

ROBOTICS

Product manual

CRB 15000



Trace back information:

Workspace 22A version a16

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**Product manual
CRB 15000
OmniCore**

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Original instructions.

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Overview of this manual

About this manual

This manual contains instructions for:

- mechanical and electrical installation of the CRB 15000
- maintenance of the CRB 15000
- mechanical and electrical repair of the CRB 15000

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

- *Standard*

Product manual scope

The manual covers all variants and designs of the CRB 15000. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

Usage

This manual should be used during:

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



Note

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

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

Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

Prerequisites

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

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

Continues on next page

Overview of this manual

Continued

References

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

Document name	Document ID
<i>Product manual, spare parts - CRB 15000</i>	3HAC079469-001
<i>Product specification - CRB 15000</i>	3HAC077390-001
<i>Product manual - OmniCore C30</i>	3HAC060860-001
<i>Circuit diagram - CRB 15000</i>	3HAC074304-003
<i>Operating manual - Integrator's guide OmniCore</i>	3HAC065037-001
<i>Technical reference manual - System parameters</i>	3HAC065041-001
<i>Application manual - Functional safety and SafeMove</i>	3HAC066559-001
<i>Application manual - Force Control Standard for GoFa</i>	3HAC083267-001
<i>Technical reference manual - Event logs for RobotWare 7</i>	3HAC066553-001



Tip

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

Revisions

Revision	Description
A	First edition.
B	Published in release 21B. The following updates are made in this revision: <ul style="list-style-type: none">Added procedure for refitting the axis-4 cover in the replacement procedure for the axis-5 joint unit.Changed the tightening torque for the axis-4 and axis-5 covers.Added procedure for refitting the swing in the replacement procedure for the base.Added step for removing and refitting cable bracket in replacement procedure for the lower arm.Corrected safety data.Updated information about SafeMove for the CRB 15000.Updated information about the arm-side interface, see Working closely with the robot in a safe way on page 79.Added information about how to calibrate the robot, see Calibration on page 719.Updated spare part number for axis-3 joint unit.
C	Published in release 21C. The following updates are made in this revision: <ul style="list-style-type: none">Updated information related to the safety data, and the brake closing time is updated.Updated how to initiate the calibration service routine.Updated information about <i>Cyclic Brake Check</i> in the maintenance section.Updated article number for brake release tool.Added information about rotating connector at the manipulator base, see Connectors at the base on page 71.

Continues on next page

Revision	Description
D	<p>Published in release 21D. The following updates are made in this revision:</p> <ul style="list-style-type: none"> • Added information about laser scanner. • Added tip in section Calibration method and when to calibrate on page 719. • Updated working range for axis 6, see Working range on page 43.
E	<p>Published in release 22A. The following updates are made in this revision:</p> <ul style="list-style-type: none"> • Updated information about ASI buttons. • Added tips about the calibration features, see Features in the routine on page 720. • Updated information for the SafeMove function Human Contact Supervision. • Updated information for lead-through, see Lead-through on page 84. • Added information about length of thread engagement for attachment screws. • Added foundation material yield strength data. • Updated information about response times in section Safety data on page 40. • Updated information about Gleitmo treated screws, see Screw joints on page 747. • Updated replacement procedures for axis-2, axis-3, axis-4, axis-5 and axis-6 cabling. • Information about online user guide added in section The Safe-Move configurator app on FlexPendant on page 86. • Added more information for laser scanners.

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

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

Continues on next page

Operating manuals

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

How to read the product manual

Reading the procedures

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

Safety information

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

Read more in the chapter [Safety on page 15](#).

Illustrations

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

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

1 Safety

1.1 Safety information

1.1.1 Limitation of liability

Limitation of liability

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

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

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

- Use of the robot in other ways than intended.
- Incorrect operation or maintenance.
- Operation of the robot when the safety devices are defective, not in their intended location or in any other way not working.
- When instructions for operation and maintenance are not followed.
- 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.

Intended use

The ABB robot is intended for automation of different tasks including moving/handling parts and production equipment or carrying sensors etc. Application ranges from traditional manufacturing to services.

The integrator of the robot system is required to perform an assessment of the hazards and risks.

The CRB 15000 manipulator is only intended for use with the ABB OmniCore C30 controller.

Spare parts and equipment

ABB supplies original spare parts and equipment which have been tested and approved. 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 Safety

1.1.2 Requirements on personnel

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.

Risk of entanglement

Loose clothing should not be worn and long hair should be tied up to reduce the risk for entanglement.

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 Safety

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

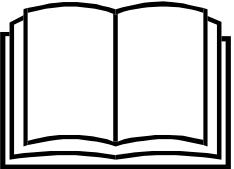
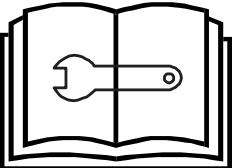
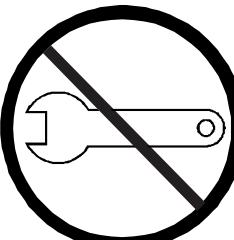
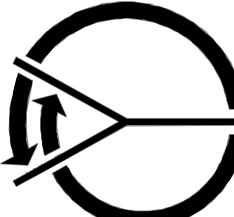
Symbol	Description
	Warning! Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, etc. xx0900000812
	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. xx0900000811
	Prohibition Used in combinations with other symbols. xx0900000839

Continues on next page

1 Safety

1.2.2 Safety symbols on manipulator labels

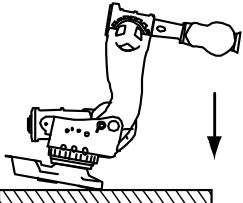
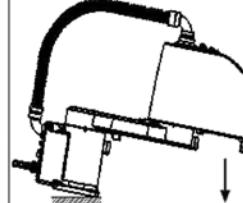
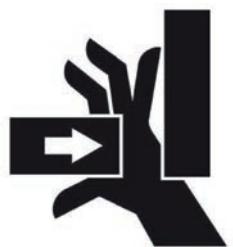
Continued

Symbol	Description
 xx0900000813	See user documentation Read user documentation for details. Which manual to read is defined by the symbol: <ul style="list-style-type: none">No text: <i>Product manual</i>.
 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 Using the brake release tool will release the brakes. This means that the robot arm can fall down.

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1.2.2 Safety symbols on manipulator labels

Continued

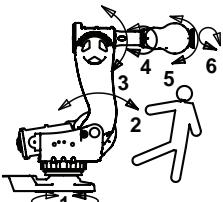
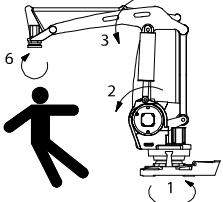
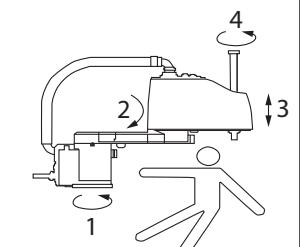
Symbol	Description
 xx0900000810	Tip risk when loosening bolts The robot can tip over if the bolts are not securely fastened.
  3HAC 057068-001	
  xx0900000817	Crush Risk of crush injuries.

Continues on next page

1 Safety

1.2.2 Safety symbols on manipulator labels

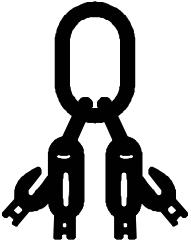
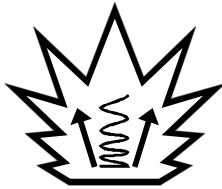
Continued

Symbol	Description
 xx0900000818	Heat Risk of heat that can cause burns. (Both signs are used)
 xx1300001087	
 xx0900000819	Moving robot The robot can move unexpectedly.
 xx1000001141	
 xx1500002616	
 xx0900000821	Lifting bolt

Continues on next page

1.2.2 Safety symbols on manipulator labels

Continued

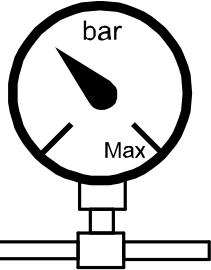
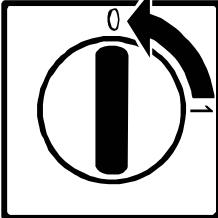
Symbol	Description
 xx1000001242	Chain sling with shortener
 xx0900000822	Lifting of robot
 xx0900000823	Oil Can be used in combination with prohibition if oil is not allowed.
 xx0900000824	Mechanical stop
 xx1000001144	No mechanical stop
 xx0900000825	Stored energy Warns that this part contains stored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

Continues on next page

1 Safety

1.2.2 Safety symbols on manipulator labels

Continued

Symbol	Description
	Pressure Warns that this part is pressurized. Usually contains additional text with the pressure level.
	Shut off with handle Use the power switch on the controller.
	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*

Reasons for selection of stops in CRB 15000

For nearly all safety functions in CRB 15000, a category 1 stop is defined.

Exceptions are only allowed:

- When there is a technical fault in the system, or
- If the standstill supervision (category 2 stop) condition is violated. This is required by ISO 10218-1 §5.5.3.

Category 1 stops are used otherwise because:

- Stopping using the motor produces repeatable stopping distances (no variation of brake friction coefficient).
- Stopping using the motor produces the shortest stopping distance without any risk of overloading structural components (pre-defined braking torque, no delay).
- Stopping using the motor saves on brake wear, so that the brake can perform its primary (holding) function for longer.
- An off-path category 1 stop is best suited to *Power and Force Limiting*: it stops as fast as possible and does not try to maintain the path, so minimizing the forces applied by the robot.

Because of these reasons, the end user/system integrator should always use a category 1 stop for CRB 15000 *Safety Functions* in the application risk assessment.

1 Safety

1.4 Safety during installation and commissioning

1.4 Safety during installation and commissioning

National or regional regulations

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

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

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

Layout

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

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

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

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

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

Allergenic material

See [Environmental information on page 739](#) for specification of allergenic materials in the product, if any.

Securing the robot to the foundation

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

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

Electrical safety

Incoming mains must be installed to fulfill national regulations.

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

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

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

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



Note

Use a CARBON DIOXIDE (CO₂) extinguisher in the event of a fire in the robot.

Continues on next page

Safety devices

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

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

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

Other hazards

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

- Water
- Compressed air
- Hydraulics

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

Specific information for GoFa robots

The CRB 15000 collaborative robot is designed to be able to work safely alongside humans and even share tasks with them. It is vital for the user of the robot to operate it in a safe way, setting up the necessary safety configurations, and ensure that appropriate risk reduction measures are implemented. See sections *Working closely with the robot in a safe way on page 79*, and *The SafeMove configurator app on FlexPendant on page 86*, as well as *Guidelines for transient and quasi-static contact, CRB 15000 on page 97* for details on how to do this.

The CRB 15000 collaborative robot has no provision for mechanical stops to limit axis motion (see ISO 10218-1, §5.12.1). Instead, safety-related soft axis limiting (see ISO 10218-1, §5.12.3) should be used to limit motion if required. This can be implemented using the safety function *Axis Position Supervision*, described in the SafeMove manual.

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 Safety

1.5 Safety during operation

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.

1.6 Safety during maintenance and repair

1.6.1 Safety during maintenance and repair

General

Corrective maintenance must only be carried out by personnel trained on the robot. Maintenance or repair must be done with all electrical, pneumatic, and hydraulic power switched off, that is, no remaining hazards. Make sure that there are no loose screws, turnings, or other unexpected parts remaining after work on the robot has been performed. 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.

Risk of exceeding design life

Regular inspections, maintenance, and exchange of worn components are essential to ensure the safe operation of this robot. Follow the instructions in section [Maintenance on page 131](#).

Related information

See also the safety information related to installation and operation.

1 Safety

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 using a brake release tool.

How to release the brakes is described in the section:

- *Manually releasing the brakes on page 52.*

1.6.3 Brake testing

When to test

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

How to test

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

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

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



Note

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

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

1 Safety

1.7 Safety during troubleshooting

General

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

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



DANGER

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

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

Related information

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

1.8 Safety during decommissioning

General

See section [Decommissioning on page 739](#).

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2 Manipulator description

2.1 About CRB 15000

Introduction

The CRB 15000 robot is a lightweight, flexible, agile 6-axis articulated robot, with a payload of 5 kg, designed specifically for manufacturing industries that use flexible robot-based automation. The robot has an open structure that is especially adapted for flexible use, and can communicate extensively with external systems.



Note

The CRB 15000 can only be used together with OmniCore C30.

2 Manipulator description

2.2 Technical data

2.2 Technical data

Weight, robot

The table shows the weight of the robot.

Robot model	Nominal weight
CRB 15000	28 kg



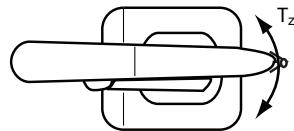
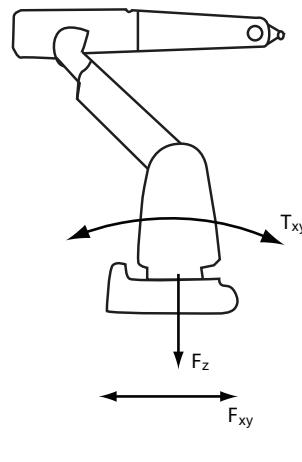
Note

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

Loads on foundation, robot

The illustration shows the directions of the robots stress forces.

The directions are valid for all floor mounted, table mounted, wall mounted and suspended robots.



xx1100000521

F_{xy}	Force in any direction in the XY plane
F_z	Force in the Z plane
T_{xy}	Bending torque in any direction in the XY plane
T_z	Bending torque in the Z plane

Continues on next page

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).

Floor mounted

Force	Endurance load (in operation)	Maximum load (emergency stop)
Force xy	$\pm 303 \text{ N}$	$\pm 1113 \text{ N}$
Force z	$+280 \pm 147 \text{ N}$	$+280 \pm 857 \text{ N}$
Torque xy	$\pm 246 \text{ Nm}$	$\pm 711 \text{ Nm}$
Torque z	$\pm 145 \text{ Nm}$	$\pm 334 \text{ Nm}$

Wall mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	$+280 \pm 130 \text{ N}$	$+280 \pm 1000 \text{ N}$
Force z	$\pm 289 \text{ N}$	$\pm 944 \text{ N}$
Torque xy	$\pm 275 \text{ Nm}$	$\pm 768 \text{ Nm}$
Torque z	$\pm 162 \text{ Nm}$	$\pm 338 \text{ Nm}$

Suspended

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	$\pm 303 \text{ N}$	$\pm 1113 \text{ N}$
Force z	$-280 \pm 147 \text{ N}$	$-280 \pm 857 \text{ N}$
Torque xy	$\pm 246 \text{ Nm}$	$\pm 711 \text{ Nm}$
Torque z	$\pm 145 \text{ Nm}$	$\pm 334 \text{ Nm}$

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	The value for levelness aims at the circumstance of the anchoring points in the robot base.
Maximum tilt	No restriction	Wall mounted robot has a work area for axis 1 that depends on payload and the positions of other axes. Simulation in RobotStudio is recommended.

Continues on next page

2 Manipulator description

2.2 Technical data

Continued

Requirement	Value	Note
Minimum resonance frequency	22Hz  Note	The value is recommended for optimal performance. Due to foundation stiffness, consider robot mass including equipment. It may affect the manipulator lifetime to have a lower resonance frequency than recommended. For information about compensating for foundation flexibility, see <i>Application manual - Controller software OmniCore</i> , section <i>Motion Process Mode</i> .
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.

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

Parameter	Value
Minimum ambient temperature	-40°C
Maximum ambient temperature	70°C
Maximum ambient temperature (less than 24 hrs)	70°C
Maximum ambient humidity	95% at constant temperature (not intended to operate with condensation)
Maximum ambient altitude	0-3,000 m (100-74 kPa)

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	5°C ⁱ
Maximum ambient temperature	40°C
Maximum ambient humidity	95% at constant temperature
Maximum ambient altitude	0-2,000 m (100-84 kPa)

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

Continues on next page

Protection classes, robot

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

Protection type	Protection class ⁱ
Manipulator, protection type Standard	IP54

ⁱ According to IEC 60529.

Environmental information

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

Joint torques

In collaborative applications, the joint torque must be considered in the risk analysis. The following table shows the maximum torque for each joint. The maximum value can be achieved on one axis at a time.

Axis	Maximum joint torque
1	175.44 Nm
2	175.44 Nm
3	90.6 Nm
4	18.72 Nm
5	21.44 Nm
6	9.2 Nm

2 Manipulator description

2.3 Safety data

2.3 Safety data

Prevailing standards and directives

For the use of industrial robots, regulations must be fulfilled as described in the following standards and directives:

- EN ISO 10218-1:2011
- Machinery Directive 2006/42/EC

Performance level and category

EN ISO 10218-1 requires structure category 3 and performance level *PL d* on the robot, see EN ISO 13849-1.

Risk assessment

The results of a risk assessment performed on the robot and its intended application may determine that a safety-related control system performance other than that stated in ISO 10218 is warranted for the application.

The SISTEMA/ABB FSDT libraries contains details for the safety functions.

Performance level for OmniCore C30 for CRB 15000

The OmniCore C30 for CRB 15000 controller safety system has a safety *category 3* with performance level *PL d* according to EN ISO 13849-1:2015 and thus fulfils the safety performance requirement of the robot safety standard EN ISO 10218-1:2011.

Safety data for SafeMove function - OmniCore C30 for CRB 15000

	SafeMove functions	Category (SRP/CS)	PFH _D (SRP/CS) [1/hour]	PL	PFH _D (including brake) ⁱ [1/hour]
1	Enabling function	3	1.96x10 ⁻⁷	d	3.33x10 ⁻⁷
2	Emergency stop	3	2.05x10 ⁻⁷	d	3.42x10 ⁻⁷
3a	Protective stop (discrete)	3	2.14x10 ⁻⁷	d	3.51x10 ⁻⁷
3b	Protective stop (safe bus)	3	2.25x10 ⁻⁷	d	3.62x10 ⁻⁷
4	Category 0 stop	3	2.25x10 ⁻⁷	d	3.62x10 ⁻⁷
5	Monitored category 1 stop	3	2.40x10 ⁻⁷	d	3.77x10 ⁻⁷
6	Axis Position Supervision	3	2.40x10 ⁻⁷	d	3.77x10 ⁻⁷
7	Axis Speed Supervision	3	2.40x10 ⁻⁷	d	3.77x10 ⁻⁷
8	Stand Still Supervision	3	2.40x10 ⁻⁷	d	3.77x10 ⁻⁷
9	Tool Position Supervision	3	2.40x10 ⁻⁷	d	3.77x10 ⁻⁷

Continues on next page

	SafeMove functions	Category (SRP/CS)	PFH _D (SRP/CS) [1/hour]	PL	PFH _D (including brake) ⁱ [1/hour]
10	Tool Orientation Supervision	3	2.40x10 ⁻⁷	d	3.77x10 ⁻⁷
11	Tool Speed Supervision	3	2.40x10 ⁻⁷	d	3.77x10 ⁻⁷
12	TCP Force Supervision	3	2.50x10 ⁻⁷	d	3.87x10 ⁻⁷
13	Axis Torque Supervision	3	2.50x10 ⁻⁷	d	3.87x10 ⁻⁷
14	Control Error Supervision	3	2.40x10 ⁻⁷	d	3.77x10 ⁻⁷
15	Contact Application Tolerance	3	2.40x10 ⁻⁷	d	3.77x10 ⁻⁷

ⁱ Calculated using $PFHd_{Brake} = 1 / (MTTFd_{Brake} \text{ (years)} \times 8760 \text{ hours/year})$. This is formally inconsistent with ISO 13849-1 but gives a realistic estimation of the risk reduction provided by the safety functions.



Note

All safety functions comply with ISO 10218-1: the SRP/CS achieves Category 3, PL d.

The Cyclic Brake Check must be run every 8-48 hours. For more details see [Running the Cyclic Brake Check routine on page 142](#).



Note

For the manipulator, all the safety functionality is included in the joint units. These are only designed to be replaced as complete units (see section [Repair on page 145](#)). Individual subcomponents shall not be exchanged.

The maximum communication and manipulator reaction times must be added to the reaction times from SafeMove (see *Application manual - Functional safety and SafeMove*).

- For stopping functions: 4 ms
- For position and torque monitoring functions: 6 ms
- Brake closing time <110 ms



Note

A violation of the standstill monitoring will result in a Category 0 stop (see ISO 10218-1 §5.5.3). Due to the brake closing time, the robot can fall some distance before it stops. Sufficient space must be provided around the robot to prevent an operator from being trapped. The falling distance and maximum speed are dependent on the robot pose, so this must be validated.

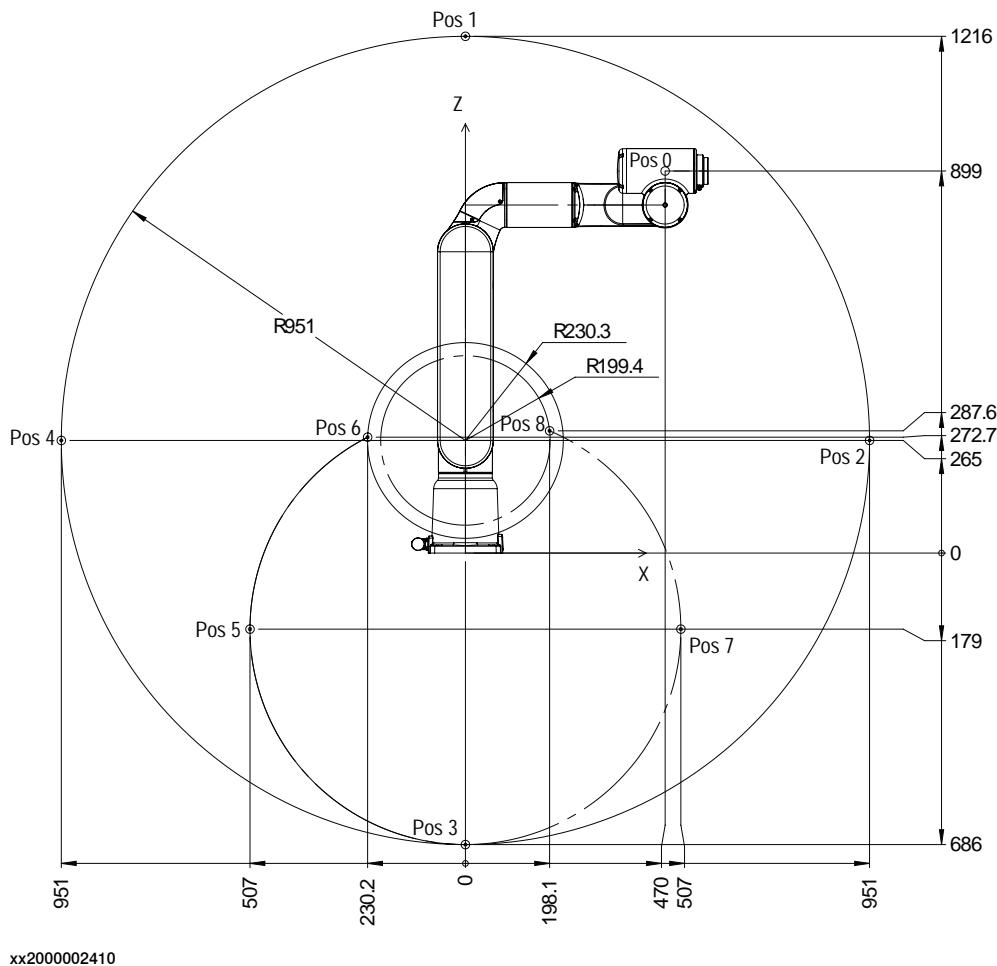
2 Manipulator description

2.4 Working range

2.4 Working range

Illustration, working range CRB 15000

This illustration shows the unrestricted working range of the robot.

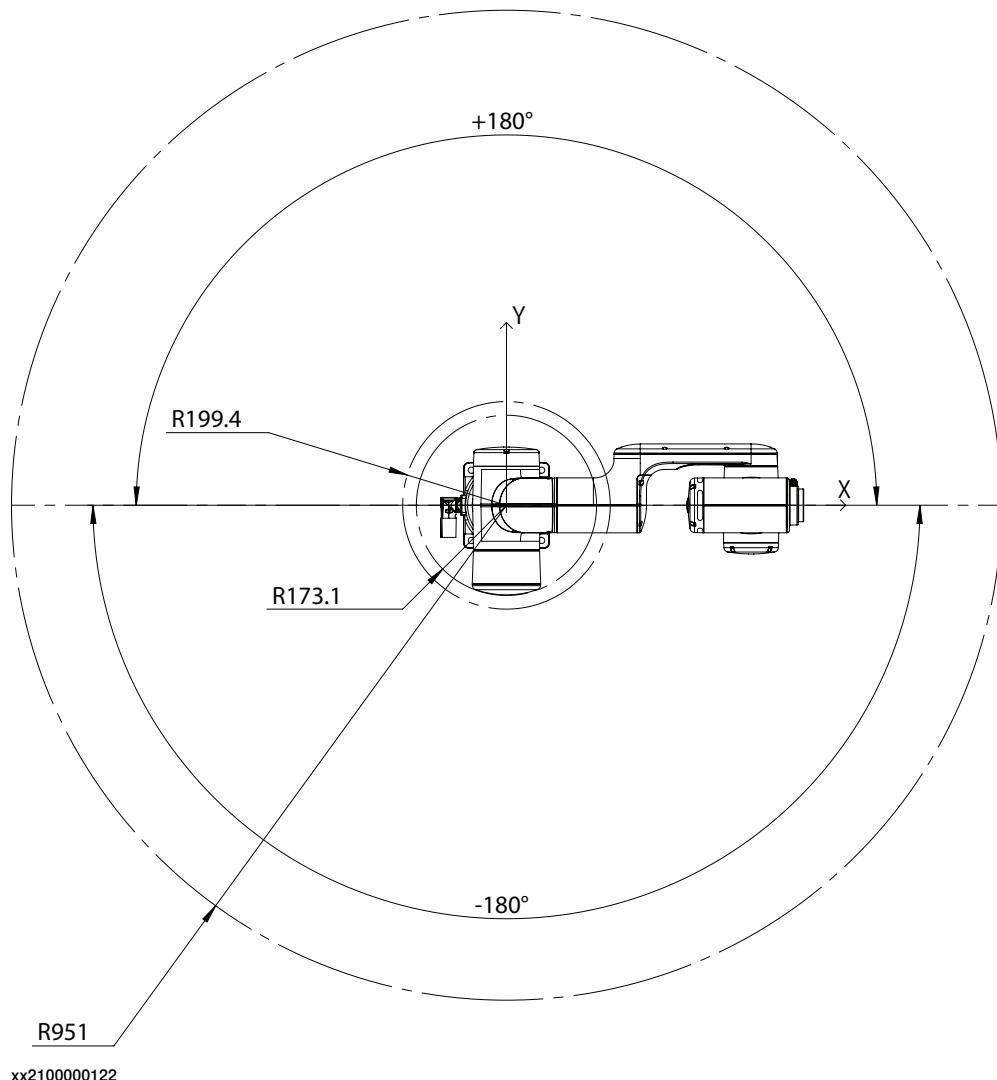


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Positions at intersection point of axes 4-5-6 and angle of axes 2 and 3

Position in the figure	Positions at wrist center (mm)		Angle (degrees)	
	X	Z	axis 2	axis 3
pos0	470	899	0°	0°
pos1	0	1216	0°	-68°
pos2	951	265	90°	-68°
pos3	0	-686	180°	-68°
pos4	-951	265	-90°	-68°
pos5	-507	-179	180°	22°
pos6	-230.2	272.7	180°	85°
pos7	507	-179	180°	-158°
pos8	198.1	287.6	180°	-225°

Continues on next page

Top view of working range**Working range**

Axis	Working range	Note
Axis 1	$\pm 180^\circ$	Wall mounted robot has a work area for axis 1 that depends on payload and the positions of other axes. Simulation in RobotStudio is recommended.
Axis 2	$\pm 180^\circ$	
Axis 3	$-225^\circ/+85^\circ$	
Axis 4	$\pm 180^\circ$	
Axis 5	$\pm 180^\circ$	
Axis 6	$\pm 270^\circ$	

2 Manipulator description

2.5 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 CRB 15000 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.

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 CRB 15000 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*

3 Installation and commissioning

3.2.1 Pre-installation procedure

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: <i>Weight, robot on page 36</i>
6	If the robot is not installed directly, it must be stored as described in: <i>Storage conditions, robot on page 38</i>
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: <i>Operating conditions, robot on page 38</i>
8	Before taking the robot to its installation site, make sure that the site conforms to: <ul style="list-style-type: none">• <i>Loads on foundation, robot on page 36</i>• <i>Protection classes, robot on page 39</i>• <i>Requirements, foundation on page 37</i>
9	Before moving the robot, please observe the stability of the robot: <i>Risk of tipping/stability on page 47</i>
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: <i>On-site installation on page 48</i>
11	Install required equipment, if any.

3.2.2 Risk of tipping/stability

Risk of tipping

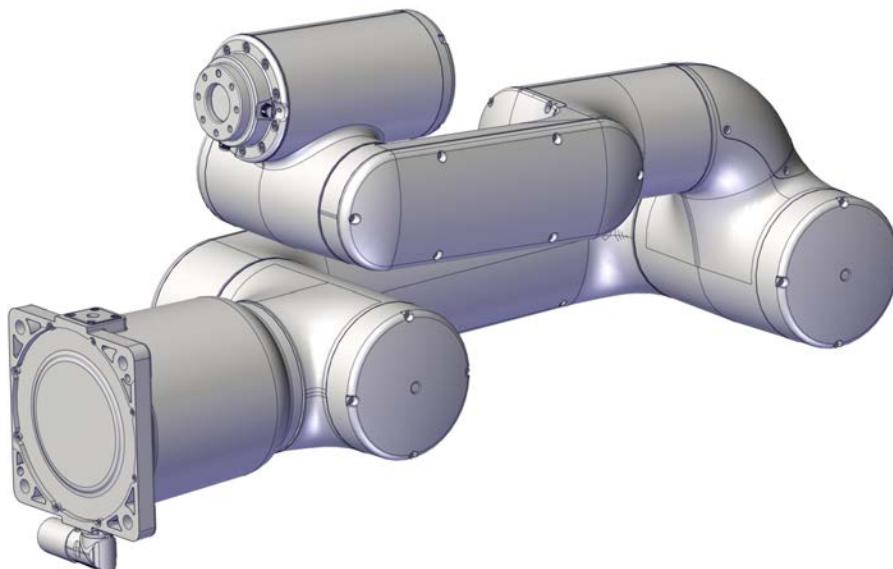
The robot is delivered lying flat in the delivery package and cannot stand on its own without being secured to the foundation.

If the robot can not be fastened to the foundation directly, store it in the delivery package.

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

Transportation and shipping position

This figure shows the robot in its shipping position, which also is a recommended transportation position.



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Axis 1	0°
Axis 2	0°
Axis 3	+85°
Axis 4	0°
Axis 5	0°
Axis 6	0°



WARNING

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

3 Installation and commissioning

3.3.1 Brief installation procedure

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 46](#).

First installation

Use these procedures to install the CRB 15000.

