cable ferrule to the bracket with the screws. **Tip** The air hoses should face the process hub side. **Tip** The position with wrapped tape is the marked position for the cable ferrule. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Tip** Align all the cable ferrules so that the cable is in a natural bending position to avoid twisting. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	Screws: Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 2.4 Nm ±10%  xx2300000496

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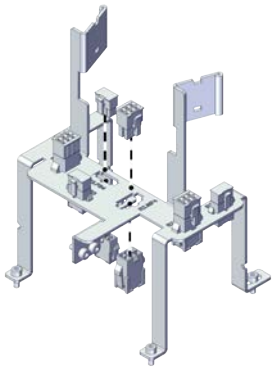
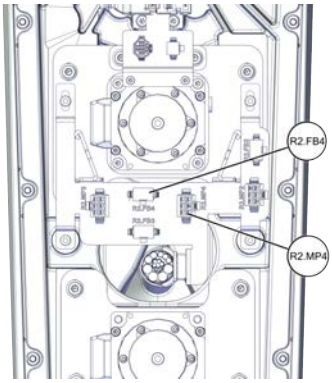
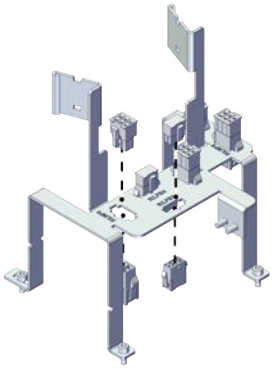
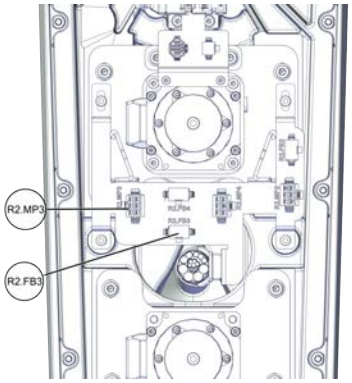
5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

Reconnecting the connectors for axis-4 motor

	Action	Note
	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000495
1	Reconnect the connectors. • R2.MP4 • R2.FB4 **Tip** See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000492
2	Route the cabling on the axis-4 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

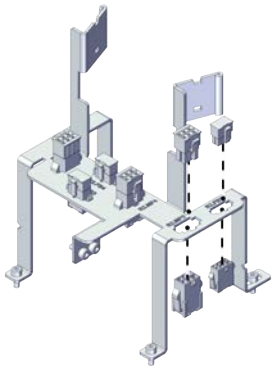
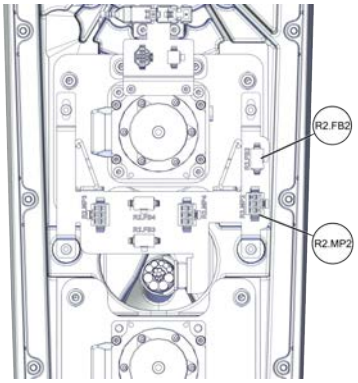
Reconnecting the connectors for axis-3 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000494
2	Reconnect the connectors. • R2.MP3 • R2.FB3 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000491
3	Route the cabling on the axis-3 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

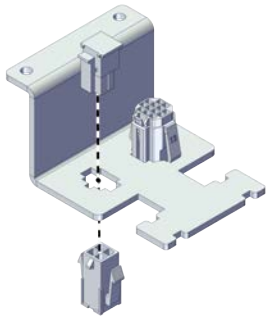
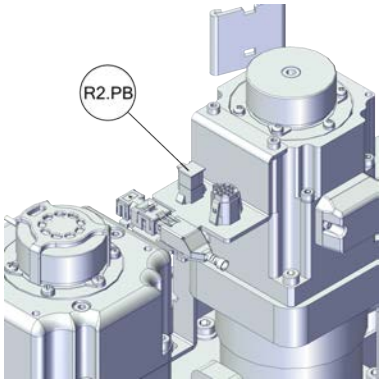
5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

Reconnecting the connectors for axis-2 motor

	Action	Note
1	Insert the female head of the connectors to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000493
2	Reconnect the connectors. • R2.MP2 • R2.FB2 See the number markings on the connectors of the main harness for help to find the corresponding connector. **DANGER** Make sure that the correct connectors are matched before reconnecting the connectors. Otherwise the robot motor may be broken.	 xx2300000490
3	Route the cabling behind the axis-2 motor. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

Reconnecting the connector for PB

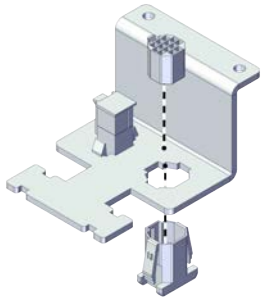
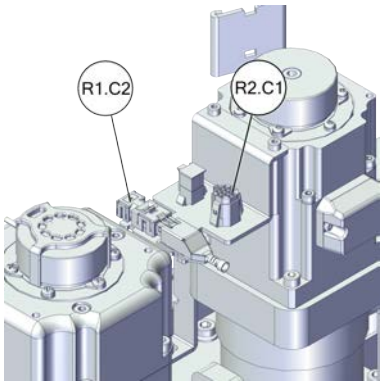
	Action	Note
1	Insert the female head of the PB connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000545
2	Reconnect the connector. • R2.PB **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx2300000543
3	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed incorrectly the cables can be damaged.	

Reconnecting the air hoses, CP/CS cabling and Ethernet cabling (if equipped)

	Action	Note
1	Route the air hoses on the process hub behind the bracket. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

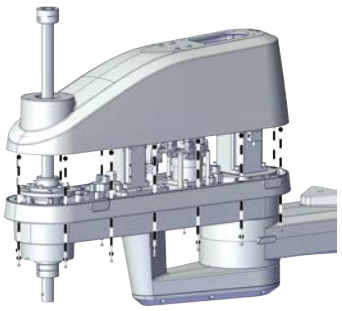
5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

	Action	Note
2	Insert the female head of the C1 cabling connector to the bracket accordingly. **Tip** The mistake proofing measure has been applied to the connectors, the connectors may be damaged if excessive force is used. **Note** The harness are not visible due to the cleanness requirements of the illustration. They are still existing inside the cable ferrule in the actual situation.	 xx2300000544
3	**For robots with C1 cabling** Reconnect the connector. • R2.C1 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	 xx2300000542
4	**For robots with C2 cabling** Reconnect the connector. • R1.C2 **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same L-shaped connector.	
5	Secure the C2 cabling to the C2 bracket with the cable straps.	
6	Reconnect the air hoses in a cross pattern with the L-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	

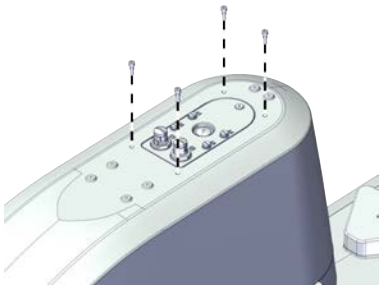
Continues on next page

	Action	Note
7	Route and secure the cabling with cable straps if needed. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Refitting the cover of the outer arm

	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x30 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000488
2	Refit the screws.	