	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 49 . See Orienting and securing the robot on page 49 .
4	Connect the manipulator to the controller.	See <ul style="list-style-type: none">• Product manual - OmniCore C30
5	Configure the safety settings.	See <ul style="list-style-type: none">• Product manual - OmniCore C30
6	How to start and run the robot is described in the product manual for the controller.	See <ul style="list-style-type: none">• Product manual - OmniCore C30
7	Install required equipment, if any. <ul style="list-style-type: none">• Installation of brake release tool on page 55	
8	 DANGER Make sure all safety requirements are met when performing the first test run.	



Note

Wait till the robot has reached room temperature before switching on the mains power. Otherwise there might be a risk of condensation on internal components such as electronics.

3.3.2 Lifting the robot

3.3.2.1 Orienting and securing the robot

Introduction

This section describes how to lift the robot and transport it to the installation site. Two persons are always required when lifting and securing the robot.

Do not leave the robot standing unfastened to the foundation, it is not stable on its own.



CAUTION

The manipulator must not be connected to power during lifting and securing it to the foundation.

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.

All hardware is enclosed in the robot delivery.

Suitable screws	M10x35
Quantity	4 pcs
Quality	8.8
Suitable washer	23/10.5/2.5 mm Steel
Guide pins	DIN6325, hardened steel Ø6x24 mm, 2 pcs
Tightening torque	30 Nm ±10%
Length of thread engagement	Minimum 15 mm for ground with material yield strength 150 MPa
Level surface requirements	0.1/500 mm

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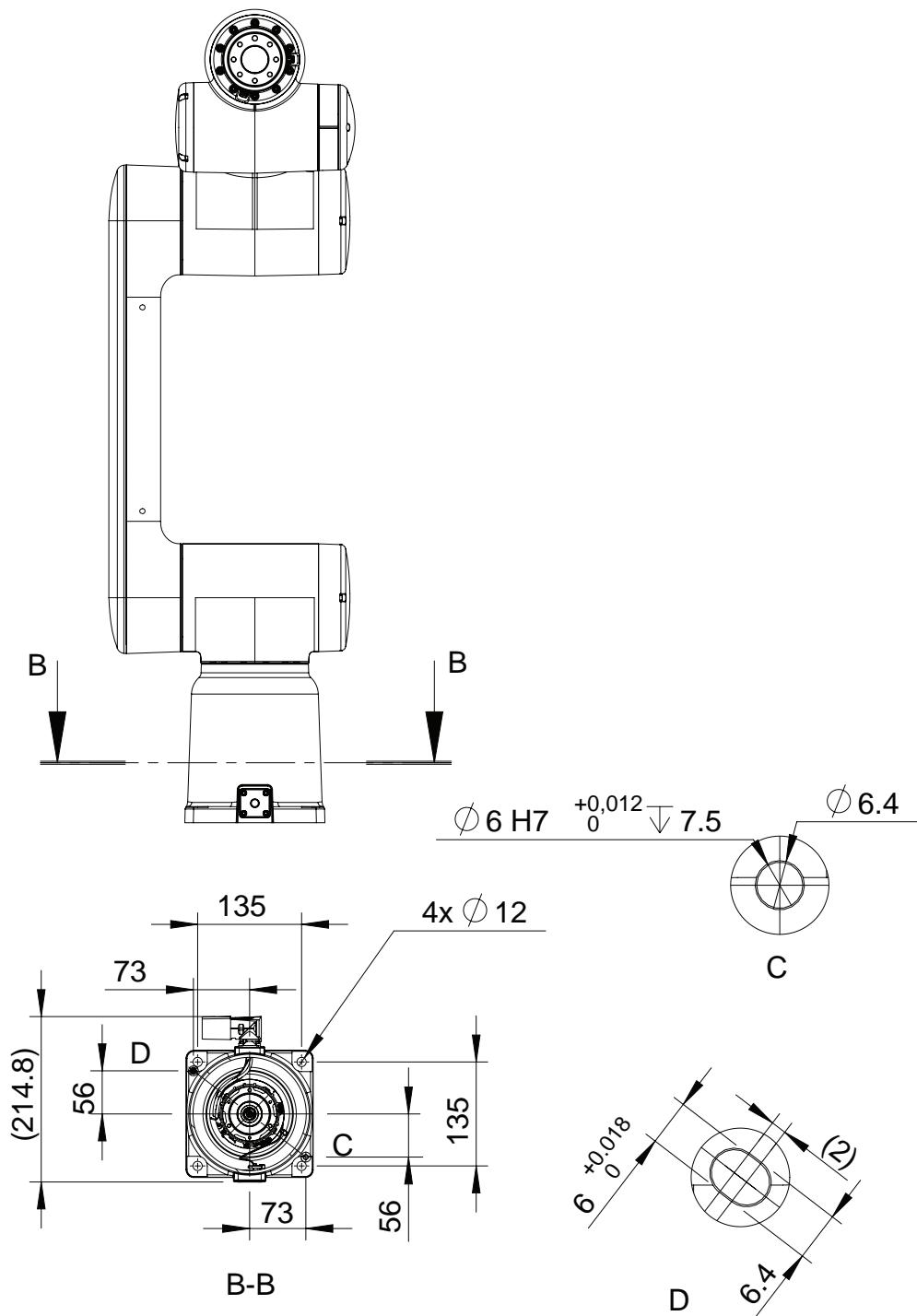
3 Installation and commissioning

3.3.2.1 Orienting and securing the robot

Continued

Hole configuration, base

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



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C	Circular hole for locating pin
D	Elongated hole for locating pin

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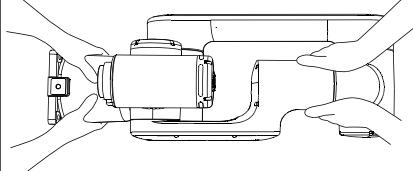
Lifting and securing the robot

Use this procedure to lift and secure the robot to its foundation.

Preparations of the installation site

	Action	Note
1	Make sure the installation site for the robot conforms to the specifications in section Technical data on page 36 .	
2	Prepare the installation site with attachment holes.	The hole configuration of the base is shown in Hole configuration, base on page 50 .

Lifting and securing the robot

	Action	Note
1	 CAUTION The CRB 15000 robot weighs 28 kg. A minimum of two persons are required for lifting as well as securing the robot in order to avoid any damage, instability, and injury. Special consideration is necessary when mounting the robot in an elevated, suspended or wall mounted position.	
2	Grasp the robot at the foot and elbow, as shown in the figure, and lift it up from the transportation package.	 xx2100000118
3	 CAUTION Do not leave the robot standing unfastened to the foundation, it is not stable on its own.	
4	Fit two pins to the holes in the base.	Centering pins: DIN6325, hardened steel Ø6x24 mm, 2 pcs .
5	Raise the robot to standing and secure to foundation, paying attention to the centering holes at the bottom of the robot base. <ul style="list-style-type: none"> • Person 1: keep holding the robot stable. • Person 2: secure the robot base to the foundation with the securing screws and washers. 	Screws: M10x35, 4 pcs, quality 8.8 Washers: 23/10.5/2.5 mm Steel
6	Tighten the bolts in a crosswise pattern to ensure that the base is not distorted.	Tightening torque: 30 Nm ±10%

3 Installation and commissioning

3.3.3 Manually releasing the brakes

3.3.3 Manually releasing the brakes

Introduction to manually releasing the brakes

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

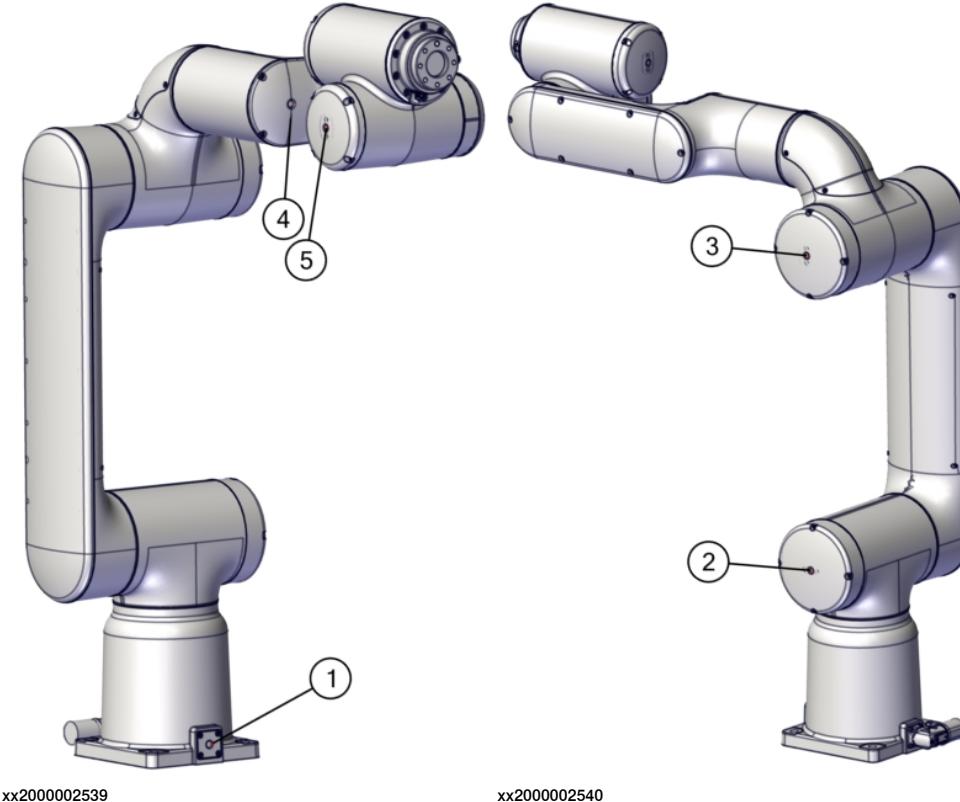
Required equipment

Equipment	Article number	Note
Brake release tool	3HAC079146-001	For releasing the holding brakes of a joint unit motor.

Location of the brake release points

The brake release points are located on each axis as shown in the figure. The numbers correspond to the axis number.

The holding brake on axis 6 can not be released manually. If axis 6 needs to be moved, release the holding brake on another proper axis instead.



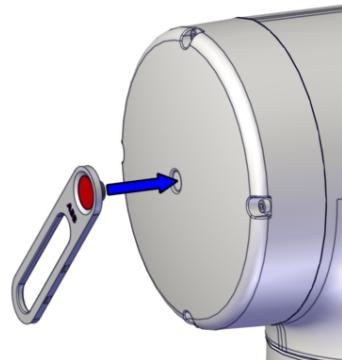
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Releasing the brakes

This procedure describes how to release the holding brakes using the brake release tool.

**Note**

The manipulator needs to be powered and motors in state Motors OFF. Do not release the brakes in automatic operating mode.

	Action	Note
1	Take out the tool from its holder.	<p>Brake release tool: 3HAC079146-001</p>  xx2000002542
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.	
3	Release the holding brake on a particular robot axis by holding the brake release tool against the small round recess at the axis. The brake will function again as soon as the tool is removed.	 xx2000002538 <p>The sensor behind the cover is triggered by the tool magnet and the corresponding motor holding brake will be released. If any faulty functionality is discovered, see Brake release tool does not work on page 728.</p>

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3 Installation and commissioning

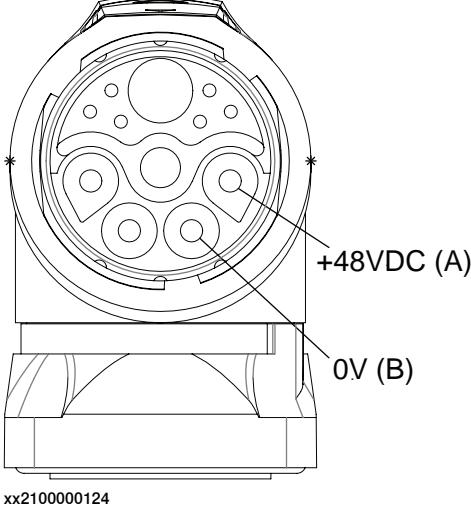
3.3.3 Manually releasing the brakes

Continued

Action	Note
4 Put back the tool in its holder and store on specified location close to the robot.	

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 sensors.

Action	Note
1  CAUTION Incorrect connections, such as supplying power to the wrong pin, may cause damage to the electrical components.	
2 Supply 0V on pin B and +48VDC on pin A.	

3.3.4 Installation of brake release tool

Brake release tool included in robot delivery

A brake release tool is included in the robot package box. The tool is used for releasing the holding brakes of the axes motors.



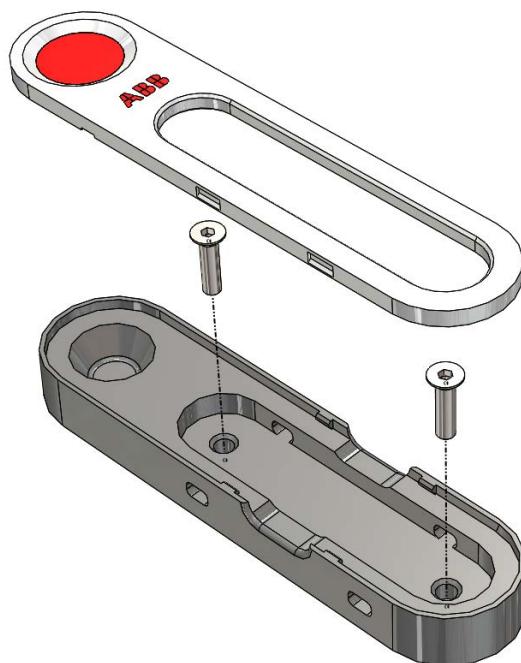
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Specify storage location

The brake release tool must be mounted or permanently stored close to the robot, for easy and quick access in case of emergency. The storage location must be well known for all personnel working with or nearby the robot.

Securing the brake release tool holder

Securing with screws



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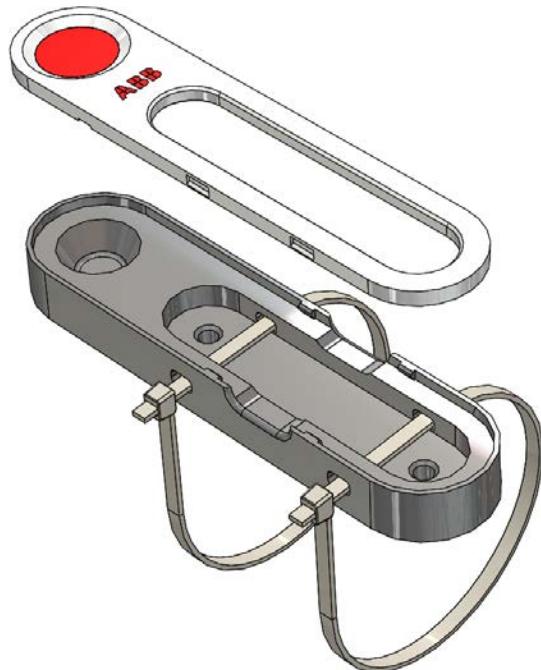
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3 Installation and commissioning

3.3.4 Installation of brake release tool

Continued

Securing with cable ties



xx2100000404

3.3.5 Setting the system parameters for an inverted or a tilted robot

3.3.5 Setting the system parameters for an inverted or a tilted robot

General

The robot is configured for mounting parallel to the floor, without tilting, on delivery. The method for mounting the robot in an inverted (upside down) or tilted position is basically the same as for floor mounting, but the system parameters that describe the mounting angle (how the robot is oriented relative to the gravity) must be re-defined.



Note

With inverted installation, make sure that the gantry or corresponding structure is rigid enough to prevent unacceptable vibrations and deflections, so that optimum performance can be achieved.



Note

The allowed mounting positions are described in the product specification for the robot. The requirements on the foundation are described in [Requirements, foundation on page 37](#).

System parameters



Note

The mounting angle must be configured correctly in the system parameters so that the robot system can control the movements in the best possible way. An incorrect definition of the mounting angle will result in:

- Overloading the mechanical structure.
- Lower path performance and path accuracy.
- Some functions will not work properly, for example *Load Identification* and *Collision detection*.

Gravity Beta

When the robot is mounted other than floor-standing (rotated around the y-axis), the robot base frame and the system parameter *Gravity Beta* must be redefined.

If the robot is mounted upside down (inverted), then *Gravity Beta* should be π (+3.141593).

If the robot is mounted on a wall, then *Gravity Beta* should be $\pm\pi/2$ (±1.570796).

The *Gravity Beta* is a positive rotation direction around the y-axis in the base coordinate system. The value is set in radians.

Gravity Alpha

If the robot is mounted on a wall (rotated around the x-axis), then the robot base frame and the system parameter *Gravity Alpha* must be redefined. The value of *Gravity Alpha* should then be $\pm\pi/2$ (±1.570796).

Continues on next page

3 Installation and commissioning

3.3.5 Setting the system parameters for an inverted or a tilted robot

Continued

The *Gravity Alpha* is a positive rotation direction around the x-axis in the base coordinate system. The value is set in radians.



Note

The system parameter *Gravity Alpha* is not supported for all robot types.

If the robot does not support *Gravity Alpha*, then use *Gravity Beta* along with the re-calibration of axis 1 to define the rotation of the robot around the x-axis.



Note

The parameter is supported for all robots on track when the system parameter *7 axes high performance motion* is set, see *Technical reference manual - System parameters*.

Gamma Rotation

Gamma Rotation defines the orientation of the robot foot on the travel carriage (track motion).

Mounting angles and values

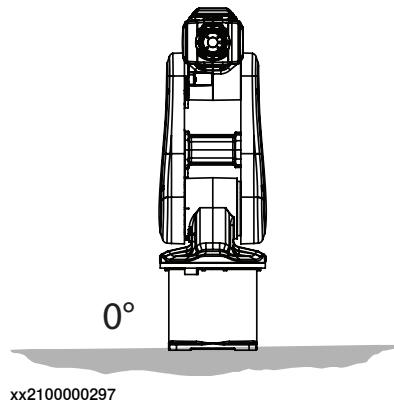
The parameter *Gravity Beta* (or *Gravity Alpha*) specifies the mounting angle of the robot in radians. It is calculated in the following way.

$\text{Gravity Beta} = A^\circ \times \frac{3.141593}{180} = B \text{ radians}$, where A is the mounting angle in degrees and B is the mounting angle in radians.

Example of position	Mounting angle (A°)	Gravity Beta
Floor mounted	0°	0.000000 (Default)
Wall mounted	90°	1.570796
Inverted mounting	180°	3.141593

Examples of mounting angles tilted around the X axis (*Gravity Alpha*)

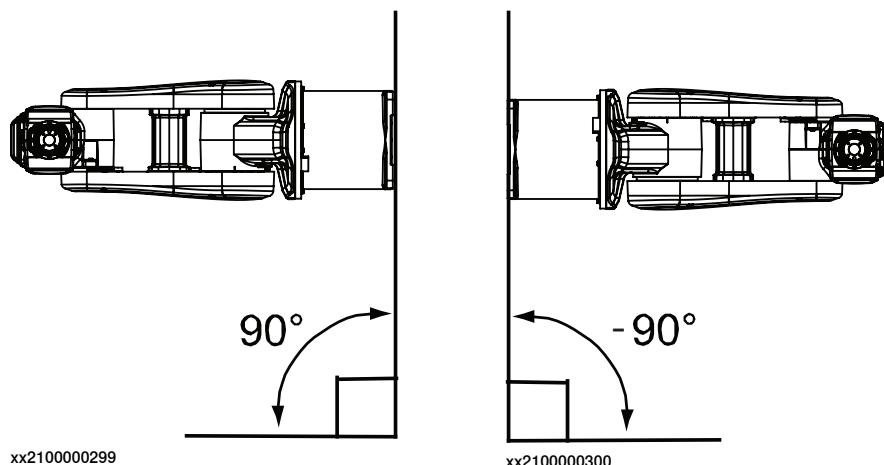
The following illustration shows the IRB 120, but the same principle applies for all robots.



Continues on next page

3.3.5 Setting the system parameters for an inverted or a tilted robot

Continued



Mounting angle	Gravity Alpha
0° (Floor mounted)	0
90° (Wall)	1.570796
-90° (Wall)	-1.570796



Note

For suspended robots (180°), it is recommended to use *Gravity Beta* instead of *Gravity Alpha*.

Limitations in working area

If mounting the robot on a wall, the working range of axis 1 is limited. These limitations are specified in the table [Working range on page 43](#).

Defining the system parameters in RobotWare

The value of the system parameters that define the mounting angle must be redefined when changing the mounting angle of the robot. The parameters belong to the type *Robot*, in the topic *Motion*.

The system parameters are described in *Technical reference manual - System parameters*.

The system parameters are configured in RobotStudio or on the FlexPendant.

3 Installation and commissioning

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 *Product specification - Robot stopping distances according to ISO 10218-1*.

3.3.7 Fitting equipment on the robot (robot dimensions)

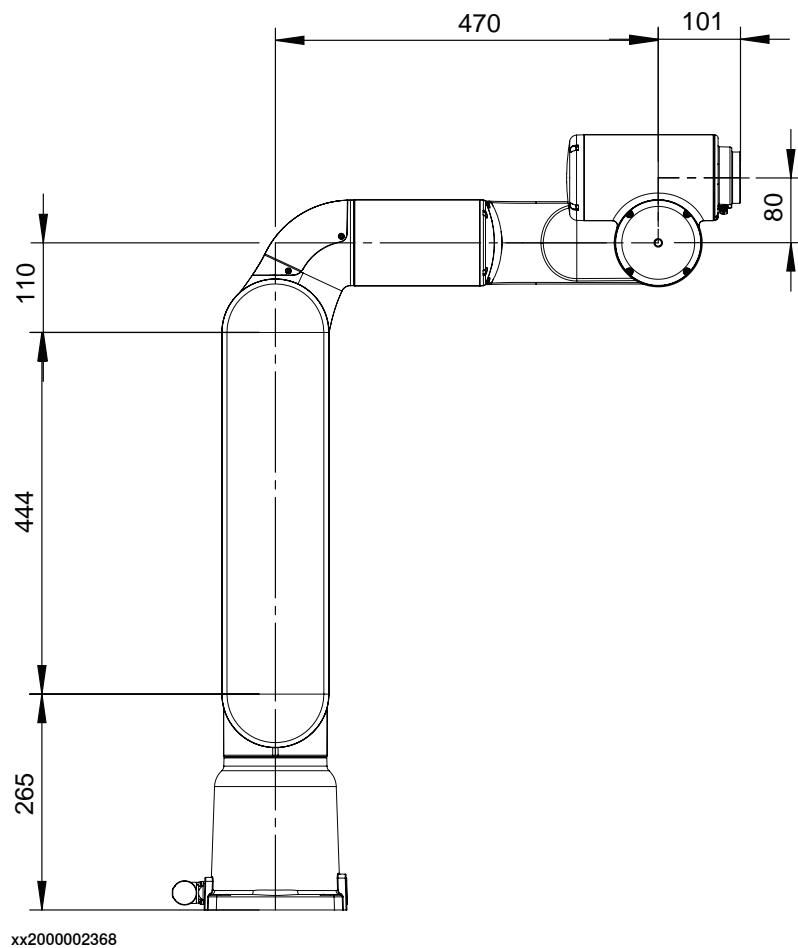


Note

Even after the robot is secured to the foundation, do not lean on it or place loads on it, except what is permitted on the tool flange.

Robot dimensions

The figure shows the dimension of the robot.



Fitting equipment on the robot

Load from equipment on robot arms

The robot arm is not designed with attachment holes for any arm load. However, for light loads such as cables, it is possible to mount them directly on the arm.

Considerations:

- Any external cable routing along the robot arm shall be done in a flexible way allowing for robot motion and taking hazards associated with entanglement into account.
- The brake release points on each axis must be accessible in the end application.

Continues on next page

3 Installation and commissioning

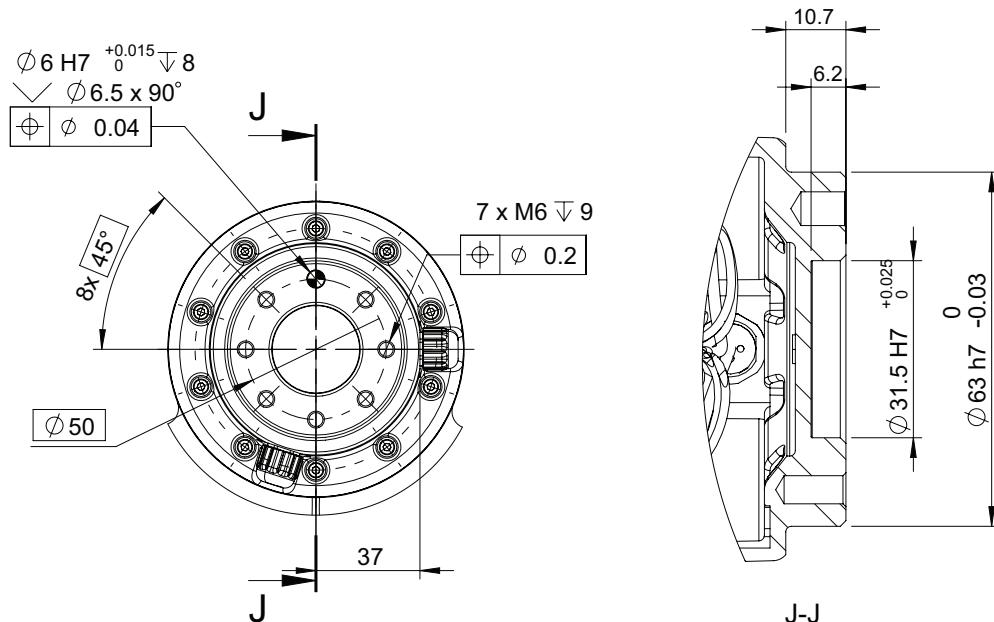
3.3.7 Fitting equipment on the robot (robot dimensions)

Continued

Brake release points are shown in [Manually releasing the brakes on page 52](#).

- The upper arm can handle a load of 5 kg. This includes the weight of the cabling, tools, and workpiece (if lifted).

Tool flange



xx2000002367

Fastener quality on tool flange

Use screws with suitable length and tightening torque for your application.

Screws with quality class 12.9 are recommended.

3.3.8 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 the brake release tool is in its intended place.
6	Verify that no personnel is leaning on, or have their head or neck close to the robot.
7	Verify that all arm covers and paddings, if any, are properly secured to the robot.
8	If maintenance or repair has been done, verify the function of the part that was maintained.
9	Verify the application in the operating mode manual reduced speed.

3 Installation and commissioning

3.3.9 Installation of laser scanner

3.3.9 Installation of laser scanner

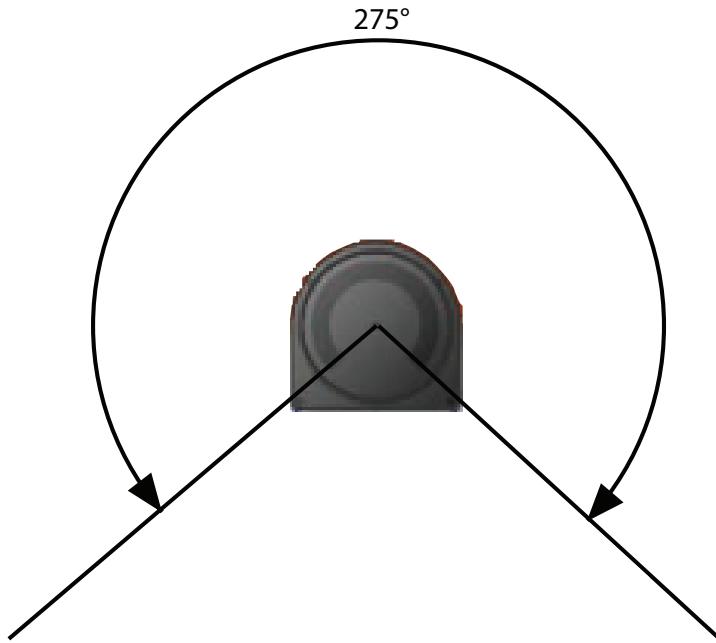
Overview

The safety separation technology and speed control for CRB 15000 is based on the connection and communication of one or two safety laser scanners in the robot. Laser scanner(s) provides a timely and continuous monitor on the activities within its scanning area and forms a protective field. One laser scanner can provide a scanning range of approximately 275°. The system integrator shall investigate the site environment and place the laser scanner to a suitable location according to the actual requirements.



CAUTION

Safety in the area that not in the scanning range must always be considered. The system integrator shall assess the potential risks within this area and make sure that proper measures have been applied to reduce risks.



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Laser scanner types

The following laser scanner package options are available:

- 1 PROFINET-based laser scanner (option 3051-1 PROFIsafe scanner)
- 2 PROFINET-based laser scanners (option 3051-3 Dual PROFIsafe scanner)
- 1 SafetyIO-based laser scanner (option 3051-2 I/O scanner)
- 2 SafetyIO-based laser scanners (option 3051-4 Dual I/O scanner)

PROFINET-based laser scanners shall connect to a PLC acting as a master first and then to the OmniCore controller with SafeMove via the PROFINET safe (PROFIsafe) network. Users need to prepare a safety PLC of their own.

Continues on next page

SafetyIO-based laser scanners connects to the OmniCore controller with SafeMove, installed with the scalable I/O device DSQC1042 Safety digital base (option 3037-1). For details about the scalable I/O device, see the product specification of the controller and *Application manual - Scalable I/O*.

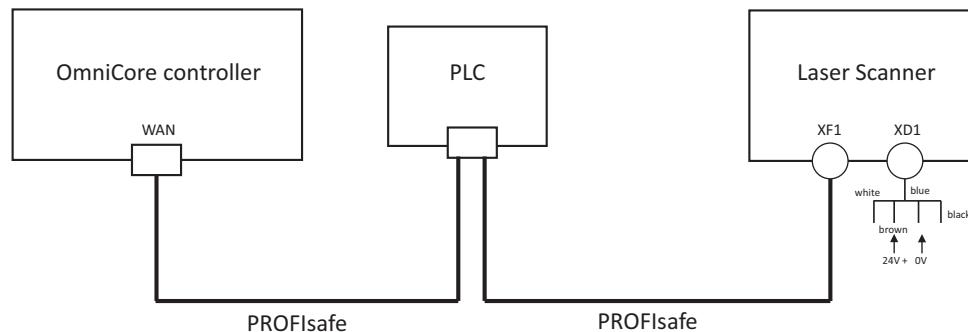
The supported PROFINET- and SafetyIO-base laser scanners are *SICK® microScan 3 Core* and *SICK® microScan 3 Pro*, respectively. Detailed scanner model can be obtained on the scanner nameplate. Other scanner types or models might not provide full functionality.

For more details about the safety laser scanners, see *Operating instructions microScan3 - PROFINET* and *Operating instructions microScan3 - Pro I/O* from the vendor.