Securing the process hub to outer arm cover

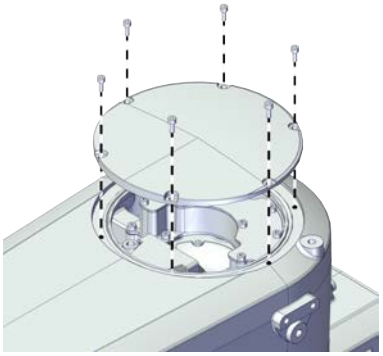
	Action	Note
1	Install a screw to the reserved hole on the process hub.	
2	Grip the screw to install the process hub.	
3	Secure the process hub to the outer arm cover with the screws. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	Screws: Hex socket head cap screw M4x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 2.4 Nm ±10% For robots with protection class IP30  xx2300000487

Continues on next page

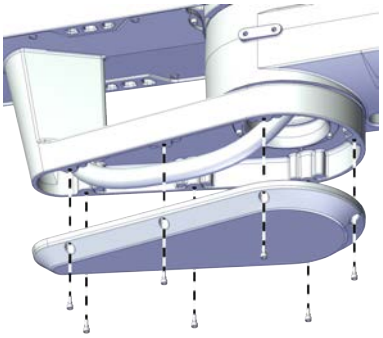
5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

	Action	Note
4	Remove the screw.	

Refitting the axis-1 cover

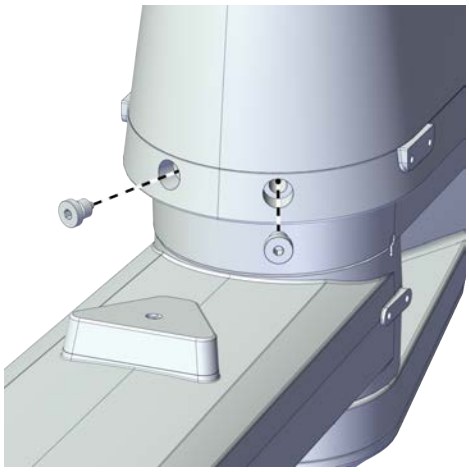
	Action	Note
1	Refit the cover.	Screw: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 2.4 Nm ±3% For robots with protection class IP30  xx2300000498
2	Refit the screws.	

Refitting the cable arm cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Refit the cover.	Screws: Hex socket head cap screw M4x10 12.9 Lafre 2C2B/FC6.9 (7 pcs) Tightening torque: 6 Nm ±3% For robots with protection class IP30  xx2300000499
3	Refit the screws.	

Continues on next page

Refilling oil to axis-2 gearbox

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**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.	
3	Open the upper oil plug. **Note** The lower oil plug has to be closed; otherwise, the oil may leak before required oil amount is filled.	 xx2300000549
4	**WARNING** 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.	
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained. **CAUTION** Oil filling must be slow to make sure air venting is fluent.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.

Continues on next page

5.8.2 Replacing the axis-2 gear unit sub-assembly
Continued

	Action	Note
6	Refit the oil plug.	Tightening torque: 10 Nm
7	**DANGER** Make sure all safety requirements are met when performing the first test run.	

Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 561*.
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 55*.	

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 572*.

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
Absolute accuracy calibration (optional)	Based on standard calibration, and besides positioning the robot at synchronization position, the Absolute accuracy calibration also compensates for: • Mechanical tolerances in the robot structure • Deflection due to load Absolute accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot. Absolute accuracy calibration data is found on the serial measurement board (SMB) or other robot memory. A robot calibrated with Absolute accuracy has the option information printed on its name plate (OmniCore). To regain 100% Absolute accuracy performance, the robot must be recalibrated for absolute accuracy after repair or maintenance that affects the mechanical structure.	CalibWare

Brief description of calibration methods

Axis Calibration method

Axis Calibration is a standard calibration method for calibration of IRB 930. 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 572*.

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.

Continues on next page

CalibWare - Absolute Accuracy calibration

The CalibWare tool guides through the calibration process and calculates new compensation parameters. This is further detailed in the *Application manual - CalibWare Field*.

If a service operation is done to a robot with the option Absolute Accuracy, a new absolute accuracy calibration is required in order to establish full performance. For most cases after replacements that do not include taking apart the robot structure, standard calibration is sufficient.

The Absolute Accuracy option varies according to the robot mounting position. This is printed on the robot name plate for each robot. The robot must be in the correct mounting position when it is recalibrated for absolute accuracy.

References

Article numbers for the calibration tools are listed in the section *Special tools on page 617*.

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.

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

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

The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See *Updating revolution counters on page 568*. 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.

If the robot has *absolute accuracy* calibration, it needs to be calibrated for new absolute accuracy.

6.2 Synchronization marks and axis movement directions

6.2.1 Synchronization marks and synchronization position for axes

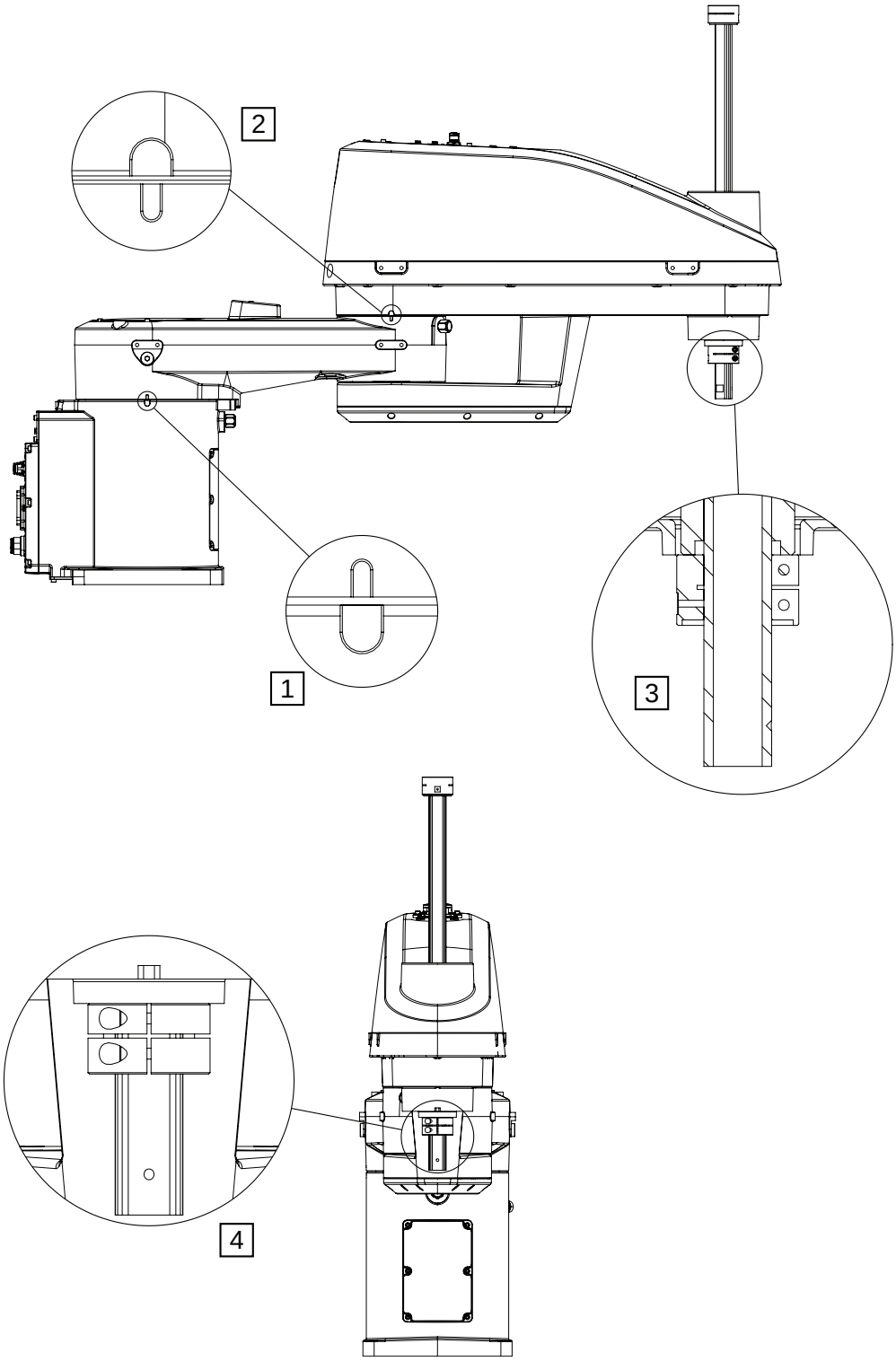
Introduction

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

Continues on next page

6.2.1 Synchronization marks and synchronization position for axes
Continued

Synchronization marks, IRB 930



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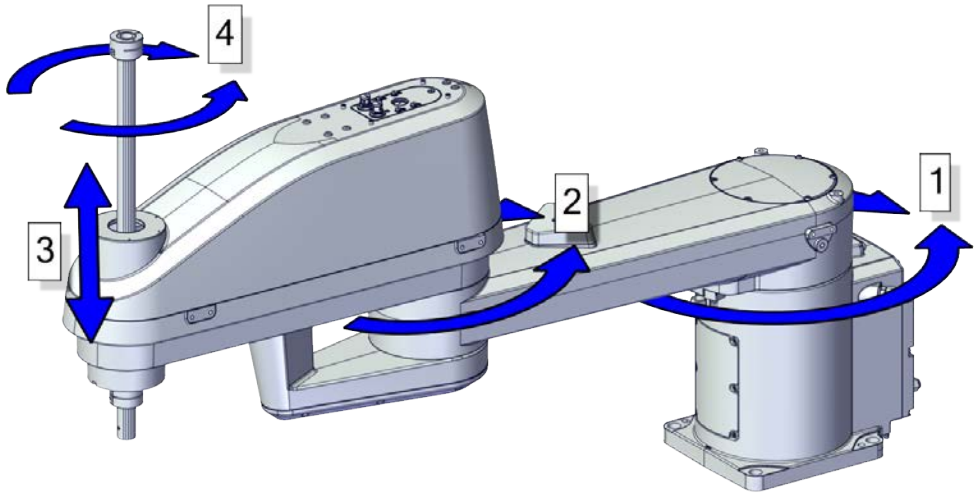
6.2.2 Calibration movement directions for all axes

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.

Manual movement directions



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6.3 Updating revolution counters

6.3.1 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.

Coupled axes

When updating the revolution counters for a coupled axis, also the axis it is coupled to needs to be at its synchronization position for the update to be correct; i.e. axis 4 needs to be in synchronization position when updating axis 3.

With reversed coupled joints, the relationship is the opposite, i.e. axis 4 needs to be in synchronization position to update axis 3.

Coupled axes	IRB 930
Axis 4, 3	x

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 565*.
3	When all axes are positioned, update the revolution counter.	*Step 2 - Updating the revolution counter with the FlexPendant on page 570*.

Continues on next page

Correct synchronization position of axes 3 and 4

When jogging the manipulator to synchronization position, it is extremely important to make sure that axes 3 and 4 are positioned correctly.

Note

At delivery the manipulator is in the correct position. Do NOT shift axis 3 or rotate axis 4 at power up before the revolution counters are updated.

If axis 4 is rotated one or more turns from its calibration position before updating the revolution counter, the correct calibration position will be lost due to non-integer gear ratio. This will further affect the calibration position of axis 3.