Connecting the laser scanner(s)

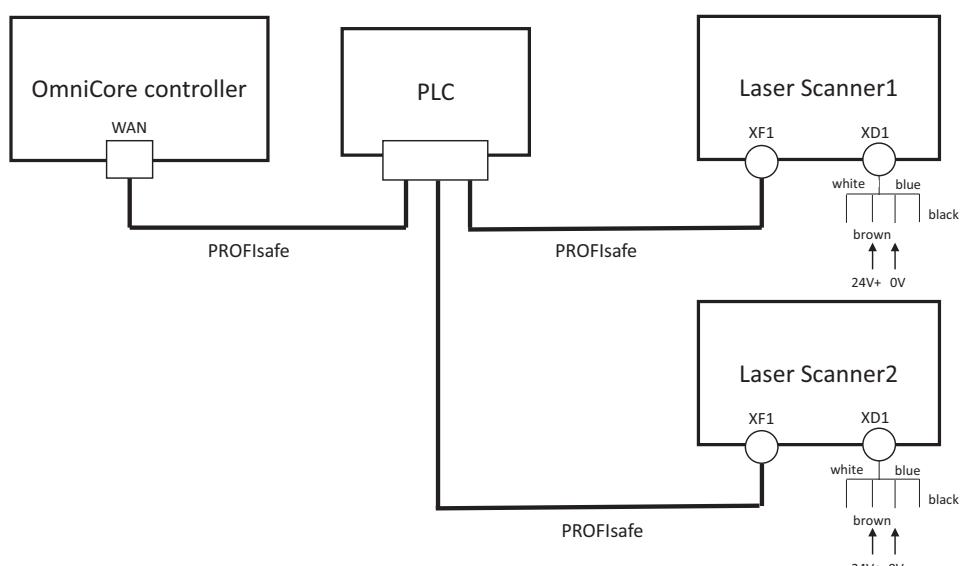
Safety laser scanners shall be connected properly according to the scanner type and system setup.

1 PROFINET-based laser scanner (option 3051-1)



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2 PROFINET-based laser scanners (option 3051-3)



xx2200000298

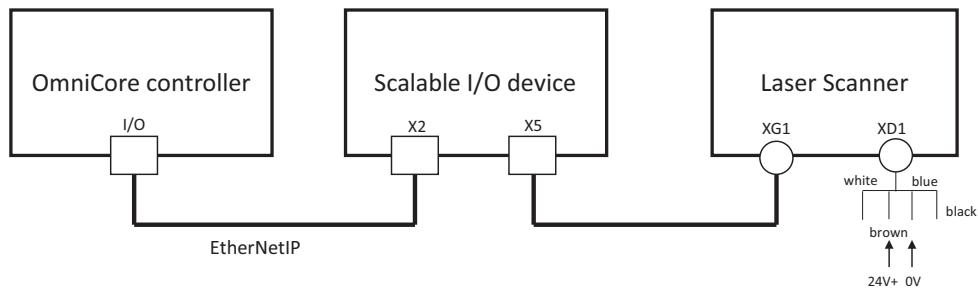
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3 Installation and commissioning

3.3.9 Installation of laser scanner

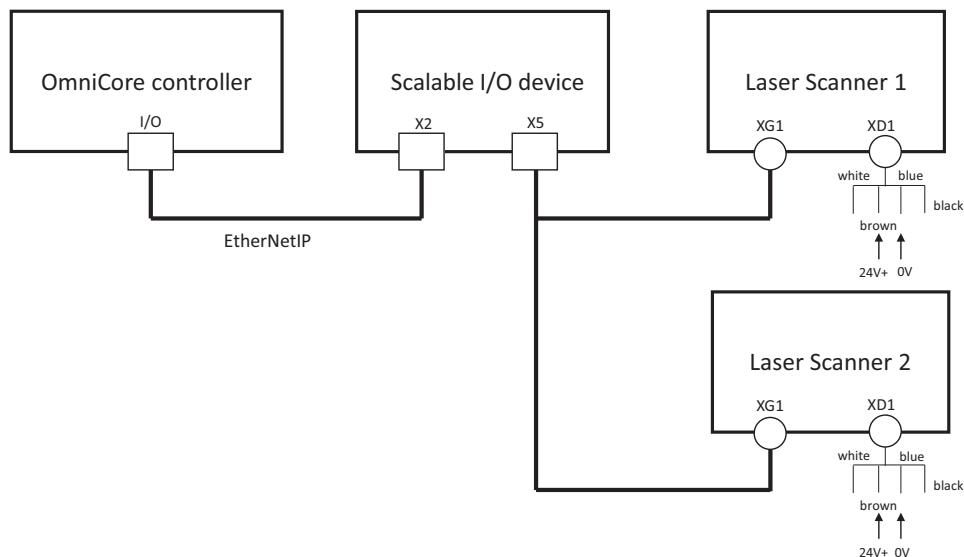
Continued

1 SafetyIO-based laser scanner (option 3051-2)



xx2200000299

2 SafetyIO-based laser scanners (option 3051-4)



xx2200000300

Continues on next page

Configuring the laser scanner(s)

Laser scanner configuration depends on the type and number of scanners connecting to the robot and RobotWare version. Refer to the following table for applicable scenario and proceed to specific section for configuration details.

Scanner type	Works with...			Number of connected scanners	RobotWare ver-sion	Re-quire...	Refer to...
	PLC	Scalable I/O device DSQC1042	OmniCore controller with SafeMove				
PROFINET-based	Y	N	Y	1	RobotWare 7.5 or earlier	N	Configuration of one PROFINET-base laser scanner (RobotWare 7.5 or earlier) on page 101
PROFINET-based	Y	N	Y	1	RobotWare 7.6 or later	Y	Configuration of one PROFINET-base laser scanner (RobotWare 7.6 or later) on page 107
PROFINET-based	Y	N	Y	2	RobotWare 7.6 or later	Y	Configuration of two PROFINET-base laser scanners (RobotWare 7.6 or later) on page 111
SafetyIO-based	N	Y	Y	1	RobotWare 7.6 or later	Y	Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later) on page 115
SafetyIO-based	N	Y	Y	2	RobotWare 7.6 or later	Y	Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later) on page 119

The following table lists the required actions for specific scenarios such as RobotWare upgrade or rollback.

Scenario	Actions
RobotWare 7.5 or an earlier version upgraded to RobotWare 7.6 or a later version	 Note Applicable only when using PROFINET-based laser scanners <ol style="list-style-type: none"> Install the Collaborative Speed Control add-in. See Information about Collaborative Speed Control add-in on page 100. Reconfigure the PLC and laser scanner. See Configuration of one PROFINET-base laser scanner (RobotWare 7.6 or later) on page 107.
RobotWare 7.6 or a later version rolled back to RobotWare 7.5 or an earlier version	 Note Applicable only when using PROFINET-based laser scanners Reconfigure the PLC and laser scanner. See Configuration of one PROFINET-base laser scanner (RobotWare 7.5 or earlier) on page 101 .

Continues on next page

3 Installation and commissioning

3.3.9 Installation of laser scanner

Continued

Scenario	Actions
Adding a new laser scanner	<ol style="list-style-type: none">1 Connect the new laser scanner in the same type as the one existing in the system. See Connecting the laser scanner(s) on page 65.2 Configure the new laser scanner. See Configuration of two PROFINET-base laser scanners (RobotWare 7.6 or later) on page 111 or Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later) on page 119.

3.4 Electrical connections

3.4.1 Robot cabling and connection points

Introduction

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



DANGER

Turn off the main power before connecting any cables.



CAUTION

Verify that the robot serial number is according to the number(s) in the *Declaration of Incorporation* (Dol).

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. Specified in the table Robot cables on page 69 .
Customer cables	Handles communication with equipment fitted on the robot by the customer, low voltage signals and high voltage power supply + protective ground. The customer cables also handle databus communication. See the product manual for the controller, see document number in References on page 10 .

Robot cables

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

Cable sub-category	Description	Connection point, cabinet	Connection point, robot
Robot cable (combined power and control cable + CP/CS)	Transfers DC bus power from power supply in the control cabinet to the drive units in the robot.	X2	R1.MP

Robot cable

Signal cable length	Article number
Hybrid floor cable 7 m	3HAC073212-002

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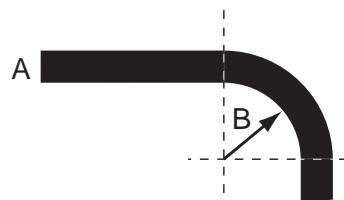
3 Installation and commissioning

3.4.1 Robot cabling and connection points

Continued

Bending radius for static floor cables

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



xx1600002016

A	Diameter
B	Diameter x10

3.4.2 Customer connections on the manipulator

Introduction

The customer cables are routed internally with the manipulator cable harness.

Customer cabling

Customer connection	Cable specification	Article number	Rating in each wire ⁱ	Note
Customer power (CP)	Raw cable is twisted pair 1x2xAWG24	See Product manual, spare parts - CRB 15000	24V ⁱⁱ 2A	Routed internally with the manipulator cable harness.
Customer signal (CS)	2x2xAWG26 in 4x2XAWG26 cable	See Product manual, spare parts - CRB 15000	24V ⁱⁱⁱ 500mA	Routed internally with the manipulator cable harness.

ⁱ Stresses above the limitation may cause permanent damage to the manipulator.

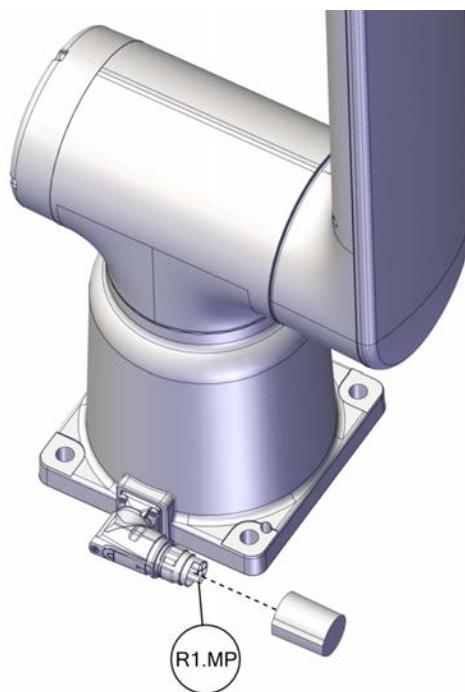
ⁱⁱ Rated 24V, max 30V

ⁱⁱⁱ Rated 24V, max 30V

Customer connectors on the manipulator

Connectors at the base

The R1.MP on the base is used for transferring DC bus, EtherCat and customer signals (CP/CS).



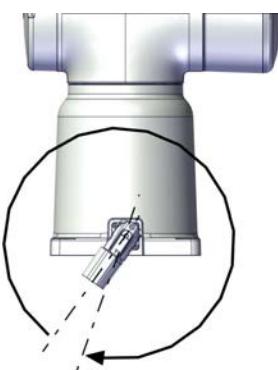
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3 Installation and commissioning

3.4.2 Customer connections on the manipulator

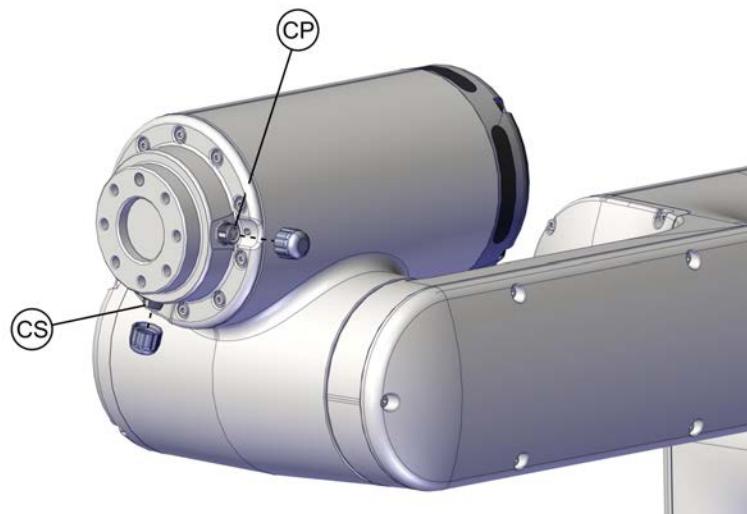
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xx2100002065

-	The connector can be rotated 330° clockwise.	
R1.MP	Receptacle angled rotatable male connector with housing and insert.	 xx2100000221
-	Plug with female connector includes housing and insert.	 xx2100000229

Connectors at the tool flange



xx2100000125

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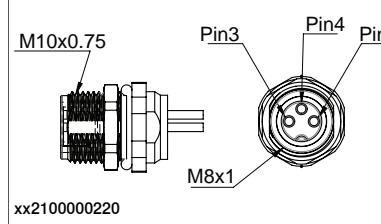
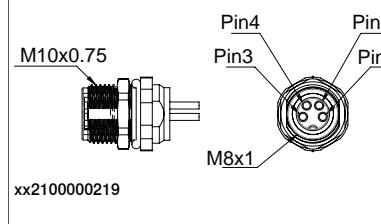
CAUTION

Always use protective caps on unused customer connectors to protect the connector and to cover sharp connector edges.



Note

Always inspect the connector for dirt or damage before connecting it. Clean or replace any damaged parts.

Pos	Connector type	Torque for mating/unmating	Layout
CP	M8 3 pin female, 200 mm wire, straight (two pins for use, one pin is spare)	0.4 Nm	 xx2100000220
CS	M8 4 pin female, 200 mm wire, straight	0.4 Nm	 xx2100000219

3 Installation and commissioning

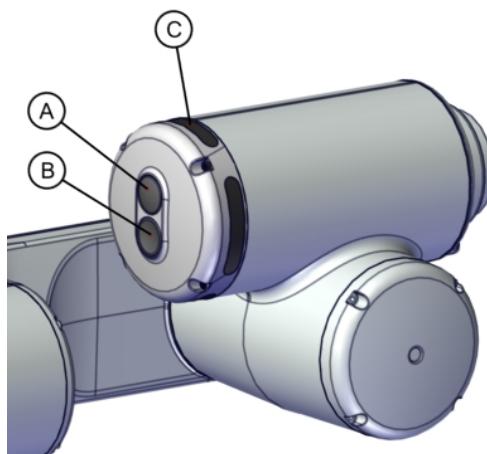
3.5.1 Configuring the arm-side interface

3.5 Arm-side interface

3.5.1 Configuring the arm-side interface

Introduction

The arm-side interface is located on axis 5, opposite to the tool flange. The configuration of the arm-side interface is done using the application **ASI Setting** on the FlexPendant.



xx2000002420

A	Up button (convex button)
B	Down button (concave button)
C	Light ring

Prerequisites

A validated safety configuration must be set up before using the arm-side interface. This must be based on a risk assessment of the application. Particular attention should be paid to the risks of impact, crushing and shearing. See [The SafeMove configurator app on FlexPendant on page 86](#), and [Application manual - Functional safety and SafeMove](#).

The tool and payload must be configured before configuring the arm-side interface. See [Operating manual - OmniCore](#).

Continues on next page



WARNING

When using the lead-through function from the arm-side interface, make sure that no one else can take control of the robot.

- In manual mode, by having a FlexPendant connected to the controller.
- In automatic mode, by setting up the system with caution regarding who has the user grant UAS_REMOTE_START_STOP_IN_AUTO. This grant is required to start or stop program execution in automatic mode. Any user with this grant should be located within eyesight of the robot. The FlexPendant can always be used to start or stop program execution.

See also [Working closely with the robot in a safe way on page 79](#).



CAUTION

The robot is delivered with the buttons and LED lights pre-configured. During installation this configuration must be verified before commissioning the application.



CAUTION

When using the arm-side interface, make sure to use zone limits or physical barriers to prevent contact between the manipulator and the human head. This applies both to commissioning and automatic operation.



CAUTION

During fine tuning of positions, make sure not to place your head too close to the manipulator.

Default configuration of the arm-side interface

On delivery, the up button is configured to enable lead-through. The down button is configured to add a move block in the *Wizard* software. The configuration is shown on the FlexPendant.

On delivery, the light ring shows the states according to the following table:

Color of the light ring	State of the robot
White	Stand by
Green	Program running
Yellow	Lead through/programming mode
Red	Error

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3 Installation and commissioning

3.5.1 Configuring the arm-side interface

Continued

Configuring the buttons



Note

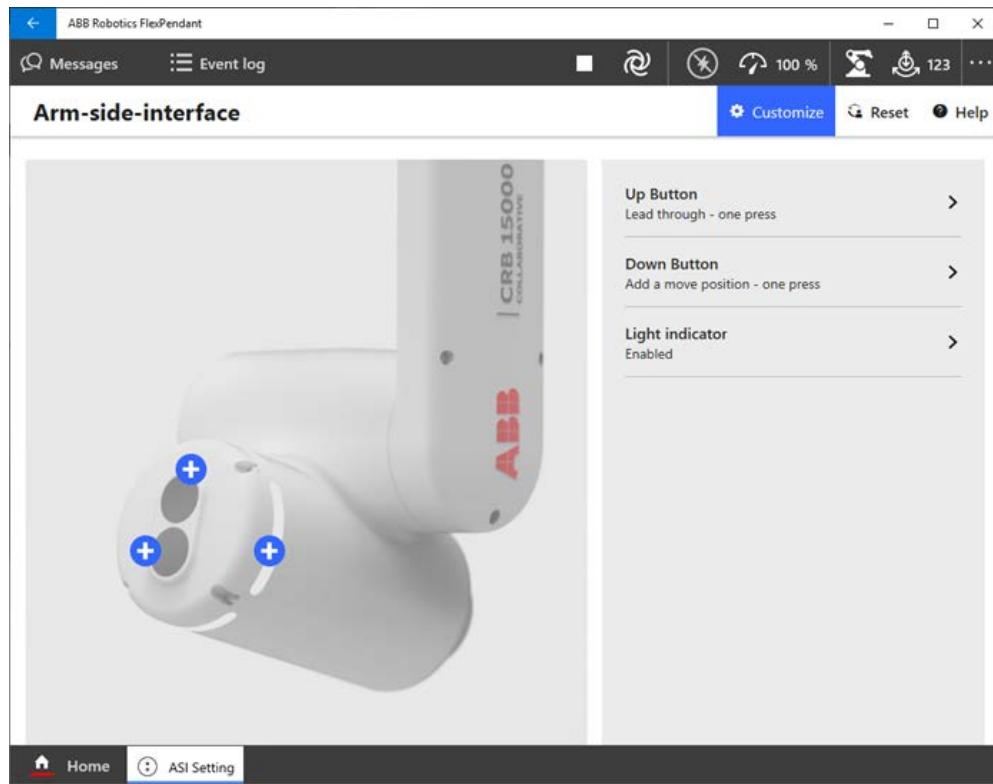
The buttons are deactivated until there is a valid safety configuration in the robot controller.

The buttons on the arm-side interface are configured with RAPID routines in the module `GOFA_ASI_Procedures`, located in the task `T_ROB1`.

On delivery, a number of pre-configured routines are available. These can be customized as needed, and more routines can be added. All routine names must start with `ASI_`

For the default configuration of the arm-side interface, no hazards can arise if both buttons are pressed simultaneously. Consequently, the ASI application does not trap or prevent this situation. Should the button configuration be changed, it must be checked whether hazards could arise if the buttons are pressed at the same time. If necessary, mitigations must be provided in the RAPID code. Simultaneous pressing of both ASI buttons shall be considered in the application risk assessment.

To change what routine to run when pressing a button, use the FlexPendant app **ASI Setting**.



For more information on RAPID, see *Technical reference manual - RAPID Instructions, Functions and Data types* and *Technical reference manual - RAPID Overview*.

Continues on next page

For more information about *Wizard*, see *Application manual - Wizard*.

Example of RAPID routine with MoveJ

Example of customized routine with the instruction MoveJ.

```
PROC ASI_MoveRobot()
    TPWrite "The robot will move along path";
    MoveJ Target_10,v1000,z100,tool0\WObj:=wobj0;
    MoveJ Target_20,v1000,z100,tool0\WObj:=wobj0;
    MoveJ Target_30,v1000,z100,tool0\WObj:=wobj0;
    MoveJ Target_20,v1000,z100,tool0\WObj:=wobj0;
    MoveJ Target_30,v1000,z100,tool0\WObj:=wobj0;
ENDPROC
```

Example of RAPID routine with TPWrite

Example of customized routine with the instruction TPWrite.

```
PROC ASI_Routine1()
    MoveJ
        [[0,0,0],[1,0,0,0],[0,0,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]],v100,z0,tool0;
    TPWrite "Example 1";
ENDPROC
```

Configuring the light ring

The arm-side interface has a light ring with LED lights that indicate status. The configuration is shown on the FlexPendant.

The light will blink when a button is pressed on the arm-side interface.



Note

In RobotWare 7.2, the light ring configuration cannot be changed, only disabled.

Testing the FlexPendant connection

The **ASI Setting** application can be used to verify to which robot the FlexPendant is connected.

- 1 In the **ASI Setting** application, select **Light indicator**.
- 2 Toggle the **Enabled** switch to turn on or off the light ring on the robot.
- 3 Inspect on which robot the light ring is affected.

3 Installation and commissioning

3.5.2 Using the arm-side interface



WARNING

When using the lead-through function from the arm-side interface, make sure that no one else can take control of the robot. See recommendations in [Configuring the arm-side interface on page 74](#).

Prerequisites

A validated safety configuration must be set up before using the arm-side interface. This must be based on a risk assessment of the application. Particular attention should be paid to the risks of impact, crushing and shearing. See [The SafeMove configurator app on FlexPendant on page 86](#), and [Application manual - Functional safety and SafeMove](#).

The tool and payload must be configured before configuring the arm-side interface. See [Operating manual - OmniCore](#).

Using the buttons on the arm-side interface

To use the function that is configured for a button, press the button. The light ring will start blinking and the defined routine will start.

If the button configured for lead-through is pressed but the arm is not moved, then the lead-through functionality is switched off after 10 seconds. For more information about lead-through, see [Lead-through on page 84](#).

The buttons on the arm-side interface can be used in both manual mode and automatic mode.



Note

The application **ASI Setting** on the FlexPendant must be open when using the buttons, if the buttons are configured differently than default.



Tip

If the buttons are not responding, close the **ASI Setting** app and reopen it.

3.5.3 Working closely with the robot in a safe way

Risk reduction when using the arm-side interface

A risk assessment must always be conducted when commissioning a robot or robot application (see ISO 10218-2). Important steps in this process are:

- Determine the limits of the machine
- Identify hazards
- Estimate and evaluate risks
- Perform an adequate risk reduction.

When someone uses the arm-side interface (ASI), they must be standing close to the manipulator. The risk assessment must therefore identify and address the possibility of collisions with the operator. These can be either unconstrained or constrained collisions, as explained below. Potential hazards to be addressed are crushing, cutting, shearing and impact, amongst others.

The arm-side interface can be used in both manual and automatic modes.

- In manual reduced speed mode, risk reduction as required by ISO 10218-1 is used:
 - 250 mm/s speed limit
 - A three-position enabling device to permit motion
- In Automatic mode, the system integrator must perform an application-specific risk assessment and risk reduction, resulting in a validated safety configuration. Use of the arm-side interface requires such a safety configuration.

Safety zones to implement speed and force limits can help to reduce the risks to an acceptable level. Further information is provided below. Programming information is provided in the RAPID manual for programming (*Technical reference manual - RAPID Instructions, Functions and Data types*), while the configuration and validation of a safety configuration is addressed in *Application manual - Functional safety and SafeMove*. In some cases, constructional measures may also be necessary to ensure that the application complies with ISO/TS 15066, which provides the relevant biomechanical limits.

Unconstrained collisions

An unconstrained collision is one where the body part involved is not trapped. Under these circumstances, only transient collisions are possible.

The risks from unconstrained collisions can be reduced by creating a zone to implement Cartesian speed limits, set by the safety function *Tool Speed Supervision* (see *Application manual - Functional safety and SafeMove*). Assistance with setting the limits is provided by the supporting function *Human Interaction Supervision*. Guidance and biomechanical limits are provided in ISO/TS 15066.

Constrained collisions

A constrained collision is one where the body part involved is trapped between the robot and another fixed object, or two parts of the robot. Constrained collisions can be either transient, if the robot can give way (at least partially), or quasi-static.

Continues on next page

3 Installation and commissioning

3.5.3 Working closely with the robot in a safe way

Continued

Wherever possible, constrained collisions shall be prevented by safely restricting the robot motion. This can be done by using the safety functions *Tool Position Supervision* and *Axis Position Supervision* (see *Application manual - Functional safety and SafeMove*). The programmed limits must allow for stopping distances.

Where there is a risk of constrained collisions (for example, due the purpose of the application), a zone shall be constructed where the safety function *Tool Force Supervision* is used to limit the contact forces. Assistance with parameter settings is provided by the supporting function *Human Interaction Supervision*. The limits are provided in ISO/TS 15066. Low speed limits (typically <100 mm/s) are required to make the force limits effective, otherwise the system cannot react fast enough.

SafeMove can only supervise motion compared to the position and speed limits set within a zone. The manipulator may therefore leave a zone at the maximum safe speed allowed within that zone. This is important for the transition between unconstrained and constrained collision zones.

To achieve safe constrained collisions, either:

- 1 The constrained collision zone must be deep enough that the manipulator stops before hurting the operator. This must happen even if it enters the zone at the maximum speed allowed in the neighboring zone.

Or:

- 2 The speed must be reduced in the neighboring safety zone, to ensure that the manipulator stops in time.

These approaches can be combined. Additional safety zones can also be introduced between the constrained and unconstrained collision zones to improve the cycle time.

Deviation: Single Point of Control

There is a deviation to ISO 10218-1 §5.3.5 in that the robot does not guarantee a Single Point of Control in automatic mode. This means that any clients connected to the robot and used for starting and stopping program execution must be considered when allowing the operator to use the ASI. Such clients include FlexPendant, RobotStudio, or other Robot Web Services applications. It also includes external PLCs starting the robot via System Inputs.

The integrator must ensure that these additional clients cannot lead to an unacceptable risk to the user in automatic mode. There are several solutions to reduce the risk in automatic mode:

- 1 For any operation of the arm-side interface in automatic mode, a validated safety configuration must be in place to prevent collisions between manipulator and user, or to ensure that they are safe. As described above, this can be achieved by a combination of safety functions and constructional measures. Appropriate safety functions must be activated for the complete range of motion of the application.
- 2 To prevent unexpected motion, initiated by additional clients:
Do not add additional clients to the robot to control program execution.

Continues on next page

If additional clients are needed, ensure that their interaction with the controller can be disabled. Disable them while using the arm-side interface.

Introduce organizational measures to prevent start of the programmed motion while someone is using the arm-side interface. For example: it shall be possible to visually confirm that the area around the robot is clear.

Finally, if risks in automatic mode cannot be sufficiently reduced by these or other means, use of the arm-side interface shall be restricted to manual mode.

3 Installation and commissioning

3.6.1 Information about software for the CRB 15000

3.6 Configuring the software

3.6.1 Information about software for the CRB 15000

Overview

CRB 15000 is designed to simplify collaborative applications. Therefore some software features work somewhat different compared with standard industrial robots. Some of them are listed in this section.

How to configure RobotWare is described in *Operating manual - Integrator's guide OmniCore*.

Emergency stops

The configuration of emergency stops is stop category 1 and cannot be changed.

Collision detection

As default CRB 15000 will have collision detection active at stand still. It also has another stop ramp compared to other robots to be able to release clamping forces.



Note

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

Recommendations for configuration of single point of control

Single point of control is the ability to operate the robot such that initiation of robot motion is only possible from one source of control and cannot be overridden from another initiation source.

In manual mode, the FlexPendant always has highest priority and can be used to start and stop program execution, jog, and configure the system. Other clients can connect to the robot, for example RobotStudio.

In automatic mode, there is no difference in priority between clients connected to the robot. The FlexPendant can always be used to start or stop program execution. Any remote client must have the user grant UAS_REMOTE_START_STOP_IN_AUTO to be able to start or stop program execution in automatic mode. Any user with this grant should be located within eyesight of the robot, unless there are presence sensing devices installed that can prevent potentially hazardous situations.

Local presence and local client

As a rule of thumb, having local presence near the robot is recommended when changing operating mode, starting or stopping execution, or jogging. This is to ensure that no one else is near the robot before doing anything that can cause a potentially hazardous situation.

A local client is a client connected directly to the robot controller, not over the network. The FlexPendant is always local client.

To become logged in as local client you must have local presence. By design, only one client can be local at any given time.

Continues on next page

With the FlexPendant, a user can verify local presence with the three-position enabling device. For robots without a connected FlexPendant, system input signals can be used to verify local presence.



CAUTION

It is the responsibility of the integrator to implement that local presence is set up in a correct way.

It is the responsibility of the integrator to implement that single point of control is set up in a correct way.

SafeMove

See [*The SafeMove configurator app on FlexPendant on page 86.*](#)

3 Installation and commissioning

3.6.2 Lead-through

3.6.2 Lead-through

What is lead-through?

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

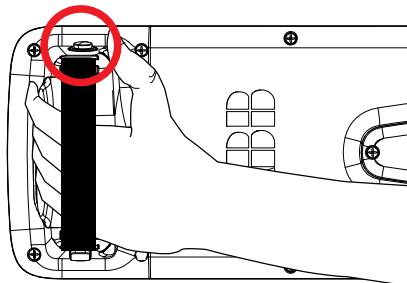
Using lead-through, you can grab the robot arm and move it manually to a desired position, as an alternative to jogging.

Using lead-through

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

- 1 Enable lead-through in one of the following ways:

- Press the thumb button on the FlexPendant.



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



Note

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

- 2 In the **Jog Mode** section select a mode.
- 3 If required, in the **Lead-through lock** section use the lock button next to a axis to lock it.



Note

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

- 4 Gently pull the robot arm to the desired position.

Continues on next page

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



Note

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

- 5 If desired, save the position.



Note

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

Lead-through can also be enabled using the RAPID instruction `SetLeadThrough`, or a button on the arm side interface, see [Arm-side interface on page 74](#). If the lead-through button is pressed but the arm is not moved, then the lead-through functionality is switched off after 10 seconds.

Lead-through is possible in both manual and automatic mode.



Note

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



Note

When using lead-through, it is important that the load is correctly defined. If the load is heavier than defined, the effect will be the same as if you are pulling the robot arm downwards. If the load is lighter than the defined load, the effect will be the same as if you are pulling the robot arm upwards.

For the CRB 15000, there is a button for updating/refreshing the load while lead-through is active.

3 Installation and commissioning

3.6.3 The SafeMove configurator app on FlexPendant

Introduction

The application **SafeMove** on the FlexPendant offers an intuitive way to visualize and configure a safety configuration for systems with the option **SafeMove Collaborative**. This includes stop functions and *Cyclic Brake Check*. To get started, see [Use cases on page 89](#).



Tip

Use the online user guide tool, included in the SafeMove configurator app, for help with the SafeMove configuration setup process.



Note

The SafeMove configurator app is currently only available for CRB 1100 and CRB 15000.

The configuration follows the same principles as when using Visual SafeMove in RobotStudio but the functionality is not as extensive.

For more information about transient contact, quasi-static contact, and body areas, see [Guidelines for transient and quasi-static contact, CRB 15000 on page 97](#).