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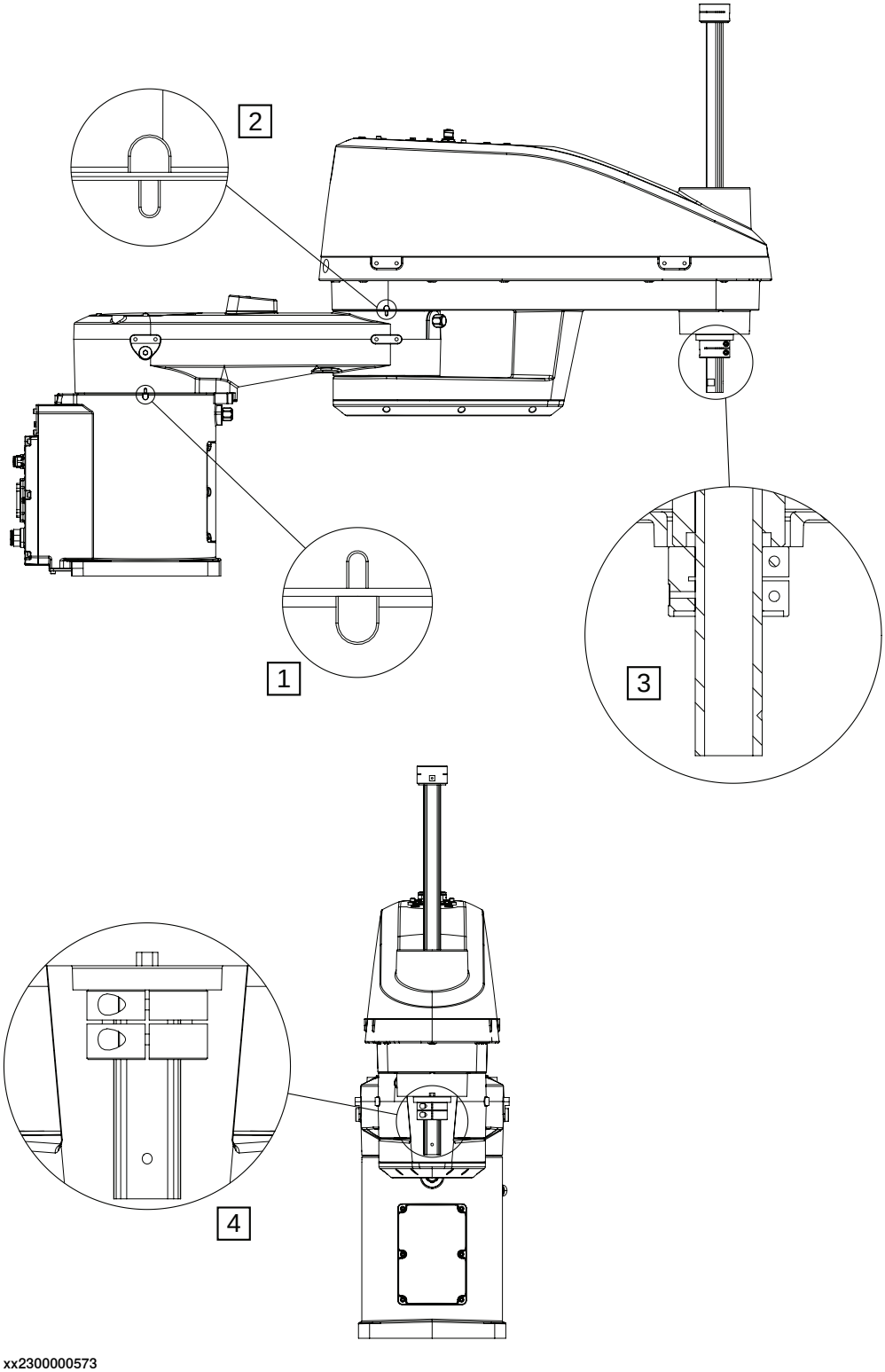
6.3.1 Updating revolution counters on OmniCore robots
Continued



Step 2 - Updating the revolution counter with the FlexPendant

Note

Revolution counters of axes 3 and 4 must be updated together.

Continues on next page

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 592*.

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	-	*				
Axis 2	*	-				

-	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.

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.

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. Required if Axis Calibration is the valid calibration method for the robot.

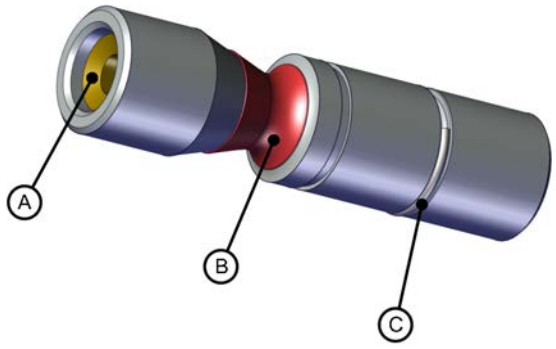
Examining the calibration tool

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

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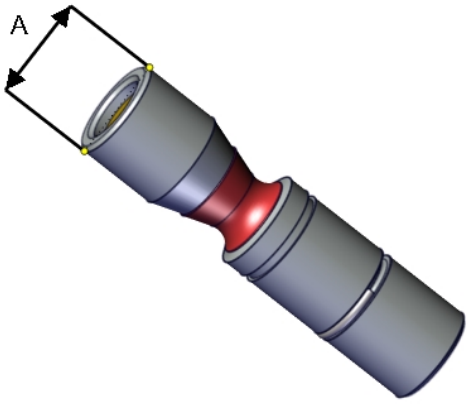
6.4.2 Calibration tools for Axis Calibration
Continued

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.



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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.	