Overview of the user interface

The user interface consists of a configurator and a 3D model that visualizes the robot with the configured encapsulations and zones. The first time that the app is opened, a default factory setting is loaded. If a safety configuration is loaded, this will be shown.

- The tab **Robot Encapsulation** contains the configuration of the encapsulations of the robot itself.
- The tab **Tool Encapsulation** contains the configuration of the encapsulations of the tools.
- The tab **Tool Data** contains the configuration for the tools.
- The tab **Safe Zones** contains the configuration of the safe zones.
- The tab **Global Settings** contains the configuration for Cyclic Brake Check and Standstill Supervision.
- The **Context menu (...)** contains functionality for loading, saving, and viewing configurations, and to reset the configuration.

The functionality is described in detail in *Application manual - Functional safety and SafeMove*.

Prerequisites

- The option **SafeMove Collaborative** is required.
- To edit a configuration, the grant **Safety Services** is required. A user without this grant can view a configuration, but not modify, write it to the controller, or apply it to the controller.

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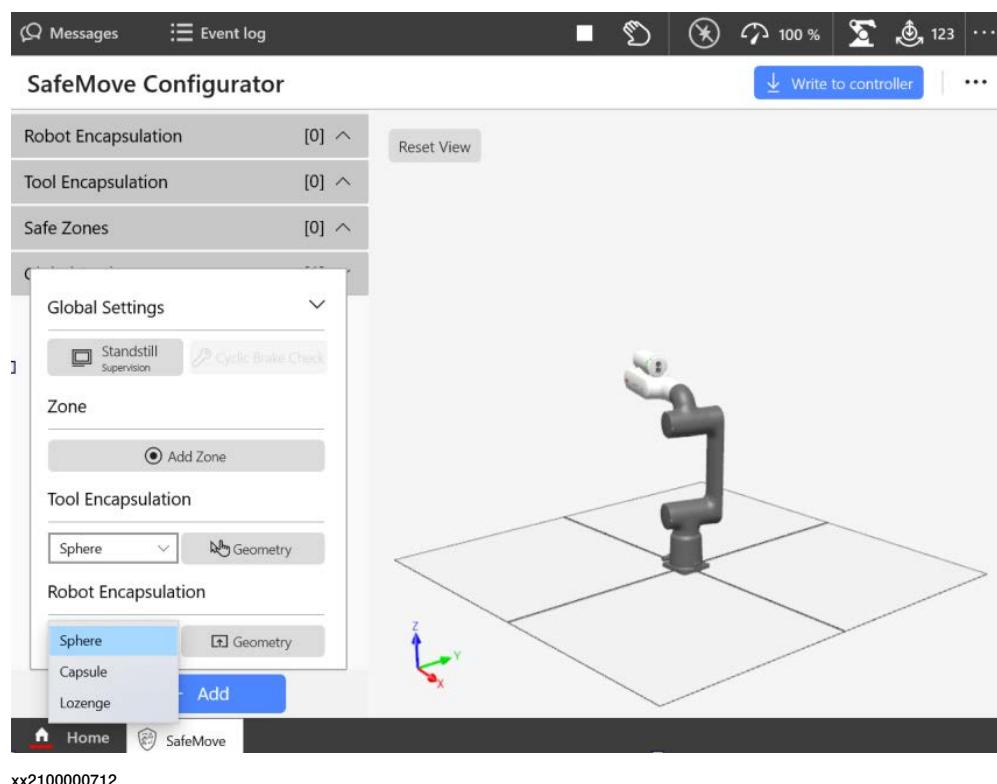
Template configurations

The template configuration is adapted for the specific manipulator, and typically contains one or two encapsulations of the arm, one encapsulation of the wrist (intended for the tool), one or two safe zones, and a Cyclic Brake Check setting. This configuration is typically a good start for a generic application with a smaller tool.

The factory setting is an empty safety configuration. A loaded configuration can be removed and the system is then reset to the factory setting.

Encapsulations

The encapsulations are geometries that can be in the shape of a sphere, capsule, or lozenge. A sphere or capsule encapsulation can be modified in dimension and position. A lozenge capsule can be modified in dimension, position, and rotation.



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3 Installation and commissioning

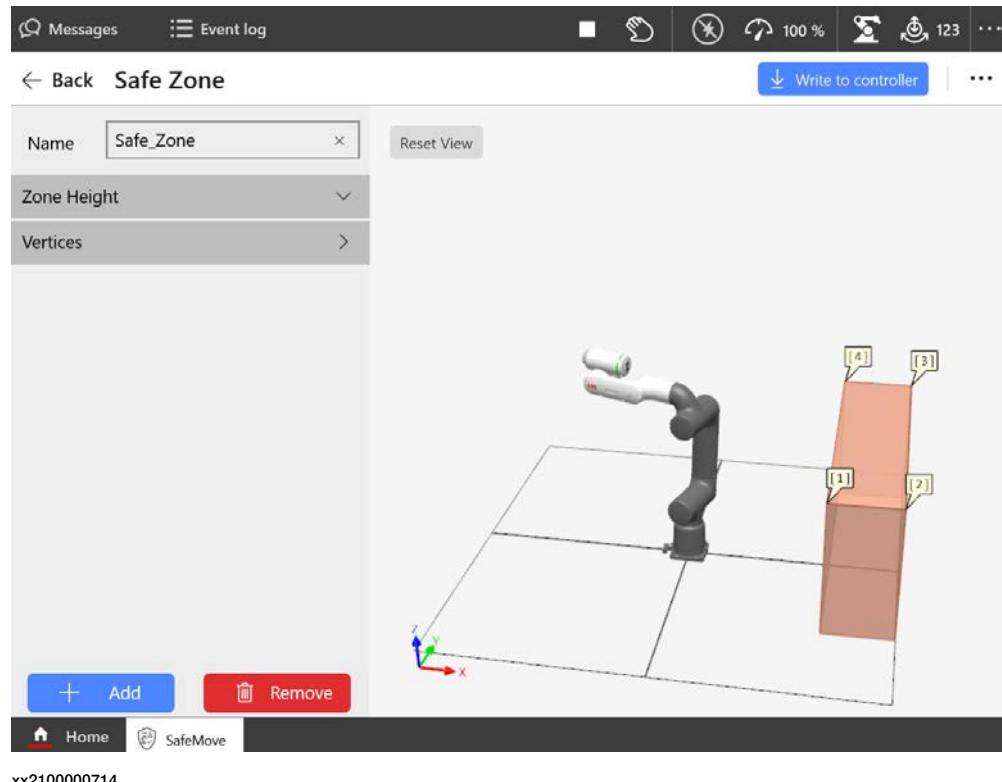
3.6.3 The SafeMove configurator app on FlexPendant

Continued

Safe zones

The default safe zone is a rectangular box with four vertices. The vertices defines the shape of the safe zone, and the position in space. More vertices can be added to define the safe zone. The minimum number of vertices is 4, and the maximum is 24.

Each vertex can be edited in x and y values.



Each vertex is numbered, from 1 and up. When a new vertex is added between two existing vertices the vertex numbers will be automatically adjusted so that they come in order. For example, if a new vertex is added between vertices 2 and 3, the vertex with index 3 will change to 4 and the new vertex will be indexed 3.

Recommended working procedure

Use this procedure when configuring SafeMove in the configurator app on FlexPendant.

- 1 Log in as a user with safety user grants.
- 2 Start the SafeMove configurator app.
- 3 Load a template configuration or an existing configuration from the Context menu (...).
- 4 Configure encapsulations.
- 5 Configure zones and their the supervision functions.
- 6 Load the configuration to the safety controller.
The robot controller is automatically restarted in this step.
- 7 Validate the configuration.

Continues on next page

8 Set the safety configuration to validated and lock it.

For more details, see [Use cases on page 89](#).

For functionality not supported in the SafeMove configurator app, use Visual SafeMove in RobotStudio.

Use cases

Starting the SafeMove configurator app

The SafeMove configurator app is available on the home screen of the FlexPendant for systems with the option *SafeMove Collaborative*. If the app is not shown, then review the system settings in RobotStudio Installation Manager and add the option.

The first time that the app is opened, a default factory setting is loaded. This contains only the manipulator with *Cyclic Brake Check* activated. There are no encapsulations, safe zones, or tool data defined.

The factory setting can always be resumed, if needed.

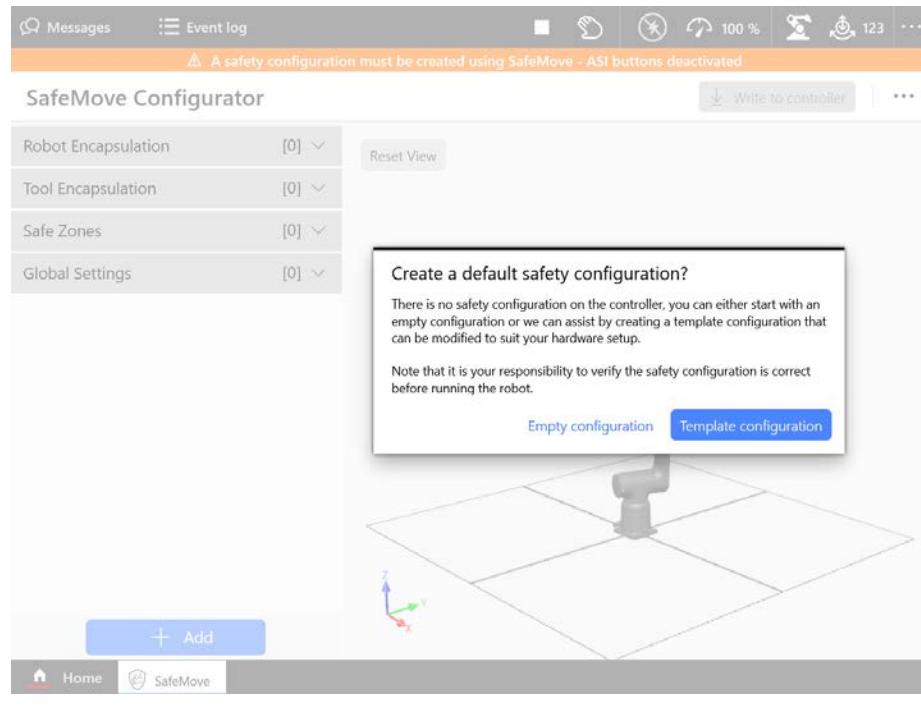
To continue and create a safety configuration, see [Use the template configuration on page 89](#).

Use the template configuration

Use the following procedure to load and apply the template configuration to the robot controller.

1 Select **Enable Edit Mode** to edit the safety configuration.

2 Select **Template configuration**.



3 Review that the template configuration is suitable for the intended application.

Continues on next page

3 Installation and commissioning

3.6.3 The SafeMove configurator app on FlexPendant

Continued

If modifications are needed, see [Modify a configuration on page 90](#).



Note

A SafeMove configuration must always be validated to verify that the desired safety is achieved. If no validation is performed, or the validation is inadequate, the configuration cannot be relied on for personal safety.

- 4 If the template configuration is suitable, select **Write to controller**.
The safety report is presented on the screen.
- 5 Save the safety report. Print out and sign this safety report.
See [ABB Safety Configuration Report on page 95](#). More information about the safety report and how to validate is described in *Application manual - Functional safety and SafeMove*.
- 6 Select **Apply to controller** to proceed.
The controller is automatically restarted when applying the configuration.

Modify a configuration

Use the following procedure to modify a loaded configuration and apply it to the robot controller.

- 1 Select **Enable Edit Mode** to edit the safety configuration.
- 2 If no configuration is loaded, load an empty configuration or a template configuration.
- 3 To add or modify an encapsulation, tap **Add** and select a geometry for **Robot Encapsulation** or **Tool Encapsulation**.
To modify the encapsulation, select it and modify the attributes.
- 4 To add or modify a zone, tap **Add** and **Add Zone**.
Select the safe zone and modify the attributes. See [Modify a safe zone on page 91](#).
- 5 To add or modify a global setting, tap **Add** and select **Standstill Supervision** or **Cyclic Brake Check**. See [Modify the Standstill Supervision settings on page 93](#) and [Modify the Cyclic Brake Check settings on page 94](#).
- 6 When the configuration is done, select **Write to controller**.
The safety report is presented on the screen.



Note

A SafeMove configuration must always be validated to verify that the desired safety is achieved. If no validation is performed, or the validation is inadequate, the configuration cannot be relied on for personal safety.

- 7 Save the safety report. Print out and sign this safety report.
The safety report and how to validate is described in detail in *Application manual - Functional safety and SafeMove*.
- 8 Apply the configuration to the controller.
The controller is automatically restarted when applying the configuration.

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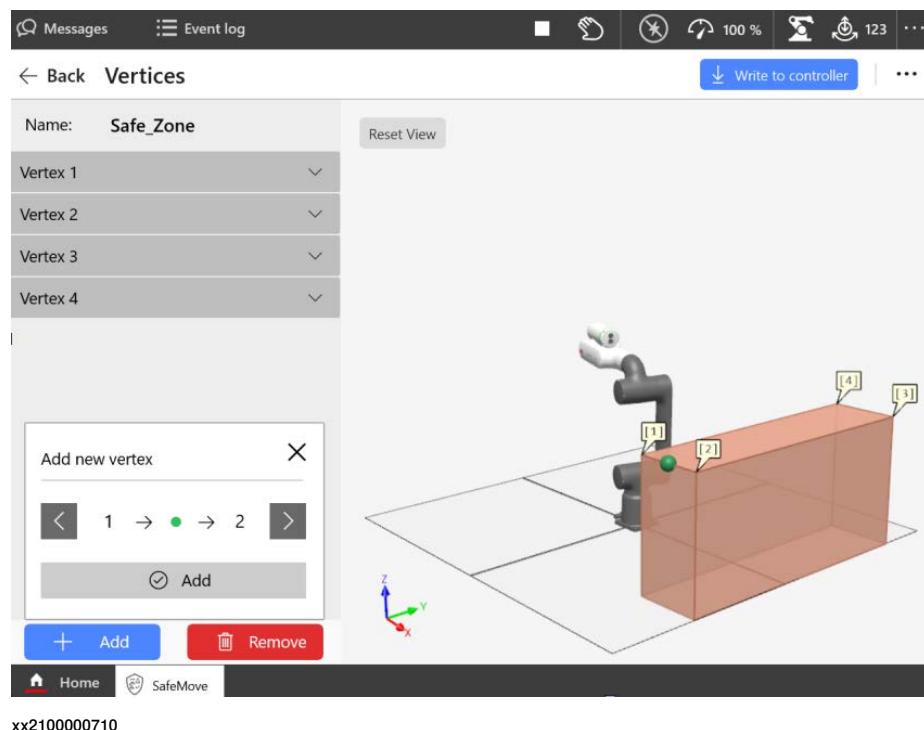
Modify a safe zone

Use the following procedure to modify a safe zone.

- 1 Add a new safe zone or select an existing safe zone.
- 2 Tap **Safe Zones** to open the attributes.
- 3 Add, modify, or remove vertices as needed to create the desired shape of the safe zone.

The green dot in the 3D visualization shows where the new vertex is located.
Use the arrows to change the position (index).

Tap the grey **Add** button to place the vertex.



- 4 To add a supervision to a safe zone, tap to select the safe zone in the 3D view, then tap **Add**.

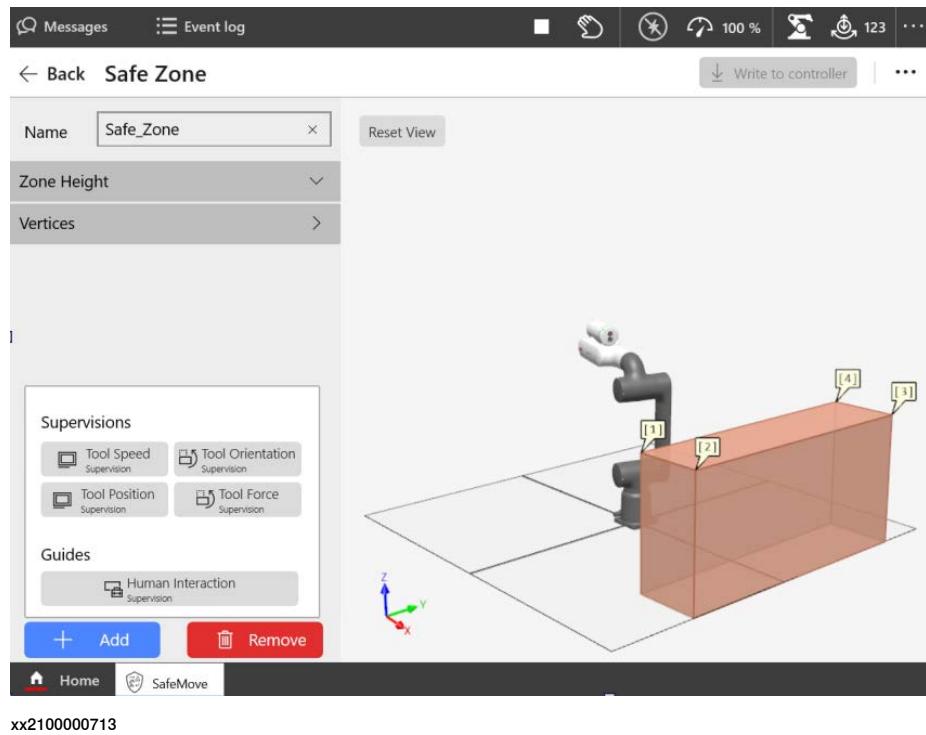
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3 Installation and commissioning

3.6.3 The SafeMove configurator app on FlexPendant

Continued

- 5 Select a supervision function or guide.



- 6 For supervision functions, select stop category, signal, and any other available setting applicable for the function.
- 7 For the guide **Human Contact Supervision**, select contact type, tooling properties, and body contact areas.

See [Use the Human Contact Supervision settings on page 92](#).



Tip

The functionality is described in detail in *Application manual - Functional safety and SafeMove*.

Use the Human Contact Supervision settings

Use the following procedure for Human Contact Supervision.

- 1 Select **Human Contact Supervision**.
- 2 Select contact type.
- 3 Define the tooling properties.
- 4 Select body contact areas. This is only used for transient contact.
- 5 Review the suggested supervisions.
- 6 When the supervision is applied, the data is transferred to *Tool Speed Supervision* and *Tool Force Supervision*.

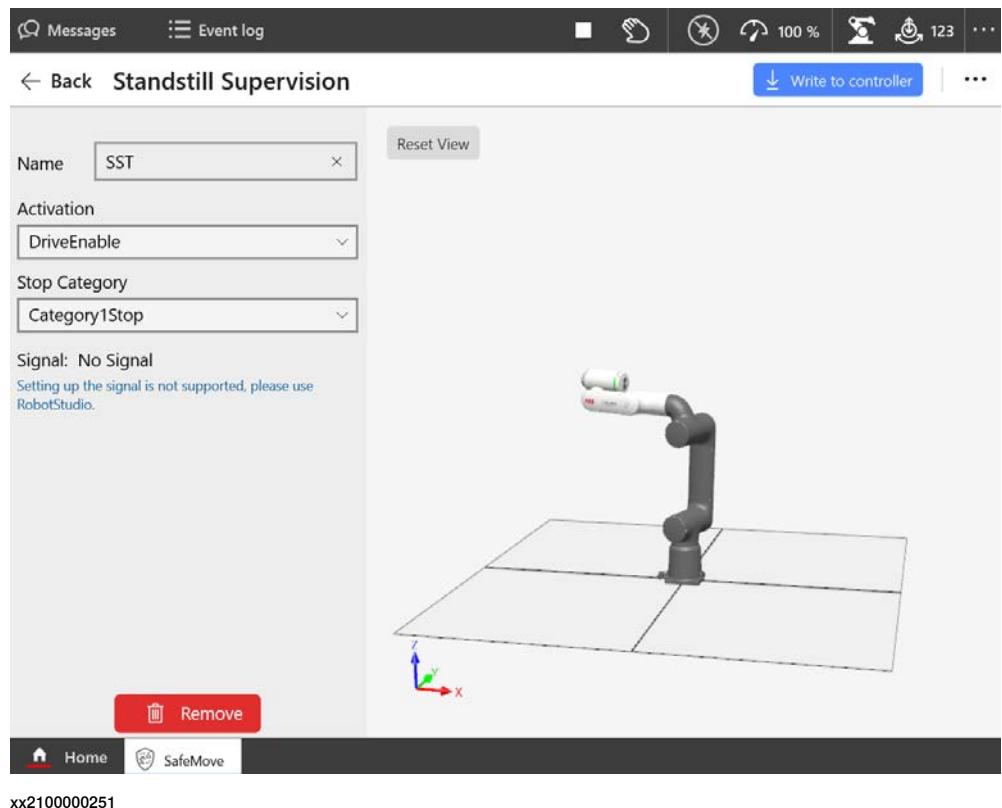
For more details, see [Guidelines for transient and quasi-static contact, CRB 15000 on page 97](#).

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Modify the Standstill Supervision settings

The Standstill Supervision functionality is not active by default. It can be added, modified, and deactivated.

The CRB 15000 has support for both stop category 0 and stop category 1 for Standstill Supervision. For other stops, only stop category 1 is available.



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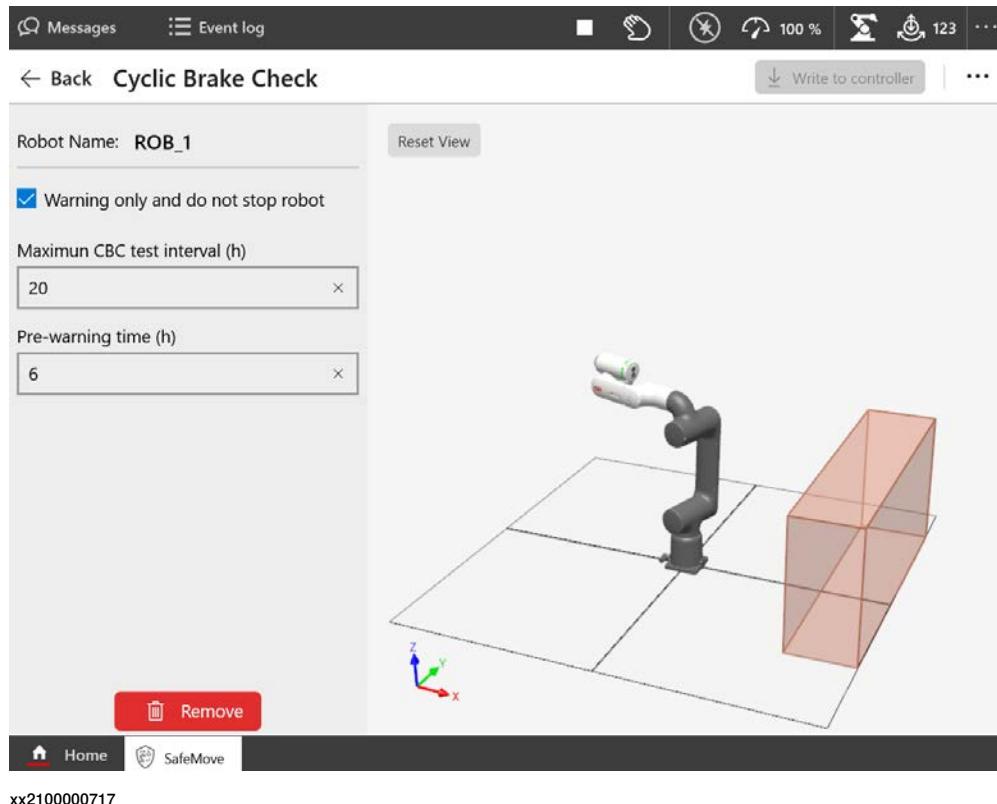
3 Installation and commissioning

3.6.3 The SafeMove configurator app on FlexPendant

Continued

Modify the Cyclic Brake Check settings

The Cyclic Brake Check functionality is active by default. It can be modified and deactivated.



Viewing the configuration report

The configuration report is available both on the FlexPendant and on the controller. It can be viewed from the **Context** menu.

Loading and exporting a safety configuration

An existing safety configuration on the FlexPendant can be exported from the **Context** menu, **Save Configuration To File**. It is also possible to load a safety configuration from a file.

Validate the safety configuration



DANGER

A SafeMove configuration must always be validated to verify that the desired safety is achieved. If no validation is performed, or the validation is inadequate, the configuration cannot be relied on for personal safety.

Each new or modified safety configuration must be validated before running in production. The validation should verify that the following is configured correctly:

- All I/O settings and signals used for safety interlocking including connected functionality
- All Stop configuration functions

Continues on next page

- All safety zones with connected supervision functions and signals used for safety interlocking
- All global supervision functions
- All tools with corresponding supervision functions



Note

Depending on the combination of functions, the validation procedures have to be modified for the specific configuration.

A more detailed description of validation of the safety configuration is found in *Application manual - Functional safety and SafeMove*.

After safety configuration is validated, it must be set to validated and locked in the system.

Preparations before validation

Do the following checks before you start the validation procedure:

- 1 Carry out the synchronization procedure.
- 2 If configured, run the service routine for the function Cyclic Break Check.
- 3 Turn off the *SafeMove Assistant* functionality, with the system parameter *Disable SafeMove Assistant*.
- 4 Start the validation procedure.

ABB Safety Configuration Report

The validation of each function should be documented in the safety report by signature of the validator.

The safety configuration report lists all parameters that are set for the installation. The report also includes a visual representation of the installation, a floor plan. This shows the robot and safety zones as seen from above.

The configuration report includes the checksum. The checksum can also be read using the RAPID function `SafetyControllerGetChecksum`.

Setting the configuration to validated

When the safety technician has validated the configuration and signed the safety report, the status of the configuration shall be changed to **Validated** on the FlexPendant.

- 1 Log in as a user with the grant **Safety Services**.
- 2 In the **Settings** app, select the **Safety Controller**, and then **Configuration**.
- 3 Select the check box **Validated**.

Setting the configuration to locked

When the responsible safety user has approved the validation of the configuration, the status of the configuration should be changed to **Locked** on the FlexPendant.

Running the robot in auto mode with the configuration unlocked will result in a warning message.

- 1 Log in as a user with the grant **Lock Safety Controller Configuration**.

Continues on next page

3 Installation and commissioning

3.6.3 The SafeMove configurator app on FlexPendant

Continued

- 2 In the *Settings* app, select the **Safety Controller**, and then **Configuration**.**
- 3 Select the check box **Locked**.**

Concluding steps

After the validation is concluded, turn on the the **SafeMove Assistant** functionality, with the system parameter *Disable SafeMove Assistant*.

3.6.4 Guidelines for transient and quasi-static contact, CRB 15000

About Human Contact Supervision

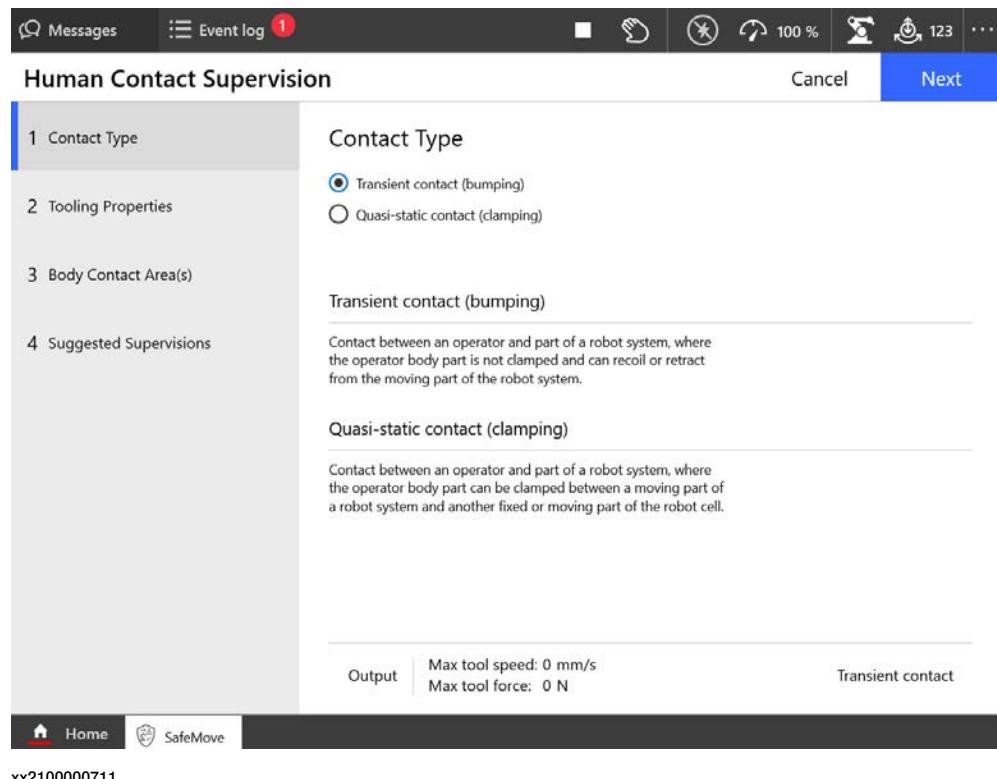
The CRB 15000 robot is designed with collaborative applications in focus, where occasional contact between the human and the robot are foreseen. This is according to ISO/TS 15066.

The supporting function *Human Contact Supervision* in SafeMove can be used to calculate maximum allowed tool force and tool speed.

Transient contact and quasi-static contact

Transient contact is contact between an operator and part of a robot system, where the operator body part is not clamped and can recoil or retract from the moving part of the robot system.

Quasi-static contact is contact between an operator and part of a robot system, where the operator body part can be clamped between a moving part of a robot system and another fixed or moving part of the robot cell.



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3 Installation and commissioning

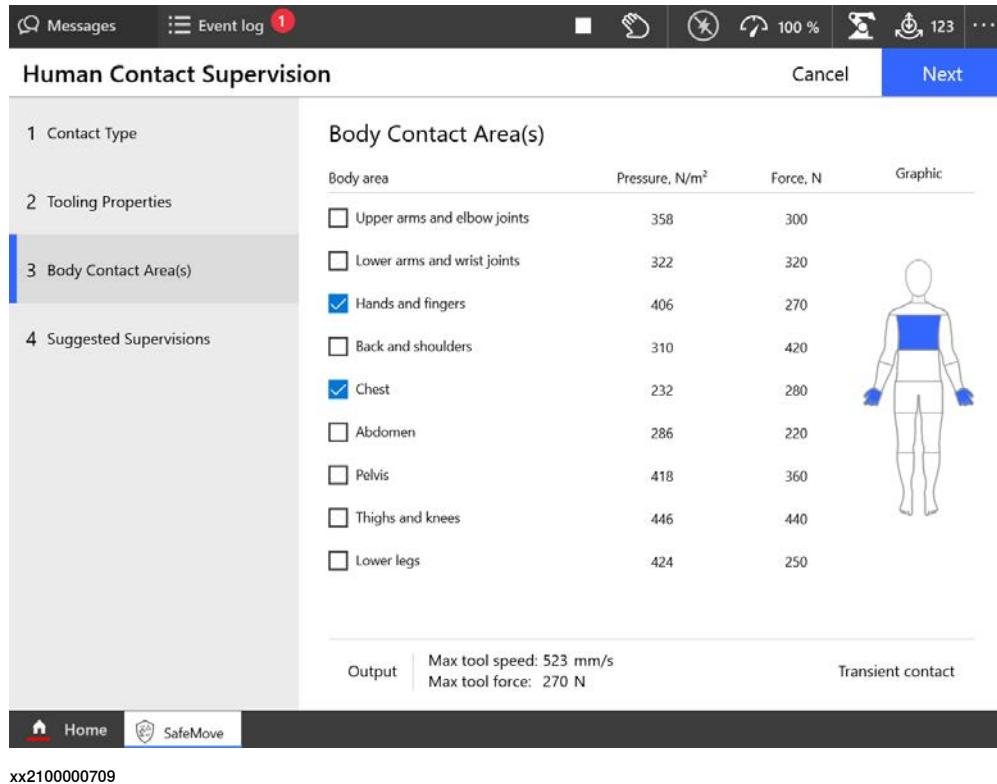
3.6.4 Guidelines for transient and quasi-static contact, CRB 15000

Continued

Body model

As defined in ISO/TS 15066, the body model is a representation of the human body consisting of individual body segments characterized by biomechanical properties.