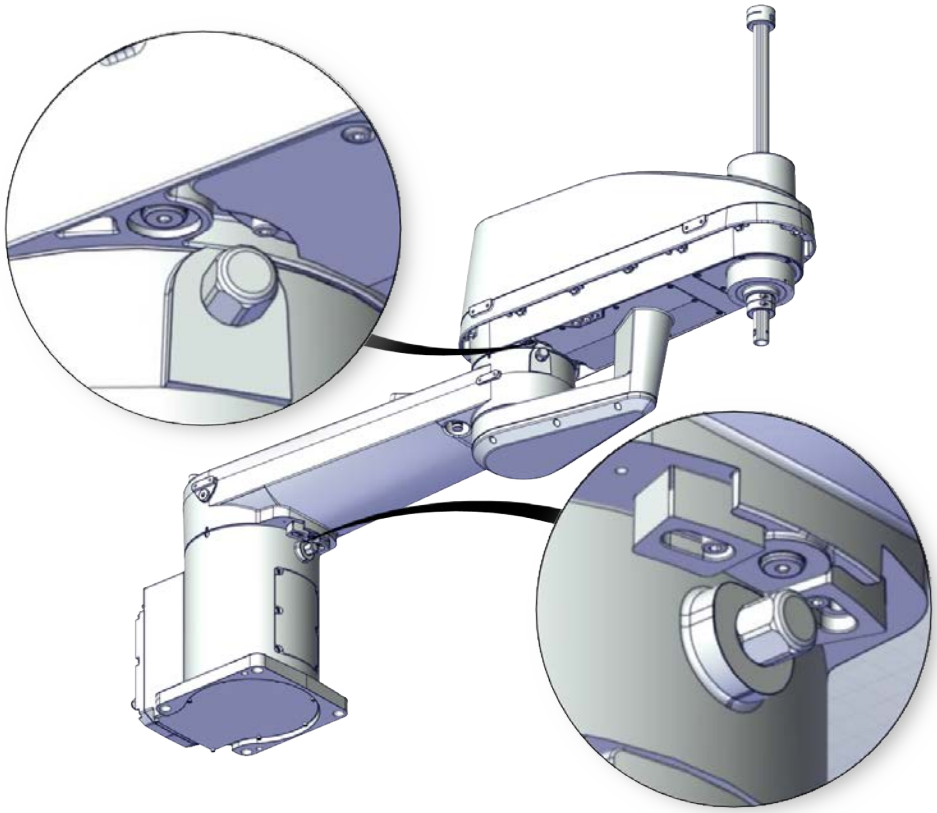
6.4.3 Installation locations for the calibration tools

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.



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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
Protective plug for bushing	3HAC053237-002	Replace if damaged or missing.

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 if Axis Calibration is the valid calibration method for the robot.

Required consumables

Consumable	Article number	Note
Clean cloth	-	

Spare parts

Spare part	Article number	Note
Protection cover and plug set	3HAC059487-001	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 573*.
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.

Continues on next page

7 The robot performs a measurement sequence by rotating the axis back and forth.
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 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.	

Continues on next page

6.4.4 Axis Calibration - Running the calibration procedure
Continued

	Action	Note
5	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 578*.

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 567*

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.

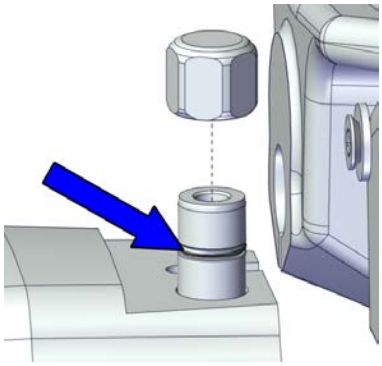
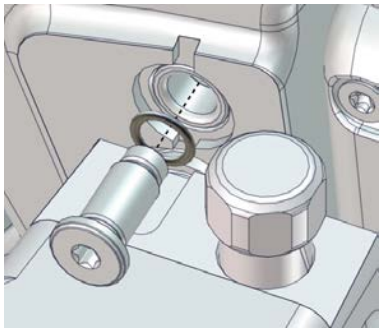
However, SafeMove may generate other warning messages anytime during the Axis Calibration routine. When a warning message is displayed, tap **Acknowledge** to confirm the unsynchronized state and continue Axis Calibration procedure.

CAUTION

SafeMove must be synchronized after the calibration is completed.

Continues on next page

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: 3HAC059487-001.
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 Protective plug for bushing: 3HAC053237-002.

6.4.5 Reference calibration

Brief introduction to Reference Calibration

> **Note**
>
> Only axes 1 and 2 of the IRB 930 can be calibrated with the reference calibration routine.

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) Download new calibration values to SafeMove. Use Visual SafeMove in RobotStudio.
12. (For system containing SafeMove) Synchronize SafeMove to activate SafeMove.
13. Perform test run.
14. Update the calibration label with new resolver values (calibration values).

Continues on next page

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 582*).

6.5 Calibrating the robot

6.5.1 Calibration position

Calibration position

The table below specifies the axis positions.

Axis	
3	2 mm
4	0°

6.5.2 Calibrating axis 1 and axis 2

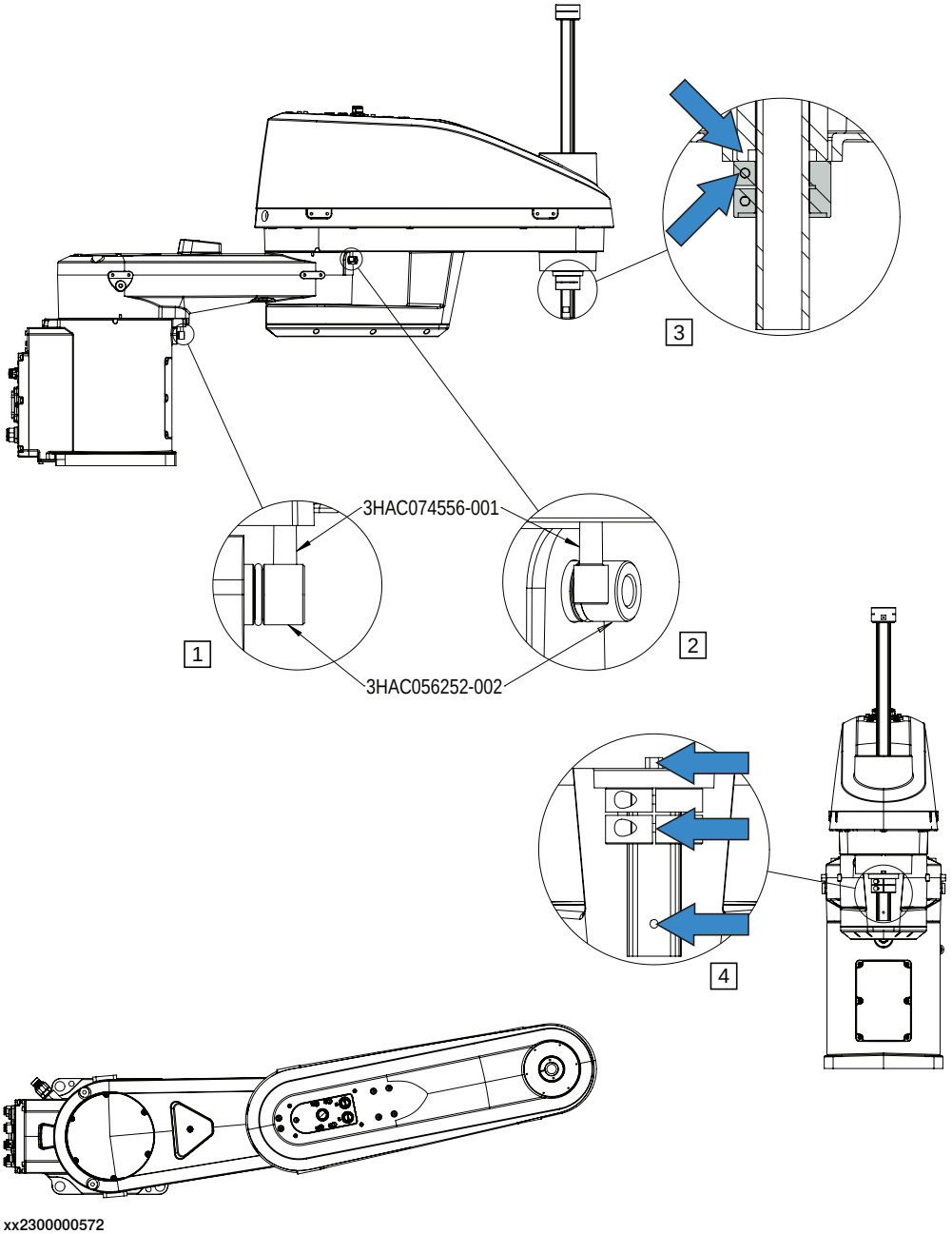
Calibrating axis 1 and axis 2

Axes 1 and 2 of the IRB 930 are calibrated using the Axis Calibration method. See *Calibrating with Axis Calibration method on page 572*.

6.5.3 Calibrating axis 3 and axis 4

Calibration position

The figure shows the axes in calibration position. The axes 3 and 4 are calibrated together.



xx2300000572

Required equipment

Axes 3 and 4 are calibrated together.

The axis-3 calibration is done by moving the ball screw spline unit so that the upper surface of the lower mechanical stopper and the lower surface of the ball screw lower nut touch each other gently.

Continues on next page

The axis-4 calibration is done by rotating the ball screw spline unit so that the opening gap on the lower mechanical stopper or the ball screw origin point is aligned with the notch on the outer arm cover.

Required consumables

Equipment	Art. no.	Note
Cleaning agent	-	Isopropanol

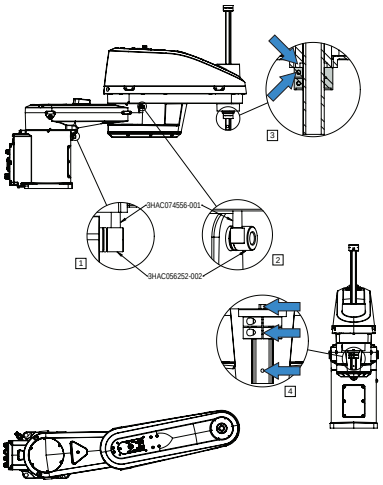
Calibrating axis 3 and axis 4

Moving the robot to calibration position

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Remove the fitted extra equipment on the robot if it may cause a collision to the arm when push the ball screw to the calibration position.	
3	Turn on the electric power to the robot.	
4	**DANGER** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways! Make sure the payload is disassembled or tooling is properly supported; otherwise, fast downward movements of axis 3 may cause severe hits.	

Continues on next page

6.5.3 Calibrating axis 3 and axis 4
Continued

	Action	Note
5	Release the brakes and manually push axis 3 until the upper surface of the lower mechanical stopper touches the lower surface of the ball screw lower nut gently. There should be no pressing force between them. When doing this, pay attention to robot pose in order to avoid arm collision.	How to release the brakes is detailed in *Manually releasing the brakes on page 58*.  xx2300000572
6	Release the brakes and manually rotate axis 4 until the opening gap on the lower mechanical stopper or the ball screw origin point is aligned with the notch on the outer arm cover. When doing this, pay attention to robot pose in order to avoid arm collision.	
7	When the axes are in position, release the brake release button to activate the brakes again.	

Performing the fine calibration procedure

	Action	Note
1	On the start screen, tap **Calibrate**.	
2	Select **Calibration** from the menu. The **Mechanical Units** page displays a list of available mechanical units. **Note** This step is required only if you are not already in the **Mechanical Unit** page when you open **Calibrate**. **Note** The **Mechanical Unit** page is displayed only if there are more than one mechanical unit available. Otherwise, the calibration summary page for the available mechanical unit is displayed.	
3	Select the unit that needs to be calibrated from the **Mechanical Unit** list. The calibration summary for the selected mechanical unit is displayed.	
4	On the right pane tap **Calibration Methods**.	
5	Tap **Calibration Parameters**. The calibration parameters are displayed.	

Continues on next page

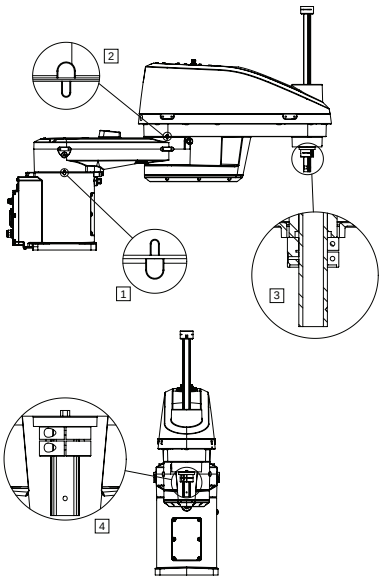
	Action	Note
6	Tap **Fine Calibration**. A dialog box is displayed, urging you to use external equipment to perform the actual calibration. Make sure all necessary calibration equipment is fitted for the axis to be calibrated. A warning that performing fine calibration can change programmed robot positions is also displayed: • Tap **Yes** to proceed. • Tap **No** to cancel.	
7	Select the check-box for the current axis/axes to be calibrated.	
8	Tap **Calibrate**. A dialog box is displayed, warning that calibration of the selected axes will be changed, which cannot be undone: • Tap **Calibrate** to proceed. • Tap **Cancel** to cancel. Tapping **Calibrate** results in briefly displaying a dialog box, announcing that the calibration process has started. The axis is calibrated and the system returns to the list of available mechanical units.	
9	Tap **OK**. The fine calibration process is complete.	