The segments of the body model has different sensitivity. In general, the application should be designed so that the human head and neck is never exposed to hazards.



Recommendations from ISO/TS 15066

A key process in the design of the collaborative robot system and the associated cell layout is the elimination of hazards and reduction of risks, and can include or influence the design of the working environment. The following factors shall be taken into consideration:

- 1 The established limits (three dimensional) of the collaborative workspace.
- 2 Collaborative workspace, access, and clearance.
- 3 Ergonomics and human interface with equipment.
- 4 Use limits.
- 5 Transitions.

For more information, see ISO/TS 15066.

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Conclusion

The values calculated in the **Human Contact Supervision** function are conservative. However, if the risk analysis for the final application shows that these values can be changed to a higher value, for example, by using padding on the arm, then the values can be changed in the settings for the tool force supervision and tool speed supervision.



CAUTION

The functionality is based on the recommendations in ISO/TS 15066. A risk assessment of the final application must always be done, where the calculations are reviewed and verified by test.

3 Installation and commissioning

3.6.5 Information about Collaborative Speed Control add-in

Overview



Note

The Collaborative Speed Control add-in is required only for robots operating in RobotWare 7.6 or later.

The Collaborative Speed Control add-in is integrated in the robot system at delivery if any of laser scanner option 3351-X is ordered. With the Collaborative Speed Control add-in installed, the speed control functionality is activated for the robot. The Collaborative Speed Control add-in is also available separately in RobotApps in RobotStudio. If you need to newly add it to an existing controller system or requires an update, refer to the installation procedure to install and add it to the robot system.

Installing the Collaborative Speed Control add-in

Perform the following procedure to install the Collaborative Speed Control add-in:

- 1 Open RobotStudio.
- 2 In the displayed **RobotApps** window, use the **Search** function or **Common tags** to find the lead-through add-in.
- 3 Click the displayed add-in icon.
- 4 In the right pane, click **Add**.
The package is automatically installed and listed in the **Add-in** navigation tree in the left pane of the window.
- 5 In the **Controller** tab page, choose **Installation Manager 7** from the **Installation Manager** list in the **Configuration** group.
- 6 In the **Installation Manager** window, connect to a real controller or select/create a virtual controller.
- 7 Proceed to the **Options** window and access the **Applications** tab page.
- 8 In the **Collaborative Features** group, choose the required option checkbox.
- 9 Click **Next** to go to the **Confirmation** window.
- 10 Select **Apply** to confirm and save the changes.

The add-in is displayed in the controller overview if it is successfully added to the controller.

3.6.6.1 Configuration of one PROFINET-base laser scanner (RobotWare 7.5 or earlier)

3.6.6 Speed control

3.6.6.1 Configuration of one PROFINET-base laser scanner (RobotWare 7.5 or earlier)

Preparing the robot system

Required options for system setup

When setting up the system using **Installation Manager** in RobotStudio, select the options [3020-2] **PROFINET Device**, [3023-2] **PROFIsafe Device** and [3043-3] **SafeMove Collaborative**, and the correct robot variant. The option **Drive System IRB Small Robot** is selected automatically after the robot type is determined.

Supported parameters for connections to scanner and PLC

Both the laser scanner and the PLC uses a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded to after the Collaborative Speed Control add-in is installed, see [Information about Collaborative Speed Control add-in on page 100](#). The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

The following list shows the configuration parameters. They need to be correctly configured in the software tools to enable communication between the scanner, PLC, and OmniCore system.

- After the robot system is set up, the default IP address of the WAN port is automatically configured as 192.168.10.10/24. Make sure the scanner and PLC are also configured in the 192.168.10.XXX segment.
- In RobotStudio, open the configuration editor: Controller > Configuration > I/O Engineering Tool, and get the:
 - PROFIsafe parameter values

Device slot	Parameter	Value
SDO	Source address	2
SDO	Destination address	3
SDI	Source address	4
SDI	Destination address	5

- device mapping information

Signal name	Device mapping (default)	Category	Device	Device slot
ProtectingArea	64	ProfiSafe	OmniCore_Internal	SDI
WarningArea	65	ProfiSafe	OmniCore_Internal	SDI
ProtectingAreaSST	66	ProfiSafe	OmniCore_Internal	SDI
WarningAreaTSP	67	ProfiSafe	OmniCore_Internal	SDI
SafetyCommunicationEnable	68	ProfiSafe	OmniCore_Internal	SDI

Continues on next page

3 Installation and commissioning

3.6.6.1 Configuration of one PROFINET-base laser scanner (RobotWare 7.5 or earlier)

Continued

- The PROFINET device name of the controller must be set to *omnicoreprofisafe*.



Tip

Previous device mapping information is based on the default setting that is configured with 8 byte DI, 8 byte DO, 8 byte SDI and 8 byte SDO. The LED control module needs to occupy 5 bits in the 8 byte SDI for the signals.

If the 8 byte DI is insufficient for the actual application, users can delete the default DI device slot and add a larger one, then, reallocate the device mapping addresses to the five signals. The signal names and corresponding functions must be the same as that defined in the default setting. This is to make sure that the LED control module can still work properly.

Take the expansion to 256 byte DI and 256 byte DO as an example. If the user expands both DI and DO to 256 byte, the possible device mapping addresses for the ProtectingArea, WarningArea, ProtectingAreaSST, WarningAreaTSP and SafetyCommunicationEnable signals in 8 byte SDI device slot should be 2048, 2049, 2050, 2051 and 2052, respectively.

GSD file

The GSD file, *GSDML-V2.xx-ABB-Robotics-OmniCore-YYYYMMDD.xml*, can be obtained from the RobotStudio or the OmniCore controller.

- In the RobotWare installation folder in RobotStudio:
...\\DistributionPackages\\ABB.RobotWare-x.x.x-xxx\\RobotPackages\\RobotControl_x.x.xxx\\utility\\service\\GSDML
- On the OmniCore Controller:
...\\products\\RobotControl_x.x.x\\utility\\service\\GSDML

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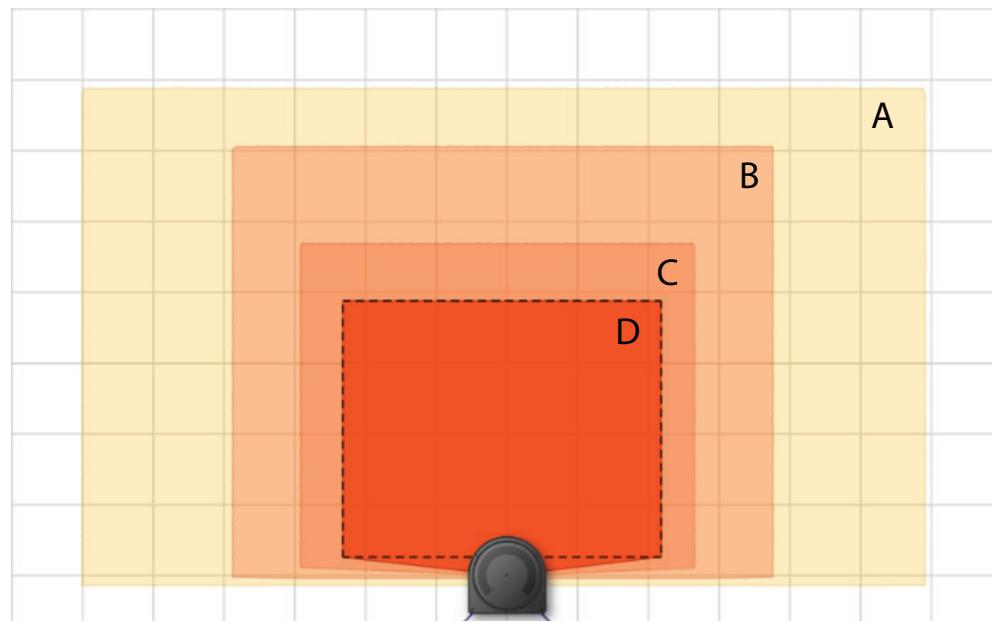
3.6.6.1 Configuration of one PROFINET-base laser scanner (RobotWare 7.5 or earlier)

Continued

Configuring the laser scanner

Protection fields

Four protection fields are defined to provide a progressive safety protection. The following figure illustrates the field ranges.



xx2100000165

	Field	Device mapping (default)	Lamp color	Description
A	WarningArea	65	Yellow	The warning area field defines the largest range, but it shall be within the scanning range of the scanner. Within this field range, the lamp unit on the process hub lights up yellow, and the robot movement speed reduces to a lower speed that is set by the user.
B	WarningAreaTSP	67	Yellow	Within this field range, the lamp unit still lights up yellow, but Tool Speed Supervision (TSP) is enabled. If the robot moves in the speed that is out of the defined range for TSP, the motor is off. For details about TSP, see <i>Application manual - Functional safety and SafeMove</i> .
C	ProtectingArea	64	Red	Within this field range, the lamp unit turns to red and the robot movement speed is reduced to 0. The robot stands still.

Continues on next page

3 Installation and commissioning

3.6.6.1 Configuration of one PROFINET-base laser scanner (RobotWare 7.5 or earlier)

Continued

	Field	Device mapping (default)	Lamp color	Description
D	ProtectingAreaSST	66	Red	<p>The protecting stop SST field defines the smallest range. However, this range shall be larger than the minimum stopping distance on the basis of the response time for a small scanning cycle time. For details about how to calculate the range, see the user manual from the vendor. For details about the stopping distance and response time, see <i>Product specification - Robot stopping distances according to ISO 10218-1</i>.</p> <p>Within this field range, the lamp unit still lights up red, but Stand Still Supervision (SST) is enabled. If the robot axes move exceeding the maximum range setting in SST, the motor is off.</p> <p>For details about SST, see <i>Application manual - Functional safety and SafeMove</i>.</p>

Configuration procedure

Before starting the configuration, obtain the *microScan 3 Core - PROFINET GSDML* file and the software tool *Safety Designer®* from SICK's website first. Make sure both the file and the software tool are in the latest versions.

Detailed procedures about how to configure the laser scanner are detailed in *SICK microScan3 Siemens PLC integration instruction manual - TIA Portal* and *SICK microScan3 Siemens PLC integration instruction manual - SIMATIC Step 7*.

Following described roughly:

- 1 Connect the laser scanner to the PLC and controller.
See the physical connection in [Connecting the laser scanner\(s\) on page 65](#).
- 2 Open configuration software tool *Safety Designer®*.
- 3 Set IP address and PROFINET name in **Configuration > Addressing**.
 - The scanner IP address must be in the same network segment with the PLC and controller, that is, 192.168.10.XXX.
 - The PROFINET name must be the same in the PLC configuration.
- 4 Set F-destination address to 12 in PROFINET area in **Configuration > Protocol Settings**.
- 5 Define the four protection fields in **Configuration > Fields**.
- 6 Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration > Inputs and outputs**.
The **Use one input source** checkbox must be selected and choose **Rx: Process image (6 Bytes)** from the drop-down list.
- 7 Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration > Monitoring cases**.

Continues on next page

Configuring the PLC

The safety PLC connecting to the laser scanner and controller must support PROFIsafe and can act as a master. Before configuration, make sure the PLC is loaded with the GSD files of the controller and laser scanner.

Detailed procedures about how to add an external device to the PLC and how to configure detailed settings, see the user manual from the vendor. Following lists the necessary settings during PLC configuration:

- Add the scanner to the PLC by adding a mS3 6Byte In/Out PROFIsafe V2.6.1 module.

The parameters **f_dest_address** and **f_source_address** are set to 12 and 1, respectively.

- Add the controller to the PLC by adding the **DI 8 bytes**, **DO 8 bytes**, **SDI 8 bytes** and **SDO 8 bytes** modules.

The parameters **f_dest_address** and **f_source_address** for the SDI are set to 3 and 2, respectively, and for the SDO are set to 5 and 4, respectively.

- Make sure the address for the SDO signal is the first address of **SDO 8 bytes** slot.

- Create variables.

Name	Type	Example address ⁱ
ProtectingTrigger	Bool	%I3.0
WarningTrigger	Bool	%I4.1
ProtectingSSTTrigger	Bool	%I3.2
WarningTSPTrigger	Bool	%I3.3
ProtectingArea	Bool	%Q68.0
WarningArea	Bool	%Q68.1
ProtectingAreaSST	Bool	%Q68.2
WarningAreaTSP	Bool	%Q68.3
SafetyCommunicationEnable	Bool	%Q68.4
ActivateScanner	Bool	%Q3.0

ⁱ %I3.X and %I4.X are the addresses of the laser scanner; %Q68.X is the address of the OmniCore controller.

%Q3.0 is for activating the monitoring cases of the laser scanner.

- Check the communication between the PLC and controller is well and activate the laser scanner; set up the communication between the laser scanner, PLC and OmniCore controller.

Configuring SafeMove

With RobotStudio

Basic steps for configuring SafeMove are as follows:

- 1 Make some initial preparations.
- 2 Configure system parameters.
- 3 Set the input and output size and name of the PROFINET internal device.

Continues on next page

3 Installation and commissioning

3.6.6.1 Configuration of one PROFINET-base laser scanner (RobotWare 7.5 or earlier)

Continued

For CRB 15000, required settings for communication between laser scanner, PLC and OmniCore controller are predefined in the configuration file.

4 Set up safety user grants.

Users must have access grants to lock safety controller configurations, safety services and software synchronization.

5 Configure robot properties.

6 Configure the synchronization position.

7 Configure the SafeMove tool definitions.

8 Configure safe I/O signals.



Note

For the first time configuring safe I/O signals using **Visual SafeMove**, make sure the **I/O Engineering Tool** is opened first. In this case, the configured safe I/O signals can be displayed in the **Visual SafeMove** window.

9 Configure zones and/or ranges.

10 Configure the supervision functions.

Tool Speed Supervision (TSP) and Stand Still Supervision (SST) must be configured.

11 Configure other functions.

12 Load the configuration to the safety controller.

13 Restart the robot controller.

Detailed configuration procedures are specified in *Application manual - Functional safety and SafeMove*.

With FlexPendant

1 Log in the FlexPendant.

The user logging in must have access grants to lock safety controller configurations, safety services and software synchronization.

2 Tap **Settings** on the home page.

3 Tap **Safety Controller**.

4 Tap **Synchronization** in the left pane.

5 Jog the robot to match the **Actual Positions** values with the **Sync Positions** values. Make sure they are the same.

6 Tap **Synchronize**.

3.6.6.2 Configuration of one PROFINET-base laser scanner (RobotWare 7.6 or later)

3.6.6.2 Configuration of one PROFINET-base laser scanner (RobotWare 7.6 or later)

Preparing the robot system

Required options for system setup

When setting up the system using **Installation Manager** in RobotStudio, select the options **[3020-2] PROFINET Device**, **[3023-2] PROFIsafe Device**, **[3043-3] SafeMove Collaborative** and **[3051-1] Profisafe Package**, and the correct robot variant. The option **Drive System IRB Small Robot** is selected automatically after the robot type is determined.

Supported parameters for connections to scanner and PLC

Both the laser scanner and the PLC uses a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded to after the Collaborative Speed Control add-in is installed, see [Information about Collaborative Speed Control add-in on page 100](#).

The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

The following list shows the configuration parameters. They need to be correctly configured in the software tools to enable communication between the scanner, PLC, and OmniCore system.

- After the robot system is set up, the default IP address of the WAN port is automatically configured as 192.168.10.10/24. Make sure the scanner and PLC are also configured in the 192.168.10.XXX segment.
- In RobotStudio, open the configuration editor: Controller > Configuration > I/O Engineering Tool, and get the:
 - PROFIsafe parameter values

Device slot	Parameter	Value
SDI	Source address	4
SDI	Destination address	5

- device mapping information

Signal name	Device mapping (default)	Category	Device	Device slot
ProtectingArea	0	ProfiSafe	OmniCore_Internal	SDI
WarningArea	1	ProfiSafe	OmniCore_Internal	SDI
SafetyCommunicationEnable	2	ProfiSafe	OmniCore_Internal	SDI

- The PROFINET device name of the controller must be set to **omnicoreprofisafe**.

Continues on next page

3 Installation and commissioning

3.6.6.2 Configuration of one PROFINET-base laser scanner (RobotWare 7.6 or later)

Continued

GSD file

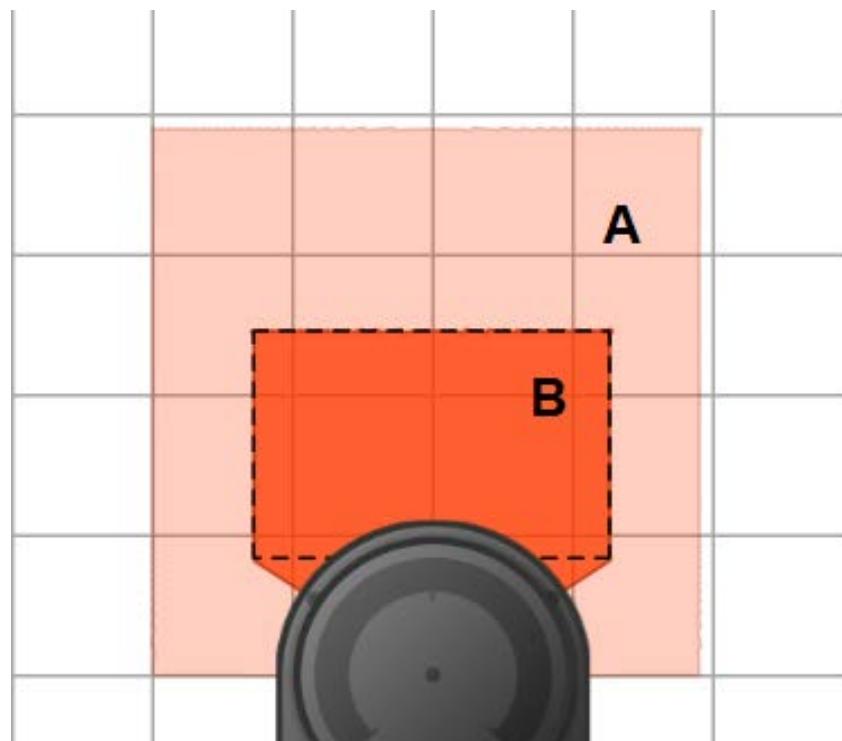
The GSD file, *GSDML-V2.xx-ABB-Robotics-OmniCore-YYYYMMDD.xml*, can be obtained from the RobotStudio or the OmniCore controller.

- In the RobotWare installation folder in RobotStudio:
...\\DistributionPackages\\ABB.RobotWare-x.x.x-xxx\\RobotPackages\\RobotControl_x.x.xxx\\utility\\service\\GSDML\\
- On the OmniCore Controller:
...\\products\\RobotControl_x.x.x\\utility\\service\\GSDML\\

Configuring the laser scanner

Protection fields

Two protection fields are defined to provide a progressive safety protection. The following figure illustrates the field ranges.



	Field	Device mapping (default)	Lamp color	Description
A	WarningArea	1	Yellow	<p>The warning area field defines the largest range, but it shall be within the scanning range of the scanner.</p> <p>Within this field range, the lamp unit on the process hub lights up yellow, and the robot movement speed reduces to a lower speed that is set by the user.</p>
B	ProtectingArea	0	Red	Within this field range, the lamp unit turns to red and the robot movement speed is reduced to 0. The robot stands still.

Continues on next page

3.6.6.2 Configuration of one PROFINET-base laser scanner (RobotWare 7.6 or later)

Continued

Configuration procedure

Before starting the configuration, obtain the *microScan 3 Core - PROFINET GSDML* file and the software tool *Safety Designer®* from SICK's website first. Make sure both the file and the software tool are in the latest versions.

Detailed procedures about how to configure the laser scanner are detailed in *SICK microScan3 Siemens PLC integration instruction manual - TIA Portal* and *SICK microScan3 Siemens PLC integration instruction manual - SIMATIC Step 7*.

Following described roughly:

- 1 Connect the laser scanner to the PLC and controller.
See the physical connection in [Connecting the laser scanner\(s\) on page 65](#).
- 2 Open configuration software tool *Safety Designer®*.
- 3 Set IP address and PROFINET name in **Configuration > Addressing**.
 - The scanner IP address must be in the same network segment with the PLC and controller, that is, 192.168.10.XXX.
 - The PROFINET name must be the same in the PLC configuration.
- 4 Set F-destination address to 12 in PROFINET area in **Configuration > Protocol Settings**.
- 5 Define the two protection fields in **Configuration > Fields**.
- 6 Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration > Inputs and outputs**.
The **Use one input source** checkbox must be selected and choose **Rx: Process image (6 Bytes)** from the drop-down list.
- 7 Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration > Monitoring cases**.

Configuring the PLC

The safety PLC connecting to the laser scanner and controller must support PROFIsafe and can act as a master. Before configuration, make sure the PLC is loaded with the GSD files of the controller and laser scanner.

Detailed procedures about how to add an external device to the PLC and how to configure detailed settings, see the user manual from the vendor. Following lists the necessary settings during PLC configuration:

- Add the scanner to the PLC by adding a **mS3 6Byte In/Out PROFIsafe V2.6.1** module.
The parameters **f_dest_address** and **f_source_address** are set to 12 and 1, respectively.
- Add the controller to the PLC by adding the **DI 8 bytes**, **DO 8 bytes**, **SDI 8 bytes** and **SDO 8 bytes** modules.
The parameters **f_dest_address** and **f_source_address** for the SDI are set to 3 and 2, respectively, and for the SDO are set to 5 and 4, respectively.
- Make sure the address for the SDO signal is the first address of **SDO 8 bytes** slot.

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3 Installation and commissioning

3.6.6.2 Configuration of one PROFINET-base laser scanner (RobotWare 7.6 or later)

Continued

- Create variables.

Name	Type	Example address ⁱ
ProtectingTrigger	Bool	%I3.0
WarningTrigger	Bool	%I4.1
ProtectingArea	Bool	%Q68.0
WarningArea	Bool	%Q68.1
SafetyCommunicationEnable	Bool	%Q68.2
ActivateScanner	Bool	%Q3.0

ⁱ %I3.X and %I4.X are the addresses of the laser scanner; %Q68.X is the address of the OmniCore controller.
%Q3.0 is for activating the monitoring cases of the laser scanner.

- Check the communication between the PLC and controller is well and activate the laser scanner; set up the communication between the laser scanner, PLC and OmniCore controller.

Configuring SafeMove

To enable SafeMove, perform the following procedure:

- 1 Log in the FlexPendant.

Make sure the user logged in have access grants to lock safety controller configurations, safety services and software synchronization.

- 2 Tap **SafeMove** on the home page.

- 3 Tap **Load** in the pop-up message box to confirm loading of template SafeMove configuration files.

The controller restarts.

- 4 After the controller is restarted, tap **Settings** on the home page.

- 5 Tap **Safety Controller**.

- 6 Tap **Synchronization** in the left pane.

- 7 Jog the robot to match the **Actual Positions** values with the **Sync Positions** values.

Make sure the values are the same.

- 8 Tap **Synchronize**.

3.6.6.3 Configuration of two PROFINET-base laser scanners (RobotWare 7.6 or later)

3.6.6.3 Configuration of two PROFINET-base laser scanners (RobotWare 7.6 or later)

Preparing the robot system

Required options for system setup

When setting up the system using **Installation Manager** in RobotStudio, select the options **[3020-2] PROFINET Device**, **[3023-2] PROFIsafe Device**, **[3043-3] SafeMove Collaborative** and **[3051-3] Dual Profisafe Package**, and the correct robot variant. The option **Drive System IRB Small Robot** is selected automatically after the robot type is determined.

Supported parameters for connections to scanners and PLC

Both laser scanners and the PLC uses a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded to after the Collaborative Speed Control add-in is installed, see [Information about Collaborative Speed Control add-in on page 100](#).

The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

The following list shows the configuration parameters. They need to be correctly configured in the software tools to enable communication between the scanners, PLC, and OmniCore system.

- After the robot system is set up, the default IP address of the WAN port is automatically configured as 192.168.10.10/24. Make sure the scanners and PLC are also configured in the 192.168.10.XXX segment.
- In RobotStudio, open the configuration editor: Controller > Configuration > I/O Engineering Tool, and get the:
 - PROFIsafe parameter values

Device slot	Parameter	Value
SDI	Source address	4
SDI	Destination address	5

- device mapping information

Signal name	Device mapping (default)	Category	Device	Device slot
ProtectingArea	0	ProfiSafe	OmniCore_Internal	SDI
WarningArea	1	ProfiSafe	OmniCore_Internal	SDI
SafetyCommunicationEnable	2	ProfiSafe	OmniCore_Internal	SDI

- The PROFINET device name of the controller must be set to **omnicoreprofisafe**.

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3 Installation and commissioning

3.6.6.3 Configuration of two PROFINET-base laser scanners (RobotWare 7.6 or later)

Continued

GSD file

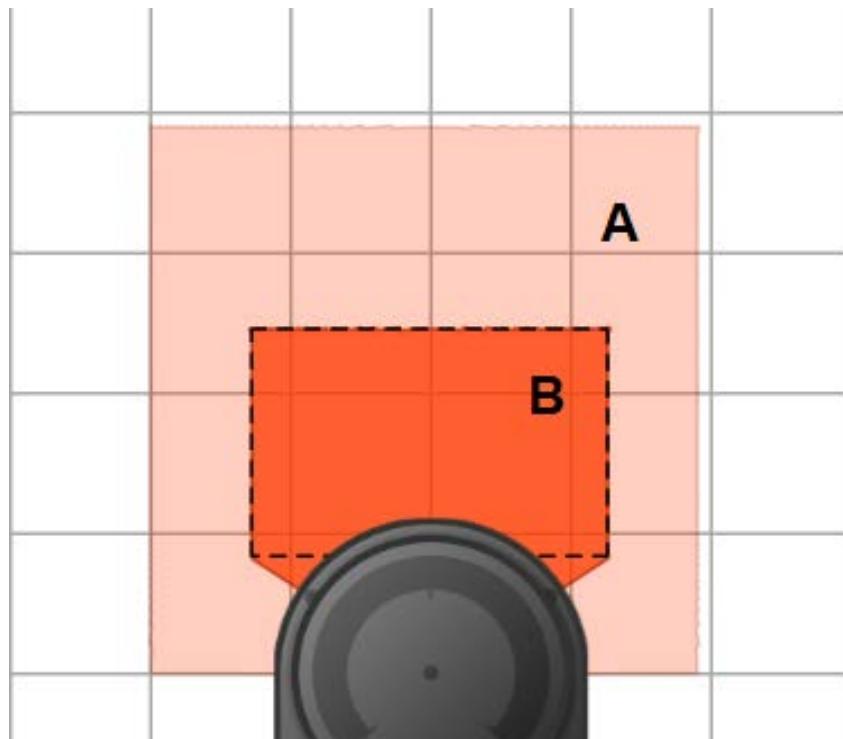
The GSD file, *GSDML-V2.xx-ABB-Robotics-OmniCore-YYYYMMDD.xml*, can be obtained from the RobotStudio or the OmniCore controller.

- In the RobotWare installation folder in RobotStudio:
...\\DistributionPackages\\ABB.RobotWare-x.x.x-xxx\\RobotPackages\\RobotControl_x.x.xxx\\utility\\service\\GSDML\\
- On the OmniCore Controller:
...\\products\\RobotControl_x.x.x\\utility\\service\\GSDML\\

Configuring the laser scanner

Protection fields

Two protection fields are defined to provide a progressive safety protection. The following figure illustrates the field ranges.



	Field	Device mapping (default)	Lamp color	Description
A	WarningArea	1	Yellow	<p>The warning area field defines the largest range, but it shall be within the scanning range of the scanner.</p> <p>Within this field range, the lamp unit on the process hub lights up yellow, and the robot movement speed reduces to a lower speed that is set by the user.</p>
B	ProtectingArea	0	Red	Within this field range, the lamp unit turns to red and the robot movement speed is reduced to 0. The robot stands still.

Continues on next page

Configuration procedure

Before starting the configuration, obtain the *microScan 3 Core - PROFINET GSDML* file and the software tool *Safety Designer®* from SICK's website first. Make sure both the file and the software tool are in the latest versions.

Detailed procedures about how to configure the laser scanners are detailed in *SICK microScan3 Siemens PLC integration instruction manual - TIA Portal* and *SICK microScan3 Siemens PLC integration instruction manual - SIMATIC Step 7*. Following described roughly:

- 1 Connect the laser scanners to the PLC and controller.
See the physical connection in [Connecting the laser scanner\(s\) on page 65](#).
- 2 Open configuration software tool *Safety Designer®*.
- 3 Set IP address, F-destination and PROFINET name in **Configuration > Addressing**.
 - The scanner IP address must be in the same network segment with the PLC and controller, that is, 192.168.10.XXX.
 - The PROFINET name must be the same in the PLC configuration.
 - The two scanners must be set to different IP address, F-destination and PROFINET name.
- 4 Set **F-destination address** to 12 for the first scanner and to 13 for the second scanner, in **PROFINET area** in **Configuration > Protocol Settings**.
- 5 Define the two protection fields for each scanners in **Configuration > Fields**.
- 6 Define the source for input signals of each scanner and configure basic settings for the inputs and outputs in **Configuration > Inputs and outputs**.
The **Use one input source** checkbox must be selected and choose **Rx: Process image (6 Bytes)** from the drop-down list.
- 7 Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration > Monitoring cases**.

Configuring the PLC

The safety PLC connecting to the laser scanners and controller must support PROFIsafe and can act as a master. Before configuration, make sure the PLC is loaded with the GSD files of the controller and laser scanners.

Detailed procedures about how to add an external device to the PLC and how to configure detailed settings, see the user manual from the vendor. Following lists the necessary settings during PLC configuration:

- Add two scanners to the PLC by adding two **mS3 6Byte In/Out PROFIsafe V2.6.1** modules.
 - The parameters **f_dest_address** and **f_source_address** are set to 12 and 1, for the first scanner, respectively.
 - The parameters **f_dest_address** and **f_source_address** are set to 13 and 1, for the second scanner, respectively.
- Add the controller to the PLC by adding the **DI 8 bytes**, **DO 8 bytes**, **SDI 8 bytes** and **SDO 8 bytes** modules.