Checking and finalizing the calibration

	Action	Note
1	**DANGER** Always remember to remove the calibration tools from the robot before jogging axes to zero position during calibration.	
2	Release the brakes and manually rotate the axis to apart the calibration pins from each other. This is done to avoid damage on the pins if incorrect operation should occur during next step of jogging.	
3	Jog axes 3 and 4 to zero degree using the FlexPendant.	

Continues on next page

6.5.3 Calibrating axis 3 and axis 4
Continued

	Action	Note
4	Check that the synchronization marks on axes 3 and 4 are aligned with each other. Are they aligned within the tolerances? • If yes, the calibration is verified OK. • If no, redo the fine calibration procedure.	 xx2300000573
5	Update the revolution counters of axes 3 and 4.	See *Updating revolution counters on page 568*.

After calibration

	Action	Note
1	Write down the new system parameters on a new label and stick on top of the calibration label on the robot.	

Note

The calibration status of axis 3 may be changed to **Not updated** after a system reinstallation or warm restart. In this case, update the revolution counters for axis 3 and axis 4 (axis 4 is coupled with axis 3). See *Updating revolution counters on page 568*.

6.6 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 592*.
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 565*.
3	Write down the values on a new label and stick it on top of the calibration label. The label is located on the base.	

6.7 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 **Jog** window on the FlexPendant.

Continues on next page

6.7.1 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 565* and *Updating revolution counters on page 568*.

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 565* and *Updating revolution counters on page 568*.

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7 Troubleshooting

7.1 Introduction to troubleshooting

Introduction

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

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

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

Troubleshooting strategies

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

Work systematically

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

Keep a track of history

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

Basic scenarios

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

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

Continues on next page

Continued

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 930 on page 98*. 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.

A humming resonance sound can occur without being an error. Mechanical resonance sound is a physical phenomenon in mechanical structures. It has no impact on product performance or lifetime. Adjusting the robot movement speed out of the range that causes the resonance will eliminate the sound.

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.
- Loss of lubrication in ball screw.
- 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.	

Continues on next page

	Action	Information
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.

7.5 Motor temperature too high

Description

The robot stops and the motor temperature for joint arg is too high.

Consequences

It is not possible to continue until the motor has cooled down. The system goes to Motors Off.

Possible causes

The symptom can be caused by:

- The values for payload and arm load are not consistent with the actual ones.
- The value for ambient temperature setting in the controller is not consistent with the actual operating temperature environment.
- The user program may contain too much high acceleration and deceleration of the joint.
- Gravity torque or external forces for the joint can also be too high.

Recommended actions

The following actions are recommended:

	Action	Information
1	**CAUTION** Allow hot parts to cool down.	
2	Verify that the values for payload and arm load are set correctly.	
3	Verify that the value for ambient temperature setting in the controller is consistent with the actual operating temperature environment.	
4	Rewrite the user program to reduce the motor utilization.	The ways could be but not limited to optimizing robot movement cycle, adjusting acc, dec as well as external force, adding wait time, and introducing alternative path/RAPID, etc.

7.6 Robot vibration during low speed movement

Description

Robot vibration, especially at the wrist, can be observed when the robot moves at a low speed.

Consequences

Slight vibration that is invisible will not affect the use of the robot. However, a clear robot vibration will decrease path accuracy and affect user applications.

Possible causes

Vibration might be caused by external factors:

- Incorrect robot installation
- Insufficient stiffness of robot pedestal
- Resonance with nearby moving machines
- Incorrect definition of payloads and tools
- Part malfunction, such as motor, gearbox, timing belt or main cable harness

Vibration might also happen when the robot moves at a low speed or in some specific poses. This is generally caused by mechanical resonance between servo system, gearbox and robot body, which is considered as an internal factor. Such vibration is a normal physical phenomenon, which is not a quality-related issue.

Recommended actions

The following actions are recommended:

	Action	Information
1	Verify that the robot is firmly secured to the foundation.	The attachment screws used for securing the robot to the foundation must be tightened with correct tightening torque. See *Orienting and securing the robot on page 60*.
2	Verify that the stiffness of robot pedestal meets the requirement.	
3	Turn off all the moving machines near to the robot and then check robot vibration again. If no vibration can be observed any more, move either the machines or the robot to another place to remove the external resonance source.	
4	Verify the payload and tools are correctly defined. If not correctly defined, redefine them.	
5	Jog the robot joint by joint to verify the functionality of each joint. If anything abnormal is found on a joint, locate the possible malfunction part with other measurements such as noise, warnings on the FlexPendant, and then replace it.	

Continues on next page

	Action	Information
6	Make sure all the external factors have been checked and excluded. If vibration remains, it might be caused by the internal factor. Contact ABB for further assistance.	

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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 606*.

Transportation

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

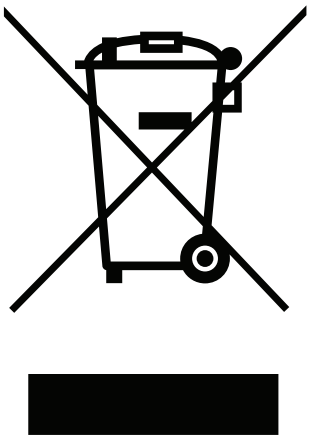
8.2 Environmental information

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	
Batteries, Lithium	Serial measurement board
Brass, zink alloys	Calibration protection cap and plug and couplings, connectors and nuts in cable harness
Cast iron/nodular iron	
Circuit boards	Serial measurement unit, brake release unit
Copper	Cables, motors
Lithium	Battery
Magnesium	Wrist casting, upper arm, back cover, tool flange, etc
Neodymium	Brakes, motors
Oil, grease	Gearboxes
Plastic/rubber	

Continues on next page

Material	Example application
Steel	

Oil and grease

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

Also note that:

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

8.3 Scrapping of robot

Note

The decommissioning process shall be preceded by a risk assessment.