Continues on next page

3 Installation and commissioning

3.6.6.3 Configuration of two PROFINET-base laser scanners (RobotWare 7.6 or later)

Continued

The parameters f_dest_address and f_source_address for the SDI are set to 3 and 2, respectively, and for the SDO are set to 5 and 4, respectively.

- Make sure the address for the SDO signal is the first address of **SDO 8 bytes slot**.
- Create variables.

Name	Type	Example address ⁱ
ProtectingTrigger	Bool	%I3.0
WarningTrigger	Bool	%I4.1
ProtectingTrigger1	Bool	%I14.0
WarningTrigger1	Bool	%I15.1
ProtectingArea ⁱⁱ	Bool	%Q68.0
WarningArea ⁱⁱⁱ	Bool	%Q68.1
SafetyCommunicationEnable	Bool	%Q68.2
ActivateScanner	Bool	%Q3.0
ActivateScanner1	Bool	%Q14.0

ⁱ %I3.X, %I4.X, %I14.X and %I15.X are the addresses of laser scanners; %Q68.X is the address of the OmniCore controller.

%Q3.0 and %Q14.0 are for activating the monitoring cases of the laser scanners.

ⁱⁱ Value of ProtectingArea depends on logic AND value of ProtectingTrigger and ProtectingTrigger1.

ⁱⁱⁱ Value of WarningArea depends on logic AND value of WarningTrigger and WarningTrigger1.

- Check the communication between the PLC and controller is well and activate the laser scanner; set up the communication between the laser scanner, PLC and OmniCore controller.

Configuring SafeMove

To enable SafeMove, perform the following procedure:

- 1 Log in the FlexPendant.

Make sure the user logged in have access grants to lock safety controller configurations, safety services and software synchronization.

- 2 Tap **SafeMove** on the home page.

- 3 Tap **Load** in the pop-up message box to confirm loading of template SafeMove configuration files.

The controller restarts.

- 4 After the controller is restarted, tap **Settings** on the home page.

- 5 Tap **Safety Controller**.

- 6 Tap **Synchronization** in the left pane.

- 7 Jog the robot to match the **Actual Positions** values with the **Sync Positions** values.

Make sure the values are the same.

- 8 Tap **Synchronize**.

3.6.6.4 Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later)

3.6.6.4 Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later)

Preparing the robot system

Required options for system setup

When setting up the system using **Installation Manager** in RobotStudio, select the options [3043-3] *SafeMove Collaborative* and [3051-2] *IO Package*, and the correct robot variant. The option *Drive System IRB Small Robot* is selected automatically after the robot type is determined.

Supported parameters for connections to scanners and scalable I/O device

The laser scanner uses a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded to the system after the Collaborative Speed Control add-in is installed, see [Information about Collaborative Speed Control add-in on page 100](#).

The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

The following table lists the device mapping information of Scalable_IO signals, which are automatically configured after the add-in installation.

Signal name	Device mapping	Device
ABB_Scalable_IO_0_DI1 ⁱ	0	ABB_Scalable_IO
ABB_Scalable_IO_0_DI2 ⁱ	1	ABB_Scalable_IO
ABB_Scalable_IO_0_DI3 ⁱⁱ	2	ABB_Scalable_IO
ABB_Scalable_IO_0_DI4 ⁱⁱ	3	ABB_Scalable_IO

ⁱ Value of ProtectingArea depends on logic AND value of ABB_Scalable_IO_0_DI1 and ABB_Scalable_IO_0_DI2. For definition of ProtectingArea, see [Configuring the laser scanner on page 116](#).

ⁱⁱ Value of WarningArea depends on logic AND value of ABB_Scalable_IO_0_DI3 and ABB_Scalable_IO_0_DI4. For definition of WarningArea, see [Configuring the laser scanner on page 116](#).

Continues on next page

3 Installation and commissioning

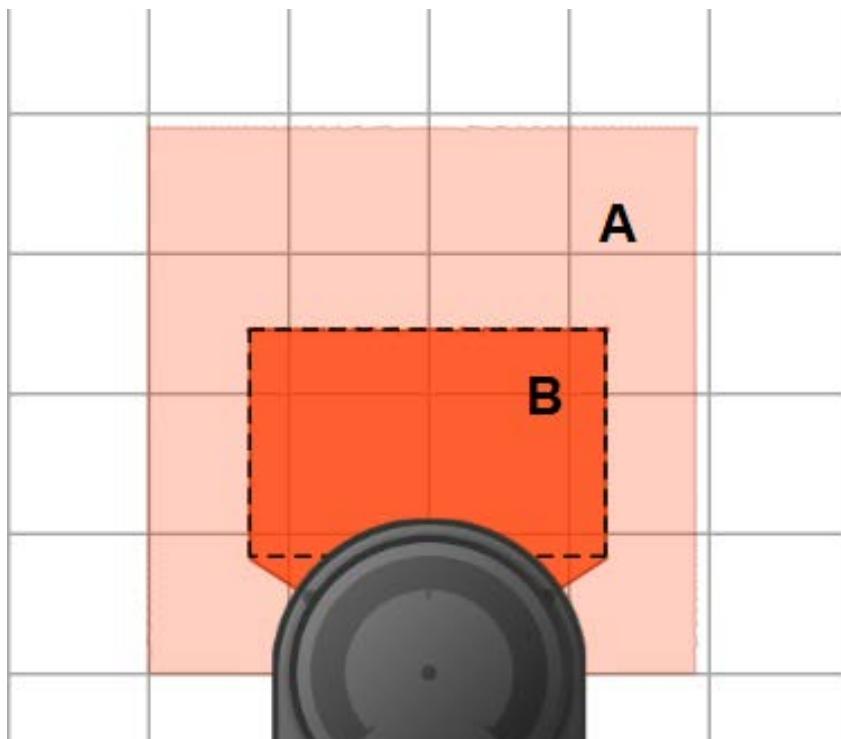
3.6.6.4 Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later)

Continued

Configuring the laser scanner

Protection fields

Two protection fields are defined to provide a progressive safety protection. The following figure illustrates the field ranges.



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	Field	Lamp color	Description
A	WarningArea	Yellow	The warning area field defines the largest range, but it shall be within the scanning range of the scanner. Within this field range, the lamp unit on the process hub lights up yellow, and the robot movement speed reduces to a lower speed that is set by the user.
B	ProtectingArea	Red	Within this field range, the lamp unit turns to red and the robot movement speed is reduced to 0. The robot stands still.

Configuration procedure

Before starting the configuration, obtain the software tool *Safety Designer®* from SICK's website first. Make sure the software tool is in the latest version.

Detailed procedures about how to configure the laser scanner are detailed in *Operating instructions microScan3 - Pro I/O* from the vendor. Following described the procedure roughly:

- 1 Open configuration software tool *Safety Designer®*.
- 2 Set IP address in **Configuration > Addressing**.

Make sure the scanner IP address is in the same network segment with the PC used for configuring the scanner.

Continues on next page

3.6.6.4 Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later)

Continued

- 3 Define the two protection fields for the scanner in **Configuration > Fields**.
- 4 Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration > Inputs and outputs**.
- 5 Select one OSSD pair from the **Signals** panel to pin1 and pin2, and select another OSSD pair to pin3 and pin4.
The two OSSD pairs will be used for defining the monitoring cases.
- 6 Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration > Monitoring cases**.
- 7 Refer to the following table to obtain the pins defined to OSSD pairs. The pins are from a 17-pin cable that will be used to connect the laser scanner and scalable I/O device.

Pin	Wiring color	Name	Function
1	Brown	OSSD1A	OSSD pair 1, OSSD A
2	Blue	OSSD1B	OSSD pair 1, OSSD B
3	White	OSSD2A	OSSD pair 2, OSSD A
4	Green	OSSD2B	OSSD pair 2, OSSD B
17	White with grey	0 V DC	0 DC

- 8 Connect the laser scanner to scalable I/O device with the defined pins.

Pin in cable	Pin position number in X2 connector of the device ⁱ
Pin1 (OSSD1A)	DI01+
Pin2 (OSSD1B)	DI02+
Pin3 (OSSD2A)	DI03+
Pin4 (OSSD2B)	DI04+
Pin17	Circuit of D101-, D102-, D103- and D104-

ⁱ For detailed information of pin definitions in connector X2 Digital inputs of the scalable I/O device DSQC1042, see the product specification of the controller and *Application manual - Scalable I/O*.

Configuring the scalable I/O device

Detailed procedures about how to connect and configure the scalable I/O device DSQC1042 are specified in *Application manual - Scalable I/O*. Following provides a rough procedure:

- 1 Make sure that the laser scanner and scalable I/O device is connected as instructed in previous configuration procedure of laser scanner.
- 2 Connect the process power supply to connector X1 of the scalable I/O device via pin locations PWR DO and GND DO.
- 3 Connect the logic power supply to connector X4 of the scalable I/O device via pin locations PWR and GND.
- 4 Connect the Ethernet cable from the robot controller to connector X5.

Continues on next page

3 Installation and commissioning

3.6.6.4 Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later)

Continued

Configuring SafeMove

To enable SafeMove, perform the following procedure:

- 1 Log in the FlexPendant.**

Make sure the user logged in have access grants to lock safety controller configurations, safety services and software synchronization.

- 2 Tap SafeMove on the home page.**

- 3 Tap Load in the pop-up message box to confirm loading of template SafeMove configuration files.**

The controller restarts.

- 4 After the controller is restarted, tap Settings on the home page.**

- 5 Tap Safety Controller.**

- 6 Tap Synchronization in the left pane.**

- 7 Jog the robot to match the Actual Positions values with the Sync Positions values.**

Make sure the values are the same.

- 8 Tap Synchronize.**

3.6.6.5 Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later)

3.6.6.5 Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later)

Preparing the robot system

Required options for system setup

When setting up the system using **Installation Manager** in RobotStudio, select the options [3043-3] *SafeMove Collaborative* and [3051-4] *Dual IO Package*, and the correct robot variant. The option *Drive System IRB Small Robot* is selected automatically after the robot type is determined.

Supported parameters for connections to scanners and scalable I/O device

The laser scanners use a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded to the system after the Collaborative Speed Control add-in is installed, see [Information about Collaborative Speed Control add-in on page 100](#).

The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

The following table lists the device mapping information of Scalable_IO signals, which are automatically configured after the add-in installation.

Signal name	Device mapping	Device
ABB_Scalable_IO_0_DI1 ⁱ	0	ABB_Scalable_IO
ABB_Scalable_IO_0_DI2 ⁱ	1	ABB_Scalable_IO
ABB_Scalable_IO_0_DI3 ⁱⁱ	2	ABB_Scalable_IO
ABB_Scalable_IO_0_DI4 ⁱⁱ	3	ABB_Scalable_IO
ABB_Scalable_IO_0_DI5 ⁱ	4	ABB_Scalable_IO
ABB_Scalable_IO_0_DI6 ⁱ	5	ABB_Scalable_IO
ABB_Scalable_IO_0_DI7 ⁱⁱ	6	ABB_Scalable_IO
ABB_Scalable_IO_0_DI8 ⁱⁱ	7	ABB_Scalable_IO

ⁱ Value of ProtectingArea depends on logic AND value of ABB_Scalable_IO_0_DI1, ABB_Scalable_IO_0_DI2, ABB_Scalable_IO_0_DI5 and ABB_Scalable_IO_0_DI6. For definition of ProtectingArea, see [Configuring the laser scanner on page 120](#).

ⁱⁱ Value of WarningArea depends on logic AND value of ABB_Scalable_IO_0_DI3, ABB_Scalable_IO_0_DI4, ABB_Scalable_IO_0_DI7 and ABB_Scalable_IO_0_DI8. For definition of WarningArea, see [Configuring the laser scanner on page 120](#).

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3 Installation and commissioning

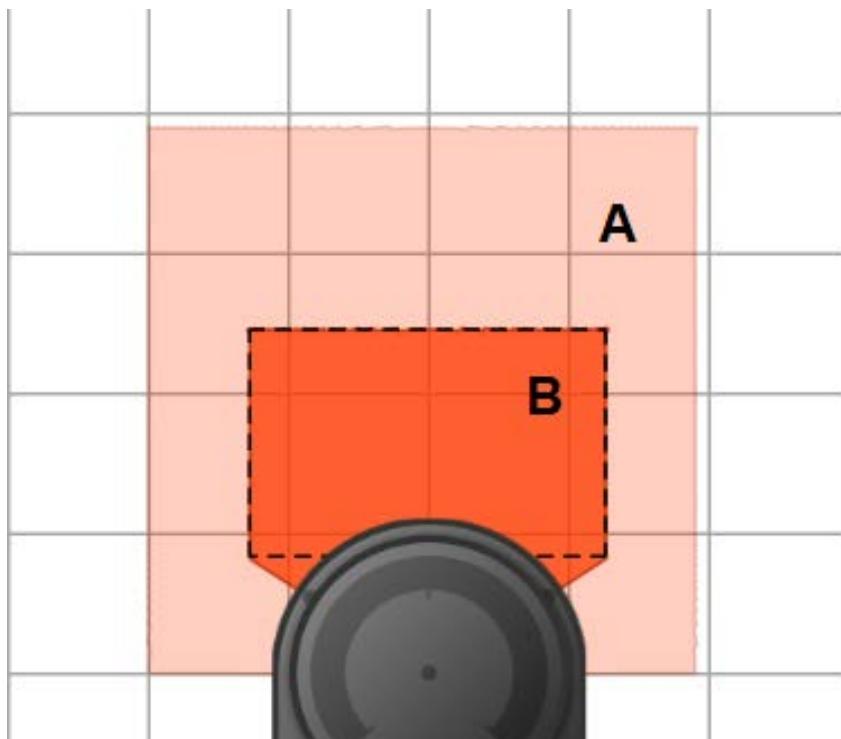
3.6.6.5 Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later)

Continued

Configuring the laser scanner

Protection fields

Two protection fields are defined to provide a progressive safety protection. The following figure illustrates the field ranges.



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	Field	Lamp color	Description
A	WarningArea	Yellow	The warning area field defines the largest range, but it shall be within the scanning range of the scanner. Within this field range, the lamp unit on the process hub lights up yellow, and the robot movement speed reduces to a lower speed that is set by the user.
B	ProtectingArea	Red	Within this field range, the lamp unit turns to red and the robot movement speed is reduced to 0. The robot stands still.

Configuration procedure

Before starting the configuration, obtain the software tool *Safety Designer®* from SICK's website first. Make sure the software tool is in the latest version.

Detailed procedures about how to configure the laser scanners are detailed in *Operating instructions microScan3 - Pro I/O* from the vendor. Following described the procedure roughly:

- 1 Open configuration software tool *Safety Designer®*.
- 2 Set IP address in Configuration > Addressing.
 - Make sure the scanner IP addresses are in the same network segment with the PC used for configuring the scanner.

Continues on next page

3.6.6.5 Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later)

Continued

- The two scanners must be set to different IP addresses.

- 3 Define the two protection fields for each scanner in **Configuration > Fields**.
- 4 Define the source for input signals of each scanner and configure basic settings for the inputs and outputs in **Configuration > Inputs and outputs**.
- 5 For both scanners, select one OSSD pair from the **Signals** panel to pin1 and pin2, and select another OSSD pair to pin3 and pin4.
The two OSSD pairs will be used for defining the monitoring cases.
- 6 Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration > Monitoring cases**.
- 7 Refer to the following table to obtain the pins defined to OSSD pairs. The pins are from a 17-pin cable that will be used to connect a laser scanner and scalable I/O device.

Pin	Wiring color	Name	Function
1	Brown	OSSD1A	OSSD pair 1, OSSD A
2	Blue	OSSD1B	OSSD pair 1, OSSD B
3	White	OSSD2A	OSSD pair 2, OSSD A
4	Green	OSSD2B	OSSD pair 2, OSSD B
17	White with grey	0 V DC	0 DC

- 8 Connect the laser scanners to safety module with the defined pins.

Scanner	Pin in cable	Pin position number in X2 connector of the device ⁱ
Scanner 1	Pin1 (OSSD1A)	D101+
	Pin2 (OSSD1B)	DI02+
	Pin3 (OSSD2A)	DI03+
	Pin4 (OSSD2B)	DI04+
	Pin17	Circuit of D101-, D102-, D103- and D104-
Scanner 2	Pin1 (OSSD1A)	D105+
	Pin2 (OSSD1B)	DI06+
	Pin3 (OSSD2A)	DI07+
	Pin4 (OSSD2B)	DI08+
	Pin17	Circuit of D105-, D106-, D107- and D108-

ⁱ For detailed information of pin definitions in connector X2 Digital inputs of the scalable I/O device DSQC1042, see the product specification of the controller and *Application manual - Scalable I/O*.

Configuring the scalable I/O device

Detailed procedures about how to connect and configure the scalable I/O device DSQC1042 are specified in *Application manual - Scalable I/O*. Following provides a rough procedure:

- 1 Make sure that the laser scanner and scalable I/O device is connected as instructed in previous configuration procedure of laser scanner.

Continues on next page

3 Installation and commissioning

3.6.6.5 Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later)

Continued

- 2 Connect the process power supply to connector X1 of the scalable I/O device via pin locations PWR DO and GND DO.
- 3 Connect the logic power supply to connector X4 of the scalable I/O device via pin locations PWR and GND.
- 4 Connect the Ethernet cable from the robot controller to connector X5.

Configuring SafeMove

To enable SafeMove, perform the following procedure:

- 1 Log in the FlexPendant.
Make sure the user logged in have access grants to lock safety controller configurations, safety services and software synchronization.
- 2 Tap **SafeMove** on the home page.
- 3 Tap **Load** in the pop-up message box to confirm loading of template SafeMove configuration files.
The controller restarts.
- 4 After the controller is restarted, tap **Settings** on the home page.
- 5 Tap **Safety Controller**.
- 6 Tap **Synchronization** in the left pane.
7 Jog the robot to match the **Actual Positions** values with the **Sync Positions** values.
Make sure the values are the same.
- 8 Tap **Synchronize**.

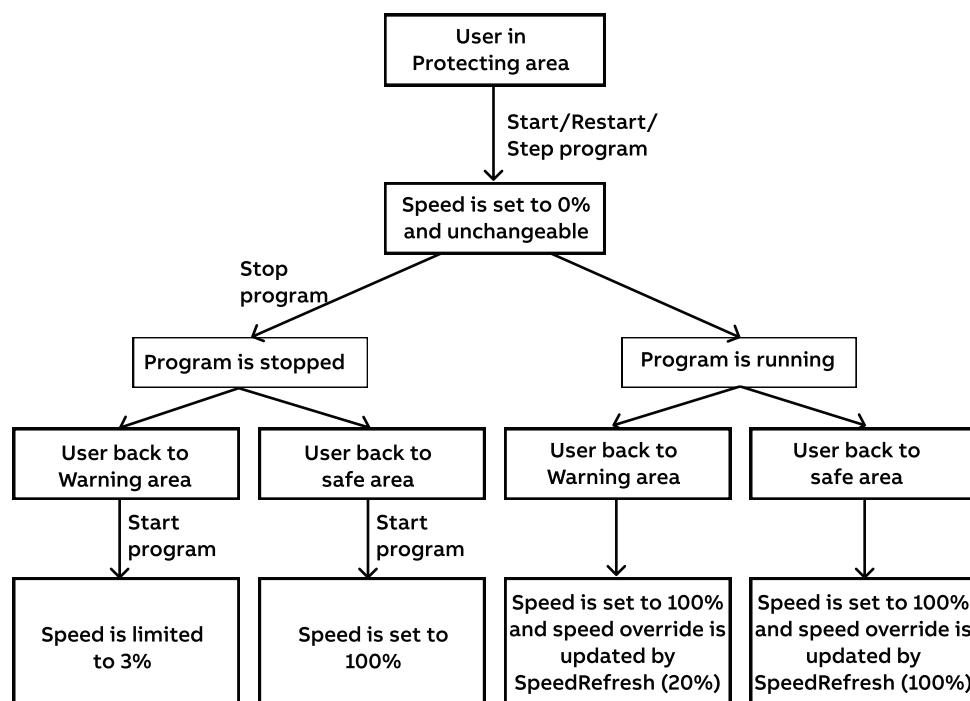
3.6.6.6 Speed control strategies

General

The speed control of CRB 15000 is affected by several factors, such as, the RobotWare version, the speed setting in the FlexPendant, the speed setting in motion instruction and the `SpeedRefresh` value. Users in different protection fields defined for laser scanner to monitor and perform different program execution actions may result in different movement speed. This section describes the speed control strategies for typical scenarios.

Strategies (RobotWare 7.5)

Users in Protecting area



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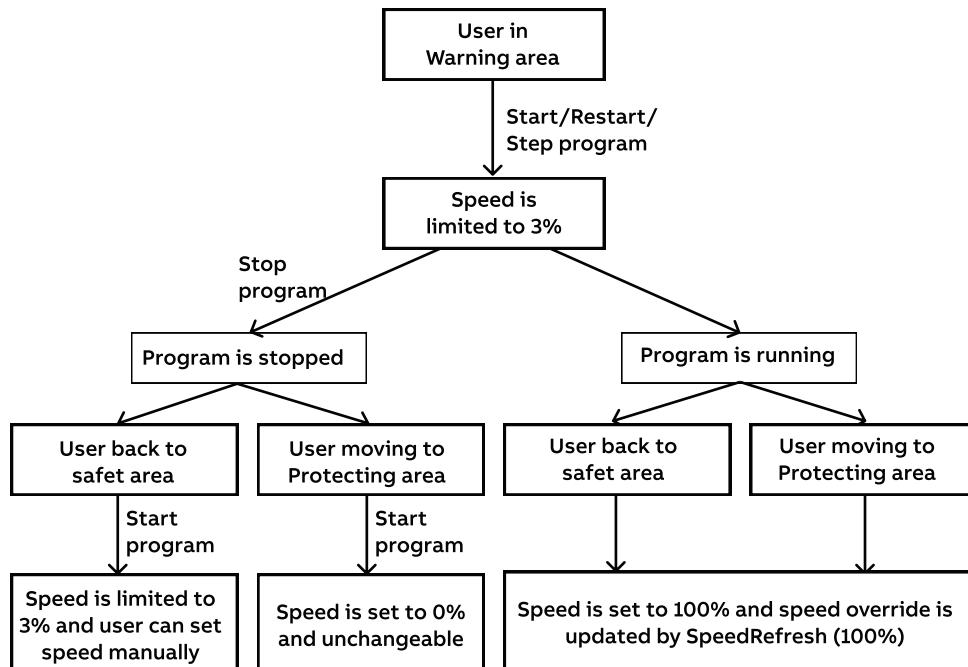
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3 Installation and commissioning

3.6.6.6 Speed control strategies

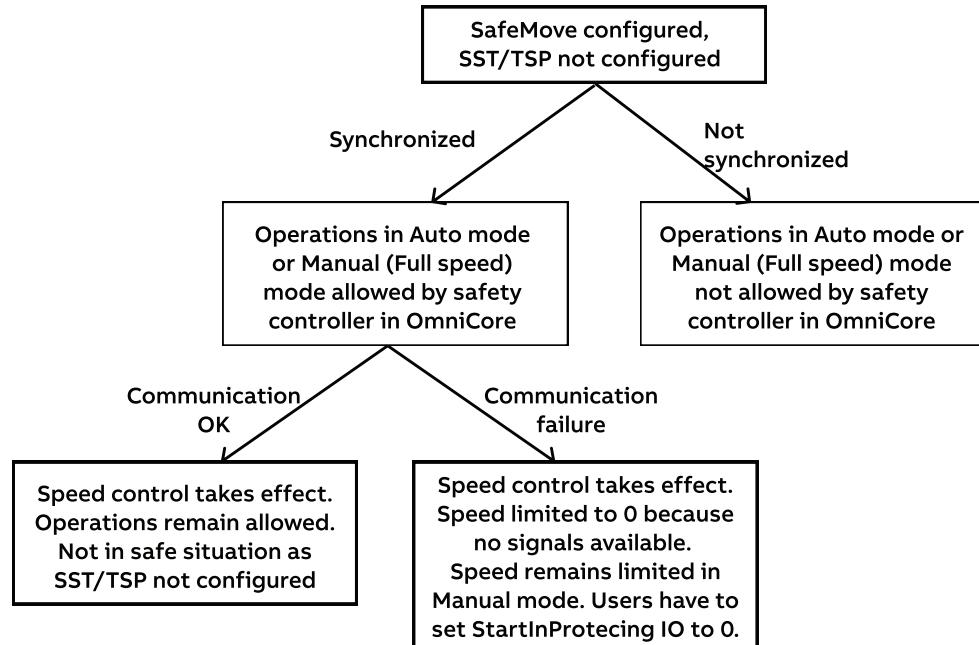
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Users in Warning area



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SafeMove triggered but SST/TSP not configured

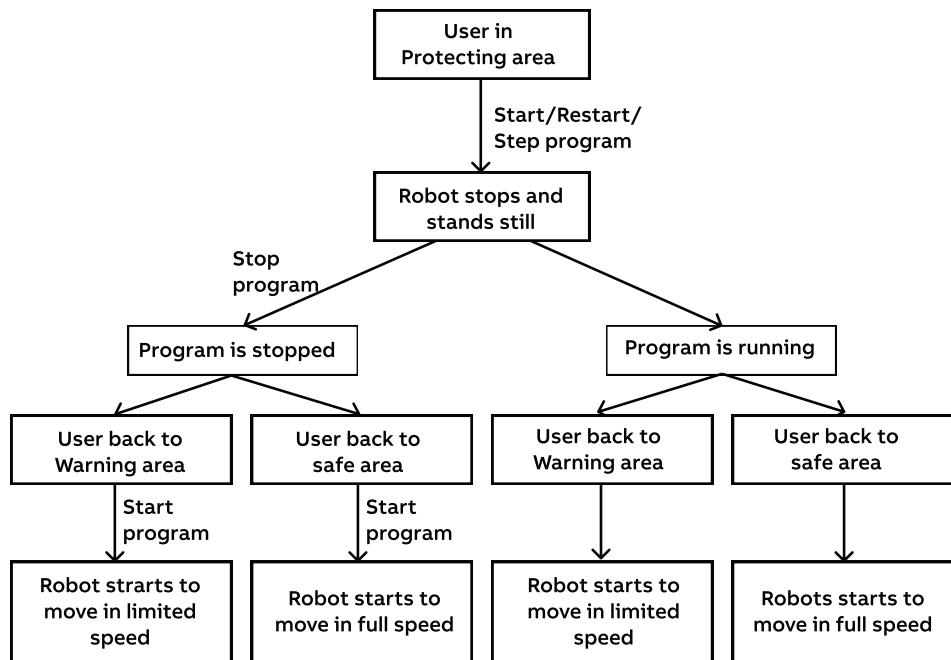


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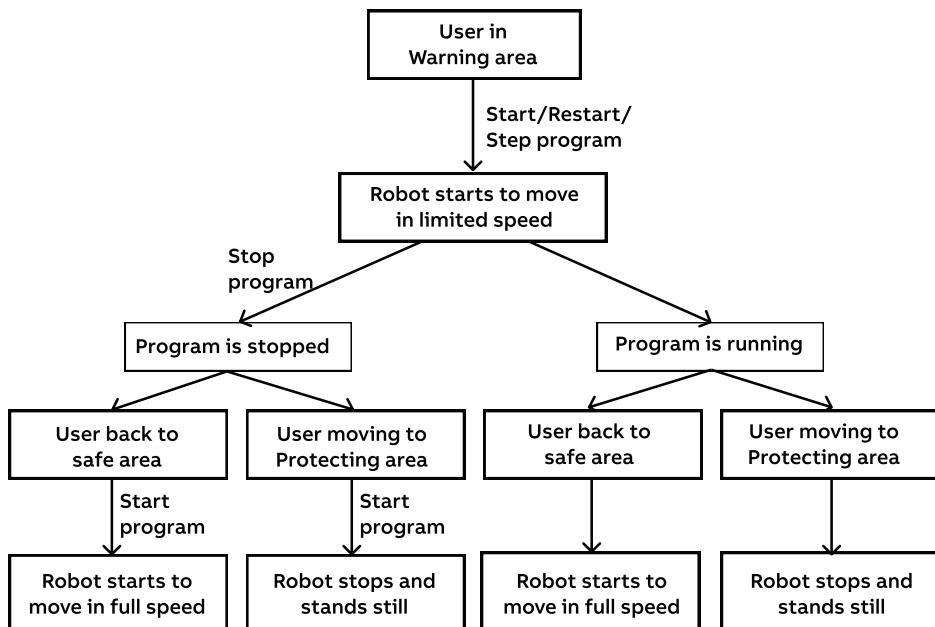
Strategies (RobotWare 7.6 or later)

Users in Protecting area



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Users in Warning area



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3 Installation and commissioning

3.6.7 Use cases of safety configurations

3.6.7 Use cases of safety configurations

General

Configurations of speed control are allowed to be modified in RAPID programs, which are loaded to the system after the Collaborative Speed Control add-in is installed.



Note

Safety configurations can only be modified for robots running in RobotWare 7.6 and later versions.

Modified configuration must always be validated to verify that the desired safety is achieved. If no validation is performed, or the validation is inadequate, the configuration cannot be relied on for personal safety.

Deactivating the SpeedHandling function



Note

Modified configuration must always be validated to verify that the desired safety is achieved. If no validation is performed, or the validation is inadequate, the configuration cannot be relied on for personal safety.

The SpeedHandling function is activated by default after the Collaborative Speed Control add-in is installed and the SafeMove template is loaded. The function is used to enable or disable speed-related actions for speed control.

It is possible to use the following procedure to deactivate the SpeedHandling function based on risk assessment of the final application:

- 1 In RobotStudio, open the RAPID program InternalSpeedHandling_User in task T_ROB1.
- 2 Navigate to the function ISH_b_FunctionlityIsUsed and set its value from default TRUE to FALSE.

```
T_ROB1/InternalSpeedHandling_User*  
49 ! in addition, the SafeMove Parameters must be set correctly!  
50 ! Following Global-SafeMove-Signals need to be configured:  
51 ! -> AtUser_MODE_IsNot_Cooperation  
52 ! -> AtUser_MODE_IsNot_IntermittCollab  
53 ! -> AtUser_Period_ms_Until_SST  
54 ! -> AtUser_Period_ms_Until_TSP  
55  
56 ! DEFAULT is 250 mm/s, change according to the TSP max velocity set in SafeMove Configuration  
57 TASK PERS num ISH_n_Speed_In_WarningArea_mm_s := 250;  
58 ! DEFAULT is TRUE, set to FALSE to disable the InternalSpeedHandling completely  
59 TASK PERS bool ISH_b_FunctionlityIsUsed := FALSE;  
60 ! DEFAULT is TRUE, set to FALSE if you don't want to get Logs from the InternalSpeedHandling  
61 TASK PERS bool ISH_b_ErrorLogShownIsUsed := TRUE;  
62 ! DEFAULT is TRUE, set to FALSE if you don't want to get TPWrite notifications from the InternalSpeedHandling displayed  
63 TASK PERS bool ISH_b_TPInformationIsUsed := TRUE;  
64
```

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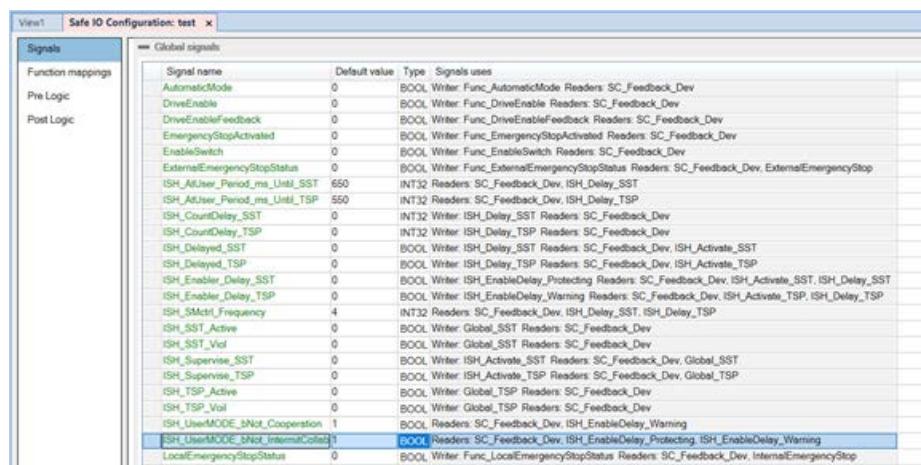
- 3 Save the change and apply to the controller.

SafeMove configurations also affect the speed control on the robot to achieve further safety. SafeMove is still functional after the SpeedHandling function in RAPID program is deactivated.

Continues on next page

Use the following procedure to disable the speed control function provided by SafeMove:

- 1 Open the RobotStudio.
- 2 Log in the controller using the Admin account and request the write access.
- 3 In the Controller tab, choose Visual SafeMove from the Safety group in the Configuration category.
- 4 In the Visual SafeMove tab, click Safe IO Configurator in the Configuration group.
- 5 In the displayed Safe IO Configuration window, go to the signal **ISH_UserMODE_bNot_ImemitCollab** in the global signal list and set the value to 1.



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- 6 Apply the configuration to the controller by clicking Write to Controller in the Controller group in the Configuration category.

If the SpeedHandling function requires to be reactivated after deactivation, make sure:

- the signal **ISH_UserMODE_bNot_ImemitCollab** in SafeMove configuration is set to 0, and,
- the function **ISH_b_FunctionlityIsUsed** in RAPID program is set to TRUE.

Changing the speed limit when WarningArea is triggered

When users enter the warning area, the robot speed is limited to 250 mm/sec by default. Use the following procedure to change the speed limit based on risk assessment of the final application:

- 1 In RobotStudio, open the RAPID program InternalSpeedHandling_User in task T_ROB1.

Continues on next page

3 Installation and commissioning

3.6.7 Use cases of safety configurations

Continued

- 2 Navigate to the function ISH_n_Speed_In_WarningArea_mm_s and set its value from default 250 to any required value.

```
T_ROB1/InternalSpeedHandling_User* x
52      ! -> AtUser_MODE_IsNot_IntermitCollab
53      ! -> AtUser_Period_ms_Until_SST
54      ! -> AtUser_Period_ms_Until_TSP
55
56      ! DEFAULT is 250 mm/s, change according to the TSP max velocity set in SafeMove Configuration
57 [ ] TASK_PERS num   ISH_n_Speed_In_WarningArea_mm_s := 200;
xx2200000437
```

- 3 Save the change and apply to the controller.

The speed limit can also be changed in SafeMove configurations using the following procedure:

- 1 Open the RobotStudio.
- 2 Log in the controller using the Admin account and request the write access.
- 3 In the **Controller** tab, choose **Visual SafeMove** from the **Safety** group in the **Configuration** category.
- 4 In the left pane of the window, choose **Global_TSP** under the **Tool Speed Supervisions** from the navigation tree.



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- 5 In the **Visual SafeMove Properties** window, set the **Max speed (mm/s)** in the **Speed limits** area to a required value.



- 6 Apply the configuration to the controller by clicking **Write to Controller** in the **Controller** group in the **Configuration** category.

Changing the execution delay time in template SafeMove configuration file

Configurations of SST and TSP are predefined in the template SafeMove configuration file as two global signals ISH_AtUser_Period_ms_Until_SST and ISH_AtUser_Period_ms_Until_TSP.

- ISH_AtUser_Period_ms_Until_SST: default value is 650 ms. If a period of 650 ms elapses after ProtectingArea is triggered but the robot still moves, the SST will trigger to stop robot movement immediately.
- ISH_AtUser_Period_ms_Until_TSP: default value is 550 ms. If a period of 550 ms elapses after WarningArea is triggered but the robot still moves in a speed larger than the defined speed limit value, the TSP will be triggered to stop robot movement immediately.

It is possible to change the values of ISH_AtUser_Period_ms_Until_SST and ISH_AtUser_Period_ms_Until_TSP according to application requirements using the following procedure. The change must be based on the risk assessment of the final application.

- 1 Open the RobotStudio.
- 2 Log in the controller using the Admin account and request the write access.

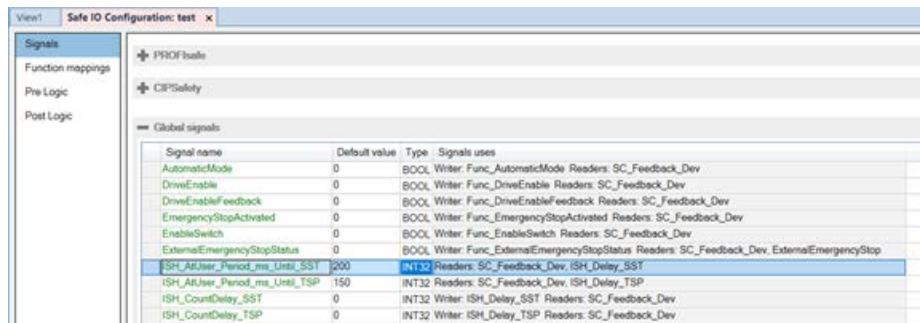
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3 Installation and commissioning

3.6.7 Use cases of safety configurations

Continued

- 3 In the **Controller** tab, choose **Visual SafeMove** from the **Safety** group in the **Configuration** category.
- 4 In the **Visual SafeMove** tab, click **Safe IO Configurator** in the **Configuration** group.
- 5 In the displayed **Safe IO Configuration** window, go to the signals **ISH_AtUser_Period_ms_Until_SST** and **ISH_AtUser_Period_ms_Until_TSP** in the global signal list and reset the value as required.



The screenshot shows the 'Safe IO Configuration' software interface with the title bar 'Safe IO Configuration: test'. On the left, there's a sidebar with tabs for 'Signals', 'Function mappings', 'Pre Logic', and 'Post Logic'. The 'Signals' tab is selected. In the main area, under 'Global signals', there is a table with columns: 'Signal name', 'Default value', 'Type', and 'Signals uses'. The table contains several rows, including:
- AutomaticMode: Default value 0, Type BOOL, Readers: SC_Feedback_Dev
- DriveEnable: Default value 0, Type BOOL, Readers: SC_Feedback_Dev
- DriveEnableFeedback: Default value 0, Type BOOL, Readers: SC_Feedback_Dev
- EmergencyStopActivated: Default value 0, Type BOOL, Readers: SC_Feedback_Dev
- EnableSwitch: Default value 0, Type BOOL, Readers: SC_Feedback_Dev
- ExternalEmergencyStopStatus: Default value 0, Type BOOL, Readers: SC_Feedback_Dev, ExternalEmergencyStop
- ISH_AtUser_Period_ms_Until_SST: Default value 200, Type INT32, Readers: SC_Feedback_Dev, ISH_Delay_SST
- ISH_AtUser_Period_ms_Until_TSP: Default value 150, Type INT32, Readers: SC_Feedback_Dev, ISH_Delay_TSP
- ISH_CountDelay_SST: Default value 0, Type INT32 Writer: ISH_Delay_SST Readers: SC_Feedback_Dev
- ISH_CountDelay_TSP: Default value 0, Type INT32 Writer: ISH_Delay_TSP Readers: SC_Feedback_Dev

Signal name	Default value	Type	Signals uses
AutomaticMode	0	BOOL	Writer: Func_AutomaticMode Readers: SC_Feedback_Dev
DriveEnable	0	BOOL	Writer: Func_DriveEnable Readers: SC_Feedback_Dev
DriveEnableFeedback	0	BOOL	Writer: Func_DriveEnableFeedback Readers: SC_Feedback_Dev
EmergencyStopActivated	0	BOOL	Writer: Func_EmergencyStopActivated Readers: SC_Feedback_Dev
EnableSwitch	0	BOOL	Writer: Func_EnableSwitch Readers: SC_Feedback_Dev
ExternalEmergencyStopStatus	0	BOOL	Writer: Func_ExternalEmergencyStopStatus Readers: SC_Feedback_Dev, ExternalEmergencyStop
ISH_AtUser_Period_ms_Until_SST	200	INT32	Readers: SC_Feedback_Dev, ISH_Delay_SST
ISH_AtUser_Period_ms_Until_TSP	150	INT32	Readers: SC_Feedback_Dev, ISH_Delay_TSP
ISH_CountDelay_SST	0	INT32	Writer: ISH_Delay_SST Readers: SC_Feedback_Dev
ISH_CountDelay_TSP	0	INT32	Writer: ISH_Delay_TSP Readers: SC_Feedback_Dev

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- 6 Apply the configuration to the controller by clicking **Write to Controller** in the **Controller** group in the **Configuration** category.

4 Maintenance

4.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the CRB 15000.

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 CRB 15000 is connected to power, always make sure that the CRB 15000 is connected to protective earth and a residual current device (RCD) before starting any maintenance work.

For more information see:

- [Product manual - OmniCore C30](#)
- [Robot cabling and connection points on page 69.](#)

4 Maintenance

4.2.1 Specification of maintenance intervals

4.2 Maintenance schedule and expected component life

4.2.1 Specification of maintenance intervals

Introduction

The intervals are specified in different ways depending on the type of maintenance activity to be carried out and the working conditions of the CRB 15000:

- 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.

4.2.2 Maintenance schedule

Scheduled and non-predictable maintenance

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

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

Life of each component

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

Maintenance schedule

Maintenance activities	Regularly	Every 6 months	Every 12 months	Reference
Cleaning the robot	x			Cleaning the CRB 15000 on page 140
Inspecting the robot	x			Inspecting the robot on page 134
Inspecting the robot harness		x ⁱ		Inspecting the cable harness on page 137
Testing the brake release functionality		x		Testing the brake release functionality on page 141
Testing the brake release tool		x		Testing the brake release functionality on page 141
Running the <i>Cyclic Brake Check</i> routine ⁱⁱ	x			Running the Cyclic Brake Check routine on page 142 Application manual - Functional safety and SafeMove
Testing the functionality of the joint electronics		x		Testing the functionality of the joint electronics on page 143

ⁱ Replace if damage or cracks are detected.

ⁱⁱ Not needed separately if already included in the application.
Recommended test interval is within the range 8-48 hours.

4 Maintenance

4.3.1 Inspecting the robot

4.3 Inspection activities

4.3.1 Inspecting the robot

Required equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Inspecting the robot

Use these procedures to inspect the robot.

Inspecting the light indicators of the manipulator

	Action	Note
1	Turn on the power supply on the controller.	
2	Check the lights of the arm-side interface. If the lights do not work as configured, contact your local ABB office.	A description of the LED output indicators is found in Arm-side interface on page 74 .

Checking the overall condition of the manipulator

	Action	Note
1	Look for abnormal wear or contamination.	Clean as necessary. See Cleaning the CRB 15000 on page 140 .
2	Check for loose hardware at robot arms, base (foundation screws), and tool flange.	Tighten loose hardware at base (foundation screws tightening torque: 30 Nm ±10%) and tool flange, if any.
3	Check for seepage of lubricants.	If any seepage is found, contact ABB.

Inspecting the covers

	Action	Note
1	Visually inspect all outer covers for damage. If any cover is damaged or cannot perform its protective function for other reasons, it must be replaced.	Spare part numbers are found in Product manual, spare parts - CRB 15000 .
2	Make sure that all covers are fully fastened. Manually check that the parts are not loose. Tighten, if needed.	Tightening torques specified in Tightening torques to be inspected on page 135 .

Inspecting the floor cable

The floor cable comprises the cabling between the robot and the controller cabinet.

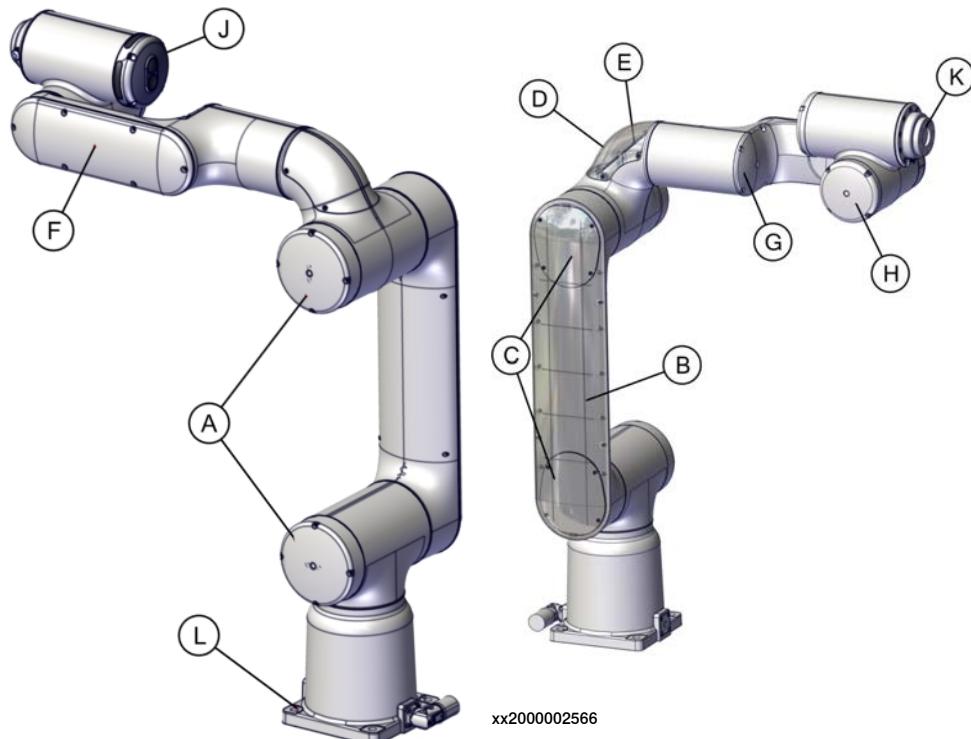
	Action	Note
1	Make an overall visual inspection of the cable in order to detect wear or damage.	Replace the cable if wear, cracks or damage is detected. See article numbers in Robot cabling and connection points on page 69 .

Continues on next page

Checking the presence of the brake release tool

	Action	Note
1	Check that the brake release tool is available at its storage location close to the robot.	Brake release tool: 3HAC079146-001. See Installation of brake release tool on page 55 .

Tightening torques to be inspected



Position	Cover	Screws	Tightening torque
A	Cover for axis 2/3	Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9	0.45 Nm
B	Lower arm cover	Hex socket head cap screw M3x16 12.9 Lafre 2C2B/FC6.9	0.45 Nm
C	Lower arm inner cover	Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9	1.4 Nm
D	Housing top cover	Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9	0.45 Nm
E	Housing inner plate	Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9	1.4 Nm

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4 Maintenance

4.3.1 Inspecting the robot

Continued

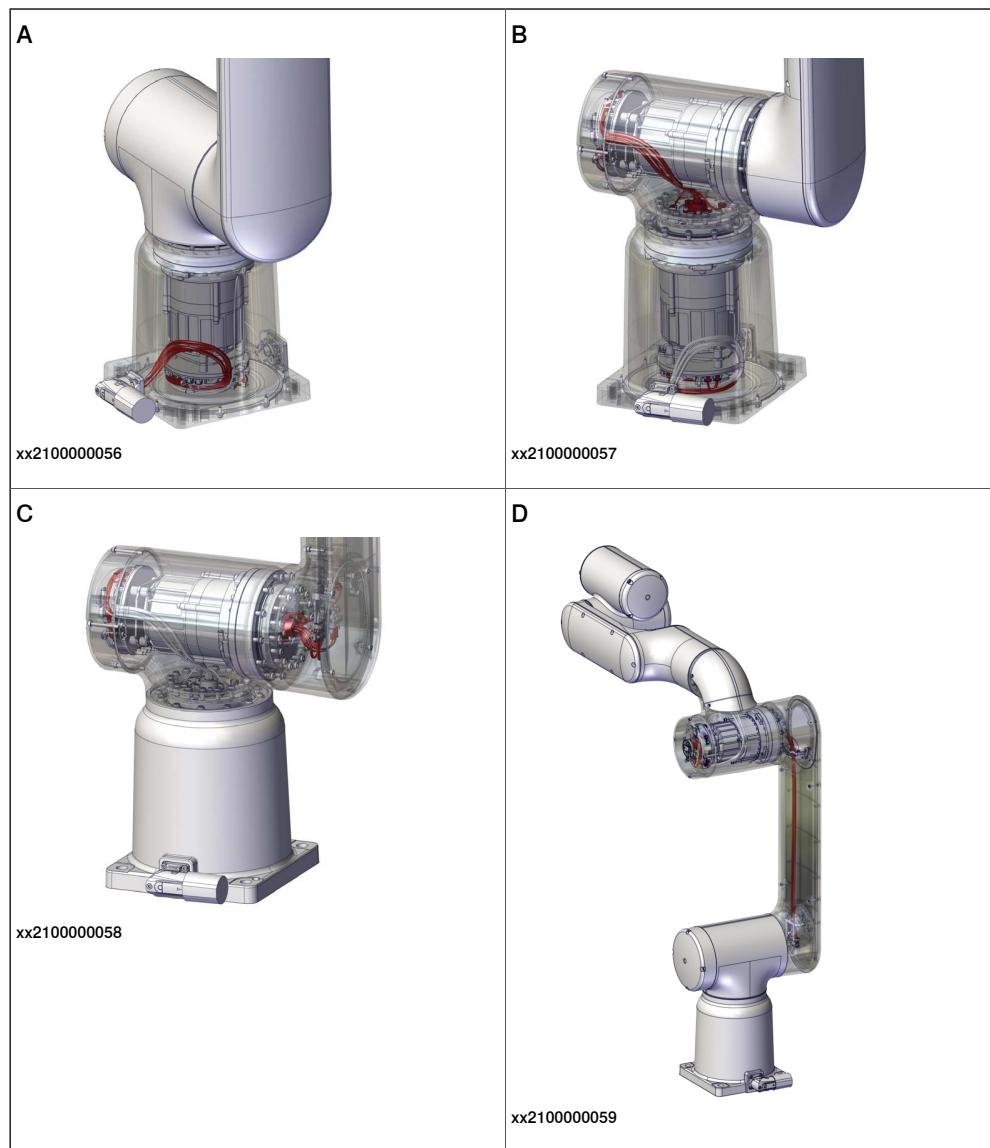
Position	Cover	Screws	Tightening torque
F	Tubular cover	Flange socket head screw with glue 3HAB3413-312 M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included.	1.6 Nm
G	Axis-4 cover	Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9	0.2 Nm
H	Axis-5 cover	Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9	0.2 Nm
J	Arm side interface	Hex socket head cap screw M3x12 12.9 Lafre 2C2B/FC6.9	0.45 Nm
K	Tool flange	Hex socket head cap screw M3x12 12.9 Lafre 2C2B/FC6.9	0.45 Nm
L	Base	M10x35 8.8	30 Nm ±10%

4.3.2 Inspecting the cable harness

4.3.2 Inspecting the cable harness

Location of cable harness

The figures show the location for the cable harness.



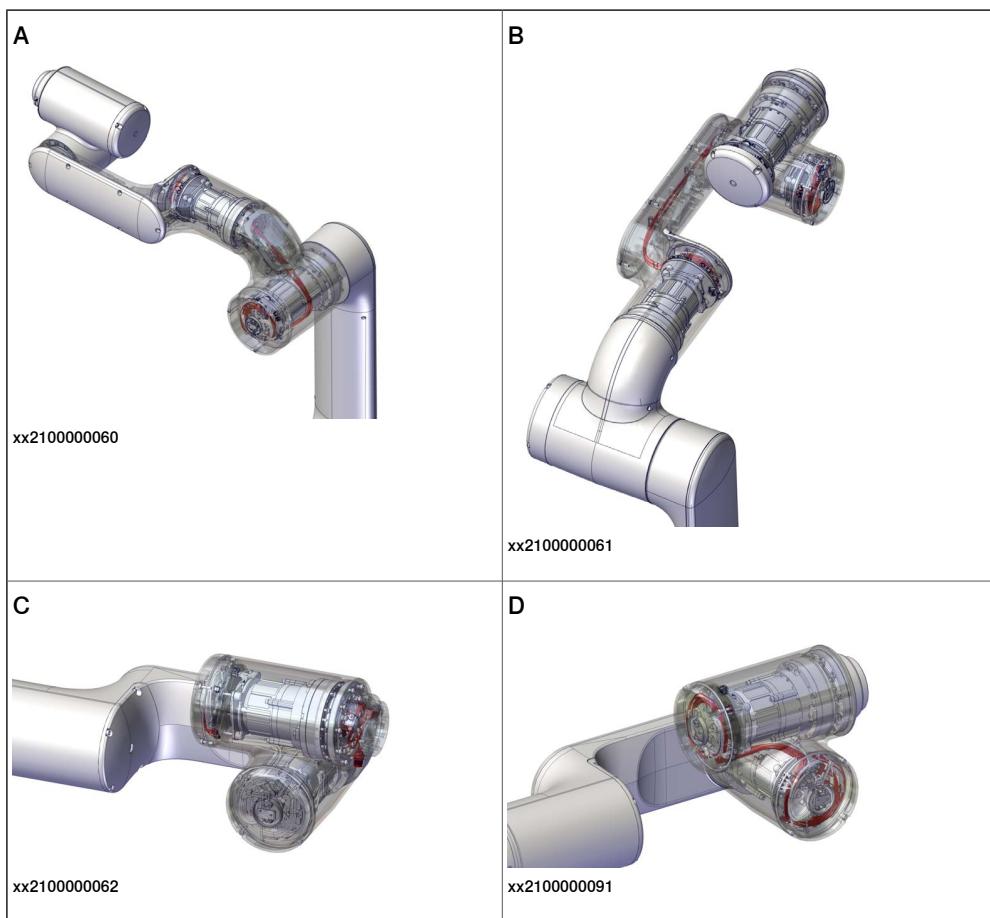
	Spare part	Spare part number
A	Cable harness, base socket	3HAC073202-001
B	Cable harness, joint 1	3HAC073204-001
C	Cable harness, joint 2	3HAC073205-001
D	Cable harness, joint 3	3HAC073207-001

Continues on next page

4 Maintenance

4.3.2 Inspecting the cable harness

Continued



	Spare part	Spare part number
A	Cable harness, joint 4	3HAC073206-001
B	Cable harness, joint 5	3HAC073206-001
C	Cable harness, joint 6	3HAC073208-001
D	Cable harness, transition joint-5 and joint-6	3HAC073209-001

Required equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Inspecting the cable harness

	Action	Note
1	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

Continues on next page

4.3.2 Inspecting the cable harness
Continued

Action	Note
2  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44.</i>	
3 Remove all covers required to achieve visibility of all cabling.	
4 Visually inspect all arm cabling. Look for abrasions, cuts or crush damages. If any damage is detected, replace the cabling.	
5 Refit all covers. If any cover is damaged, it must be replaced.  CAUTION Be careful not to squeeze any cabling during the refitting procedure.	Replacement information for the covers, such as part numbers and tightening torques for the attachment screws are detailed in section <i>Tightening torques to be inspected on page 135.</i>

4 Maintenance

4.4.1 Cleaning the CRB 15000

4.4 Cleaning activities

4.4.1 Cleaning the CRB 15000

General

To secure high uptime it is important that the CRB 15000 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 CRB 15000.



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 spray from a distance closer than 0.4 m.
- 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 or steam
Standard	Yes	Yes. With light cleaning detergent.	No	No

4.5 Testing activities

4.5.1 Testing the brake release functionality

When to test the brake release functionality

Test the brake release functionality regularly as a maintenance activity.

The brake release functionality shall be tested after heavy collisions. This does not apply to collisions which may routinely be experienced as part of a power and force limiting application.

Required equipment

Equipment	Article number	Note
Brake release tool	3HAC079146-001	For releasing the holding brakes of a joint unit motor.

Testing the brake release functionality

	Action	Note
1	Test the brake release functionality on each axis, by using the brake release tool.	See Manually releasing the brakes on page 52 .
2	If the holding brake does not release, check following: <ul style="list-style-type: none">• Check for event log messages on the FlexPendant.• Look for damage to the magnet. Replace the tool if damaged.• See troubleshooting section Brake release tool does not work on page 728.	For OmniCore, all event logs from the software can be seen on the FlexPendant, or in <i>Technical reference manual - Event logs for RobotWare 7</i> .

4 Maintenance

4.5.2 Running the Cyclic Brake Check routine

4.5.2 Running the Cyclic Brake Check routine

When to run the Cyclic Brake Check routine

The Cyclic Brake Check routine shall be run in the application every 8-48 hours.

For set-up, see *Application manual - Functional safety and SafeMove*.

For advanced users

If it is not possible to run the Cyclic Brake Check routine regularly in the application, then:

- The holding brake safety is reduced to the equivalent of *PL c*.
- Use of such a configuration must be justified by risk assessment.
- The method described in [Brake testing on page 31](#) can be used to check that the brakes still function correctly.

4.5.3 Testing the functionality of the joint electronics**When to test the joint electronics**

Test the functionality regularly as a maintenance activity.

Required equipment

No special equipment is required.

Testing the joint electronics

	Action	Note
1	Turn off power to the controller and then turn the power on again.	
2	Verify that the robot starts as expected.	

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5 Repair

5.1 Introduction

Structure of this chapter

This chapter describes repair activities for the CRB 15000. 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. Individual subcomponents shall not be exchanged.

Report replaced units



Note

When replacing a part on the CRB 15000, report to your local ABB the serial number, the article number, and the revision of both the replaced unit and the replacement unit.

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

Safety information

Make sure to read through the chapter [Safety on page 15](#) before commencing any service work.



Note

If the CRB 15000 is connected to power, always make sure that the CRB 15000 is connected to protective earth and a residual current device (RCD) before starting any repair work.

For more information see:

- [Product manual - OmniCore C30](#)

5 Repair

5.2.1 Mounting instructions for sealings

5.2 General procedures

5.2.1 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 procedure below describes how to fit rotating sealings.



CAUTION

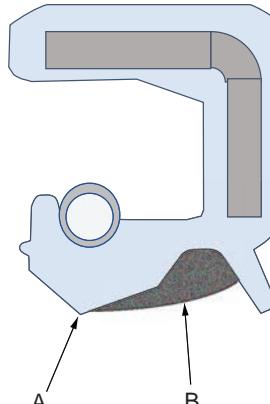
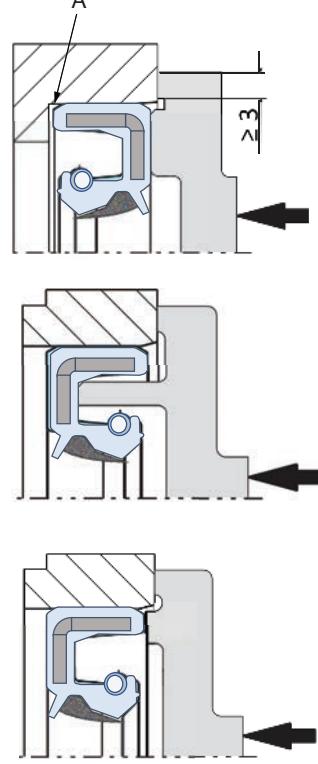
Please observe the following before commencing any assembly of sealings:

- Protect the sealing during transport and mounting, especially the main lip.
- 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.

	Action	Note
1	Check the sealing to ensure that: <ul style="list-style-type: none">• 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.	

Continues on next page

5.2.1 Mounting instructions for sealings
Continued

	Action	Note
3	<p>Lubricate the sealing with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the sealing.)</p> <p>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.</p>	<p>Article number is specified in Equipment on page 146.</p>  <p>xx2000000071</p> <p>A Main lip B Grease C Dust lip</p>
4	<p>Mount the sealing correctly with a mounting tool. Never hammer directly on the sealing as this may result in leakage.</p>	 <p>xx2000000072</p> <p>A Gap</p>

Continues on next page

5 Repair

5.2.1 Mounting instructions for sealings

Continued

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, preferably with a brush.
4	Tighten the screws evenly when fastening the flange joint.

O-rings

The following procedure describes how to fit o-rings.

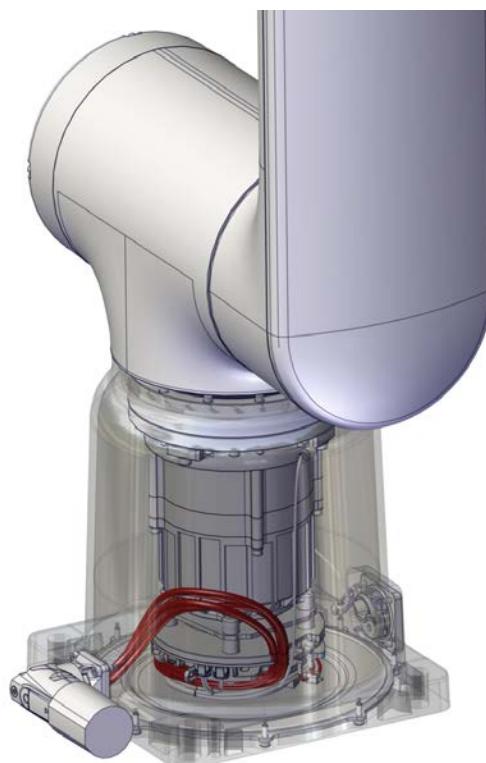
Action	Note
1 Ensure that the correct o-ring size is used.	
2 Check the o-ring for surface defects, burrs, shape accuracy, or deformation.	Defective o-rings, including damaged or deformed o-rings, may not be used.
3 Check the o-ring grooves. The grooves must be geometrically correct and should be free of pores and contamination.	
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.	

5.3 Cable harness

5.3.1 Replacing the base cabling

Location of the cable harness

The cable harness is located as shown in the figure.



xx2100000056

Summary of the replacement procedure

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

- 1 Jog the robot to transportation position.
- 2 Loosen the robot from the foundation and lay it down on its back.
This step requires two persons.
- 3 Remove the base cover.
- 4 Replace the cabling.