Important when scrapping the robot

DANGER

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

- Always remove all batteries. If a battery is exposed to heat, for example from a blow torch, it will explode.
- Always remove all oil/grease in gearboxes. If exposed to heat, for example from a blow torch, the oil/grease will catch fire.
- When motors are removed from the robot, the robot will collapse if it is not properly supported before the motor is removed.
- A used robot does not have the same performance as on delivery. Springs, brakes, bearings, and other parts might be worn or broken.

9 Reference information

9.1 Introduction

General

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

9.2 Applicable standards

General

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

Robot standards

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

Other standards used in design

Standard	Description
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements, normative reference from ISO 10218-1
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments
IEC 61000-6-4	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
ISO 13849-1:2006	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design, normative reference from ISO 10218-1
IEC 61340-5-1	Protection of electronic devices from electrostatic phenomena - General requirements

Region specific standards and regulations

Standard	Description
ANSI/RIA R15.06	Safety requirements for industrial robots and robot systems
ANSI/UL 1740	Safety standard for robots and robotic equipment
CAN/CSA Z 434-03	Industrial robots and robot Systems - General safety requirements
ANSI/ESD S20.20	Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
EN ISO 10218-1	Robots and robotic devices — Safety requirements for industrial robots — Part 1: Robots

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 Screw joints

General

This section describes how to tighten the various types of screw joints on ABB robots.

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

UNBRAKO screws

UNBRAKO is a special type of screw recommended by ABB for certain screw joints. It features special surface treatment (Gleitmo as described below) and is extremely resistant to fatigue.

Whenever used, this is specified in the instructions, and in such cases, *no other type of replacement screw* is allowed. Using other types of screws will void any warranty and may potentially cause serious damage or injury.

Gleitmo treated screws

Gleitmo is a special surface treatment to reduce the friction when tightening the screw joint. It is recommended by ABB for M6-M20 screw joints. Screws treated with Gleitmo may be reused 3-4 times before the coating disappears. After this the screw must be discarded and replaced with a new one.

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

Generally, screws are lubricated with *Gleitmo 603* mixed with *Geomet 500* or *Geomet 702* in proportion 1:3. *Geomet* thickness varies according to screw dimensions, refer to the following.

Dimension	Lubricant	Geomet thickness
M6-M20 (any length except M20x60)	*Gleitmo 603 + Geomet 500*	3-5 µm
M6-M20 (any length except M20x60)	*Gleitmo 603 + Geomet 720*	3-5 µm
M20x60	*Gleitmo 603 + Geomet 500*	8-12 µm
M20x60	*Gleitmo 603 + Geomet 720*	6-10 µm

Screws lubricated in other ways

Screws lubricated with Molykote 1000 or Molykote P1900 should *only* be used when specified in the repair, maintenance or installation procedure descriptions.

In such cases, proceed as follows:

1. Apply lubricant to the screw thread.
2. Apply lubricant between the plain washer and screw head.
3. Screw dimensions of M8 or larger must be tightened with a torque wrench. Screw dimensions of M6 or smaller may be tightened without a torque wrench *if* this is done by trained and qualified personnel.

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Lubricant	Article number
Molykote 1000 (molybdenum disulphide grease)	3HAC042472-001
Molykote P1900 (molybdenum disulphide grease)	3HAC070875-001

Tightening torque

Before tightening any screw, note the following:

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

Tightening torque for oil-lubricated screws with slotted or cross-recess head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws* with *slotted or cross-recess head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Tightening torque for oil-lubricated screws with allen head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws* with *allen head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

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

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Dimension	Tightening torque (Nm) Class 8.8, oil-lubricated	Tightening torque (Nm) Class 10.9, oil-lubricated	Tightening torque (Nm) Class 12.9, oil-lubricated
M24	680	960	1150

Tightening torque for lubricated screws (Molykote, Gleitmo or equivalent) with allen head screws

The following table specifies the recommended standard tightening torque for *screws lubricated with Molycote 1000, Gleitmo 603 or equivalent* with *allen head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Dimension	Tightening torque (Nm) Class 10.9, lubricated [i]	Tightening torque (Nm) Class 12.9, lubricated [i]
M5		8
M6		14
M8	28	35
M10	55	70
M12	96	120
M16	235	300
M20	460	550
M24	790	950

[i] Lubricated with Molycote 1000, Gleitmo 603 or equivalent

9.5 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.	

9.6 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	Ring-open-end spanner 8-19 mm	
1	Socket head cap 2.5-17 mm	
1	Torx socket no: 20-60	
1	Box spanner set	
1	Torque wrench 10-100 Nm	
1	Torque wrench 75-400 Nm	
1	Ratchet head for torque wrench 1/2	
2	Hexagon-headed screw M10x100	
1	Hexagon-headed screw M16x90	
1	Hex bit socket head cap no. 14 socket 40 mm L=100 mm	
1	Hex bit socket head cap no. 14 socket 40 mm L=20 mm	To be shortened to 12 mm
1	Hex bit socket head cap no. 6 socket 40 mm L=145 mm	
1	Hex bit socket head cap no. 6 socket 40mm bit L=220 mm	
1	Plastic mallet	

9.7 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 616*, and of special tools, listed directly in the instructions and also gathered in this section.

Special tools

Note

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

Tools and equipment with spare part number: (These tools can be ordered from ABB)	
-	24 VDC power supply
3HAC074119-001	Calibration toolbox, Axis Calibration Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
-	Sonic tension meter Used for measuring the timing belt tension.
-	Dynamometer Used for measuring the timing belt tension.
3HAC087847-001	IRB 930 auxiliary shaft Used to install the ball screw nut. Special tool for L2
3HAC087848-001	A1 Sealing press tool Used to install the A1 sealing. Special tool for L2.
3HAC090313-001	A2 Sealing press tool Used to install the A2 sealing. Special tool for L2.
3HAC090314-001	A2 Sealing ring assembling tool Used to install the A2 sealing ring. Special tool for L2.
3HAC090315-001	A2 Sealing ring disassembling tool Used to uninstall the A2 sealing ring. Special tool for L2.

9.8 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.

10 Spare parts

10.1 Spare part lists and illustrations

Location

Spare parts and exploded views are not included in the manual but delivered as a separate document for registered users on myABB Business Portal, *www.abb.com/myABB*.

Tip

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

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