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Continues on next page

5 Repair

5.3.1 Replacing the base cabling

Continued

Spare part	Article number	Note
Cable harness, base socket	3HAC073202-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cable ties	-	
O-ring, nitrile rubber	3HAB3772-64	Base cover
Grease	3HAC042536-001	Shell Gadus S2

Removing the base cabling

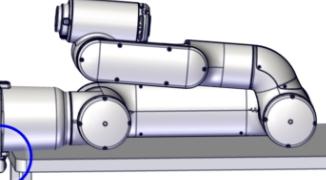
Use these procedures to remove the base cabling.

Preparations before removing the cabling

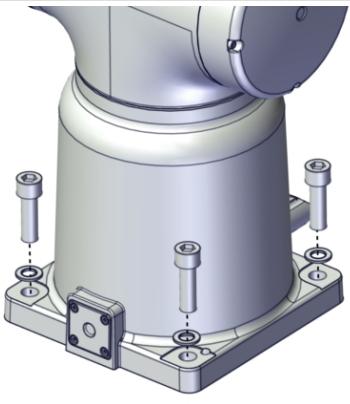
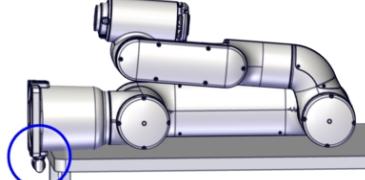
	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none">• Axis 1: 0°• Axis 2: 0°• Axis 3: +85°• Axis 4: 0°• Axis 5: 0°• Axis 6: 0°	 xx2100000113
2	<p> CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

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5.3.1 Replacing the base cabling
Continued

Action	Note
3 Prepare a working bench where the robot can be laid down on its back with the base socket outside the table edge.	 xx2100000414

Laying down the robot

Action	Note
1  CAUTION The CRB 15000 robot weighs 28 kg. A minimum of two persons are required for lifting as well as securing the robot in order to avoid any damage, instability, and injury.	
2 Loosen the robot from the foundation. <ul style="list-style-type: none"> • Person 1: keep holding the robot stable. • Person 2: loosen the robot base from the foundation by removing the attachment screws and washers. • Both persons: grasp the robot at appropriate locations and lay it down on its back on a working bench. Do not damage the base socket.  xx2100000415	 xx2100000414

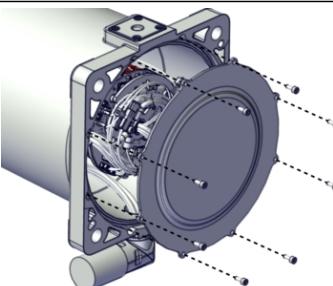
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5 Repair

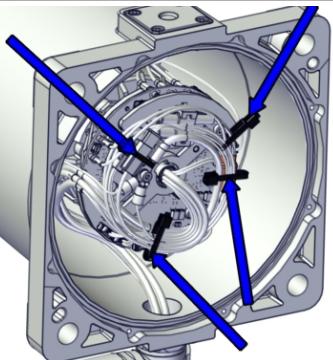
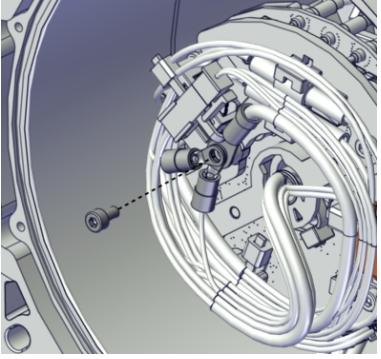
5.3.1 Replacing the base cabling

Continued

Removing the base cover

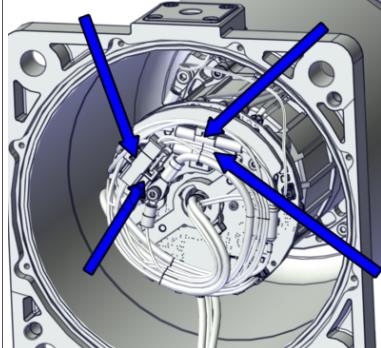
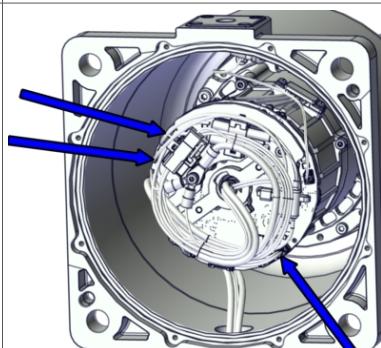
	Action	Note
1	Remove the bottom cover by removing the attachment screws.	 xx2000002007

Disconnecting the base cabling

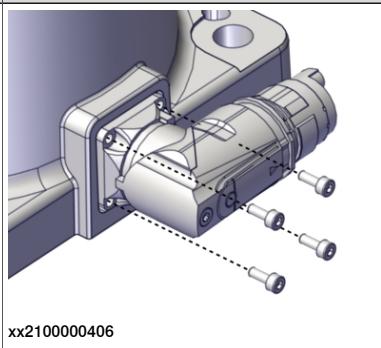
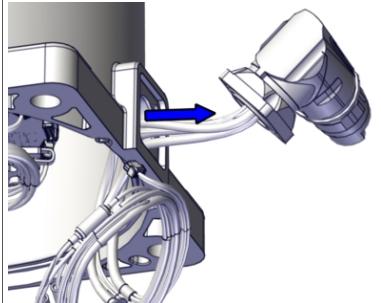
	Action	Note
1	Cut the cable ties.	 xx2100000424
2	Remove the functional and protective earth cables by removing the screw.	 xx2100000425

Continues on next page

5.3.1 Replacing the base cabling
Continued

Action	Note
3 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J1.DC+ • J1.DC- • J1.CS • J1.CP 	 xx2100000426
4 Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D1.X1 from X1 • D1.DC+ from DC+ • D1.DC- from ground 	 xx2100000405

Removing the base cabling

Action	Note
1 Remove the attachment screws.	 xx2100000406
2 Pull out the cabling from the base.	 xx2100000407

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5 Repair

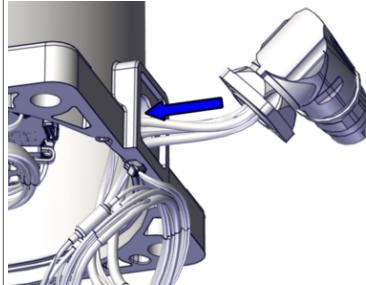
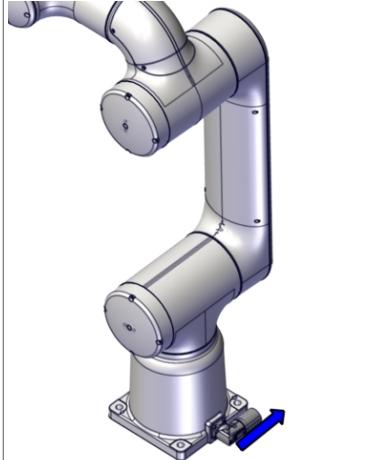
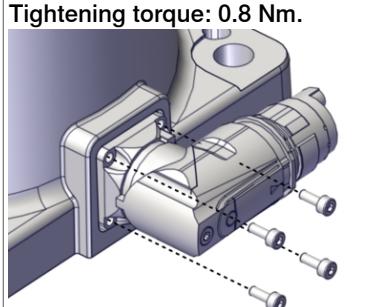
5.3.1 Replacing the base cabling

Continued

Refitting the base cabling

Use these procedures to refit the base cabling.

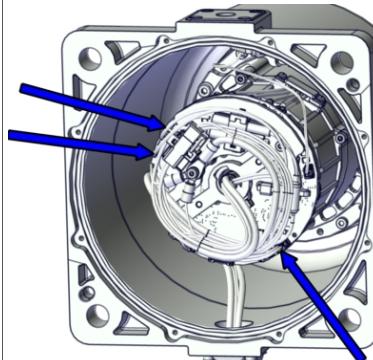
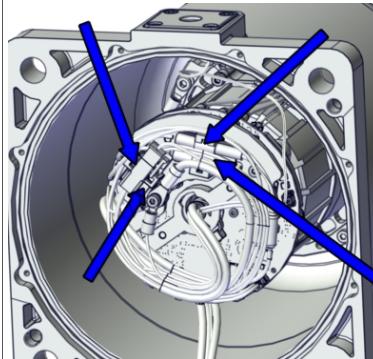
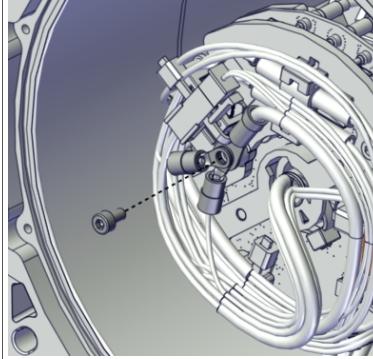
Refitting the base cabling

Action	Note
1 Insert the cabling into the base.	 xx2100000408
2 Orient the base connector so that it points to the right, seen from back of the robot.	 xx2100000409
3 Secure the base connector with the attachment screws.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm.</p>  xx2100000406

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5.3.1 Replacing the base cabling
Continued

Connecting the base cabling

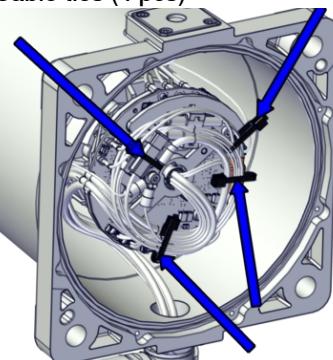
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44.</i>	
2	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D1.X1 to X1 • D1.DC+ to DC+ • D1.DC- to Ground 	 xx2100000425
3	Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J1.DC+ to J1.DC+ • J1.DC- to J1.DC- • J1.CS to J1.CS • J1.CP to J1.CP 	 xx2100000426
4	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2100000425

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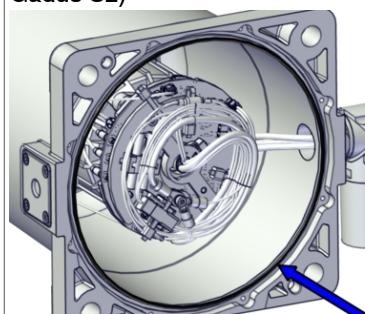
5 Repair

5.3.1 Replacing the base cabling

Continued

	Action	Note
5	Secure the cabling with cable ties.	<p>Cable ties (4 pcs)</p>  <p>xx2100000424</p>

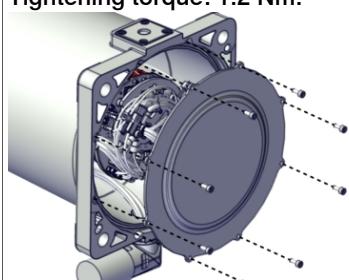
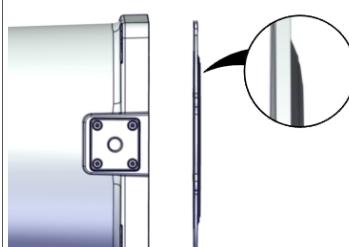
Refitting the base cover

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	<p>O-ring, nitrile rubber: 3HAB3772-64 Grease: 3HAC042536-001 (Shell Gadus S2)</p>  <p>xx2000002016</p>

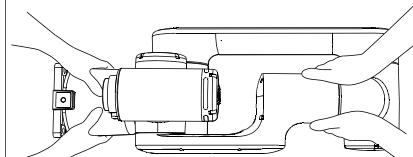
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5.3.1 Replacing the base cabling

Continued

Action	Note
<p>2 Refit the bottom cover with the attachment screws.</p> <p>Note</p> <p>Fit the cover in correct direction, the protrusion of the cover must face outwards.</p>	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.2 Nm.</p>  <p>xx2000002007</p>  <p>xx2100000268</p>

Lifting and securing the robot

Action	Note
<p>1 CAUTION</p> <p>The CRB 15000 robot weighs 28 kg. A minimum of two persons are required for lifting as well as securing the robot in order to avoid any damage, instability, and injury.</p> <p>Special consideration is necessary when mounting the robot in an elevated, suspended or wall mounted position.</p>	
<p>2 Grasp the robot at the foot and elbow, as shown in the figure, and lift it up from the transportation package.</p>	 <p>xx2100000118</p>
<p>3 CAUTION</p> <p>Do not leave the robot standing unfastened to the foundation, it is not stable on its own.</p>	
<p>4 Fit two pins to the holes in the base.</p>	<p>Centering pins: DIN6325, hardened steel Ø6x24 mm, 2 pcs .</p>

Continues on next page

5 Repair

5.3.1 Replacing the base cabling

Continued

	Action	Note
5	Raise the robot to standing and secure to foundation, paying attention to the centering holes at the bottom of the robot base. <ul style="list-style-type: none">• Person 1: keep holding the robot stable.• Person 2: secure the robot base to the foundation with the securing screws and washers.	Screws: M10x35, 4 pcs, quality 8.8 Washers: 23/10.5/2.5 mm Steel
6	Tighten the bolts in a crosswise pattern to ensure that the base is not distorted.	Tightening torque: 30 Nm ±10%

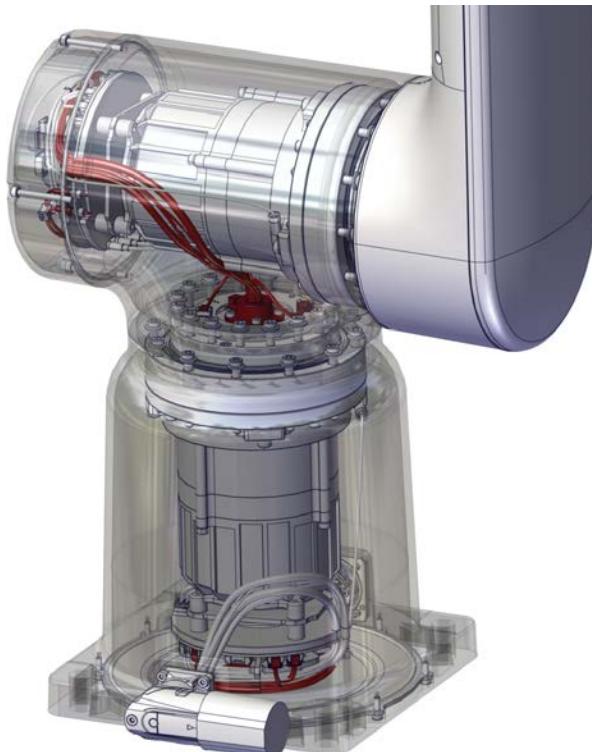
Concluding procedure

	Action	Note
1	 DANGER Make sure all safety requirements are met when performing the first test run.	

5.3.2 Replacing the axis-1 cabling

Location of the cable harness

The cable harness is located as shown in the figure.



xx2100000057

Summary of the replacement procedure

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

- 1 Separate the cabling between the swing and the lower arm.
- 2 Remove the lower and upper arm undivided.
- 3 Remove the axis-2 joint unit.
- 4 Remove the swing.
- 5 Loosen the base from the foundation and lay it down on its side.
- 6 Replace the cabling.

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Continues on next page

5 Repair

5.3.2 Replacing the axis-1 cabling

Continued

Spare part	Article number	Note
Cable harness, joint 1	3HAC073204-001	Also order new Cable tie: 3HAC075545-001.
Flange socket head screw with glue	3HAB3413-435	M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when re- fitting a joint unit. If ordering a new joint unit spare part, new screws are included.
Cable tie	3HAC075545-001	For securing joint unit cable.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3. Attachment screws M4x35 (4 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

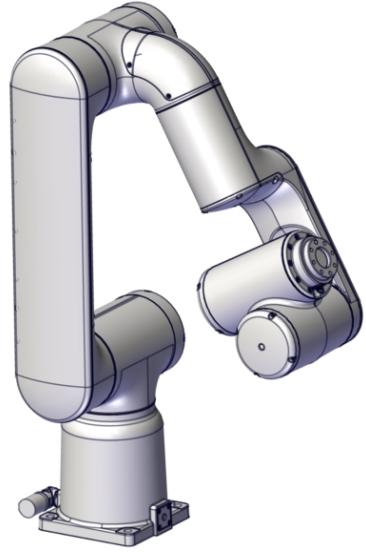
Consumable	Article number	Note
Cable ties	-	
O-ring, nitrile rubber	3HAB3772-64	Base cover
O-ring	3HAC061327-044	Lower arm, inner cover. 1 pcs / cover. Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.
Grease	3HAC042536-001	Shell Gadus S2
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574

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Removing the joint cabling

Use these procedures to remove the joint-1 cabling.

Preparations before removing the cabling

	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none"> • Axis 1: 0° • Axis 2: 0° • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. 	 xx2100000044
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

Removing the lower arm covers

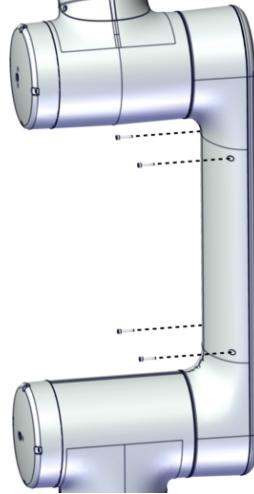
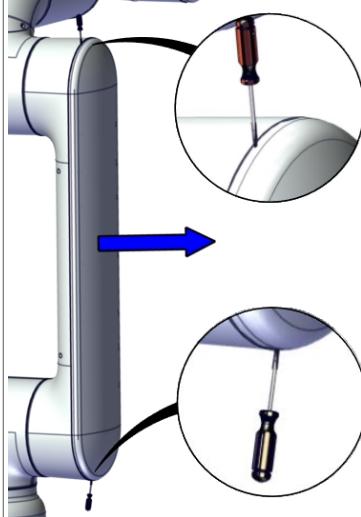
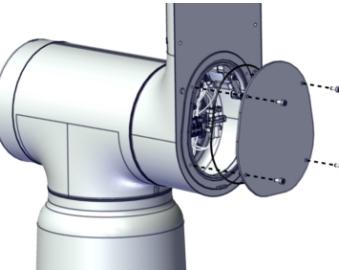
	Action	Note
1	<p>! CAUTION</p> <p>Make sure that all supplies for electrical power are turned off.</p>	

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5 Repair

5.3.2 Replacing the axis-1 cabling

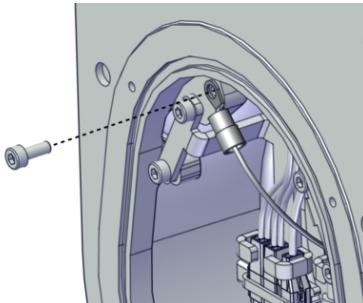
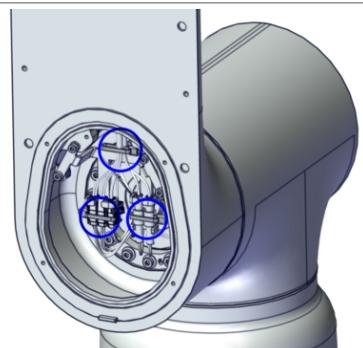
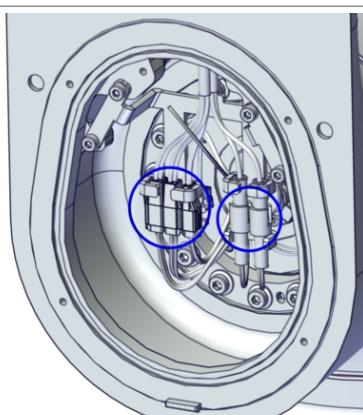
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Action	Note
2 Remove the four lower arm cover screws.	 xx2000001929
3 Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267
4 Remove the inner cover by removing the four screws.	 xx2000001930

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5.3.2 Replacing the axis-1 cabling
Continued

Disconnecting the cabling between the lower arm and the swing

Action	Note
1 Remove the functional earth cable by removing the screw.	 xx2000001936
2 Cut the cable ties.	 xx2000001937
3 Snap loose and disconnect all connectors.	 xx2000001938

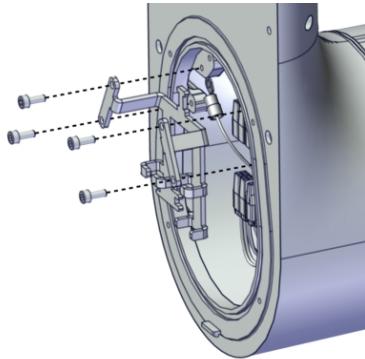
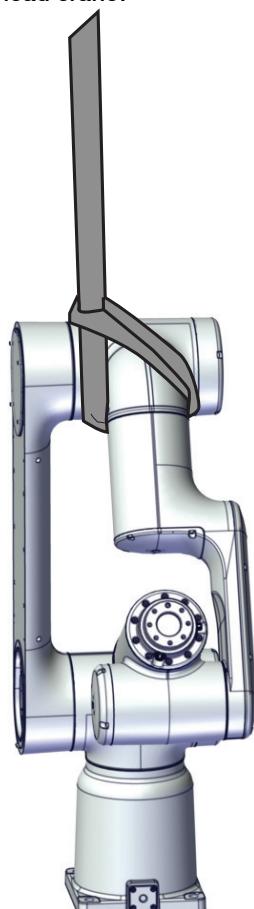
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5 Repair

5.3.2 Replacing the axis-1 cabling

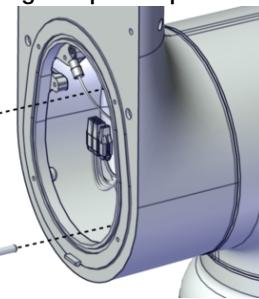
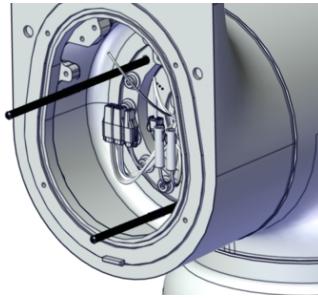
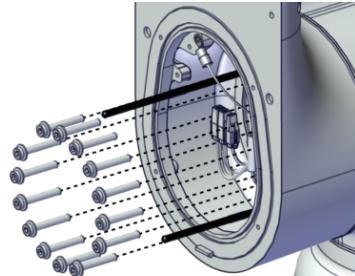
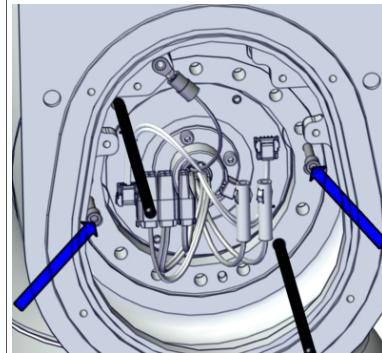
Continued

Removing the lower and upper arm assembled

	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939
2	Secure the weight of the upper and lower arm.  CAUTION The weight of the complete upper and lower arm together is 18 kg	Suggestion with lifting sling and an overhead crane:  xx2100000294

Continues on next page

5.3.2 Replacing the axis-1 cabling
Continued

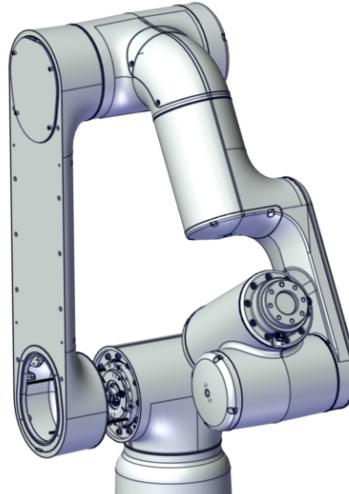
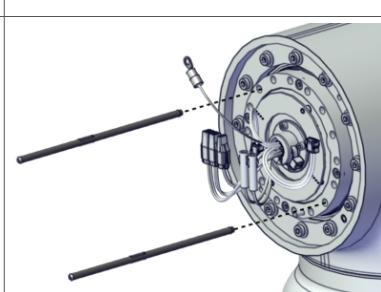
Action	Note
3 Remove two attachment screws and fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.</p>  <p>xx2000001951</p>  <p>xx2000001960</p>
4 Remove the lower arm attachment screws.	 <p>xx2000001940</p>
5 Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 <p>xx2000002151</p>

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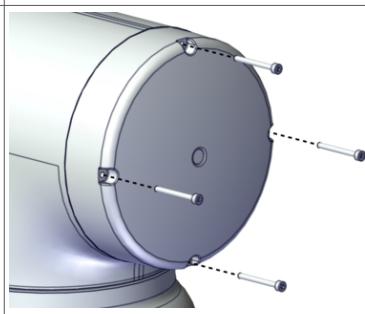
5 Repair

5.3.2 Replacing the axis-1 cabling

Continued

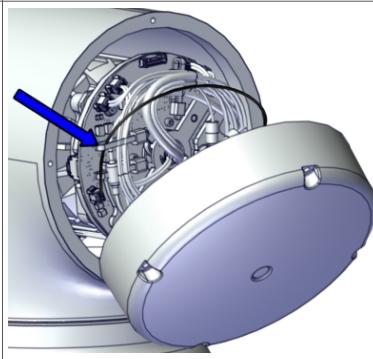
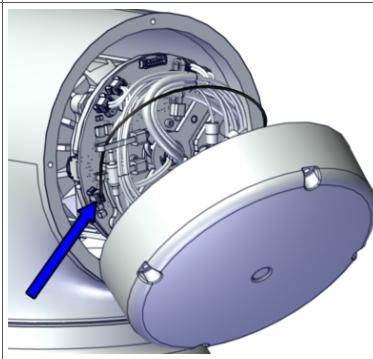
Action	Note
6 Remove the complete arm system from the swing.	 xx2000001941
7 Remove the guide pins.	 xx2000002432

Removing the swing cover

Action	Note
1  CAUTION Make sure that all supplies for electrical power are turned off.	
2 Remove the cover screws.	 xx2000001935

Continues on next page

5.3.2 Replacing the axis-1 cabling
Continued

Action	Note
<p>3</p> <p> CAUTION</p> <p>There is cabling connected between the cover and the joint unit drive board.</p> <p>Open the cover with care to avoid damage to the cabling or the connector(s).</p> <p>Do not leave the cover in location without being secured with the attachment screws.</p>	
<p>4</p> <p>Open the cover and cut the cable tie that holds the brake release cable.</p>	 <p>xx2000001931</p>
<p>5</p> <p>Disconnect the brake release connector DR.X8 from the drive board.</p> <p>Remove the cover.</p>	 <p>xx2000001932</p>

Disconnecting the axis-2 joint unit cabling

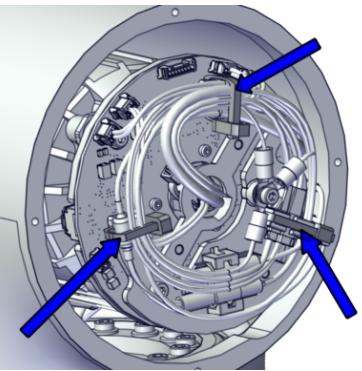
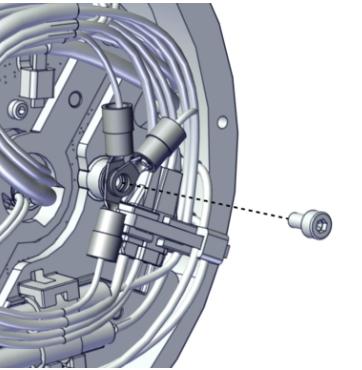
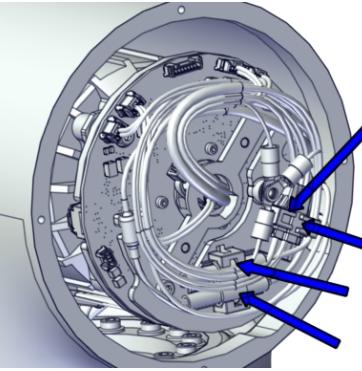
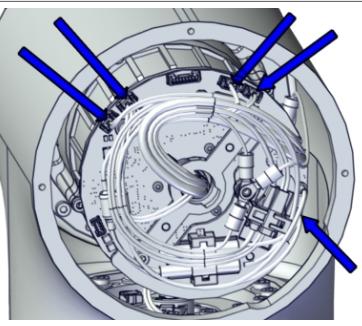
Action	Note
<p>1</p> <p> ELECTROSTATIC DISCHARGE (ESD)</p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	

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5 Repair

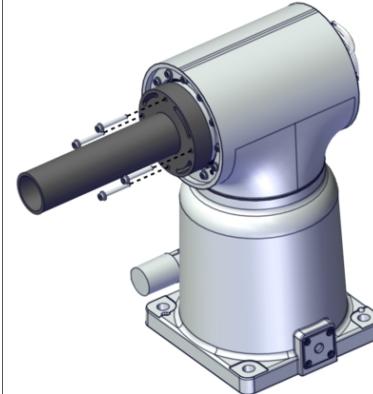
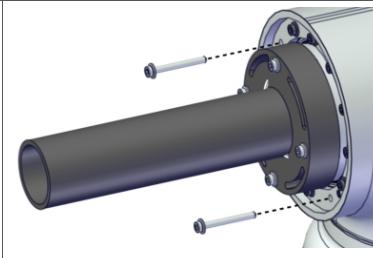
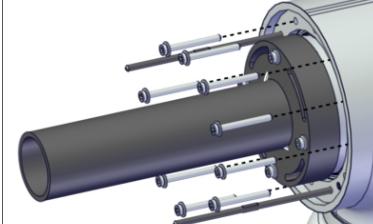
5.3.2 Replacing the axis-1 cabling

Continued

Action	Note
2 Cut the cable ties.	 xx2000001946
3 Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J2.DC+ • J2.DC- • J2.CS • J2.CP 	 xx2000001944
5 Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 <p> CAUTION</p> <p>Use tweezers to unlock connectors and pull them off.</p>	 xx2000002013

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Removing the axis-2 joint unit

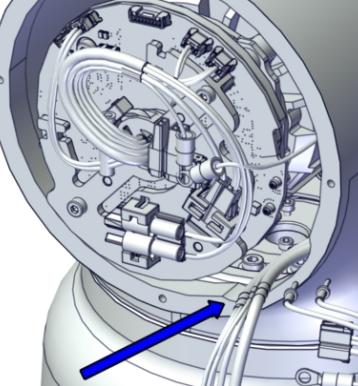
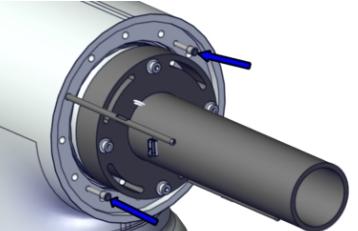
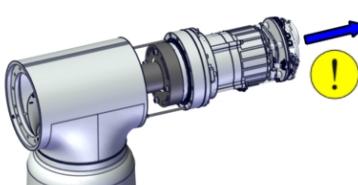
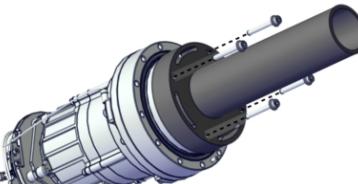
	Action	Note
1	<p>Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)</p>  <p>xx2000001956</p>
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx2100000295</p>
3	Fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002433</p>
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx2000001943</p>

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5 Repair

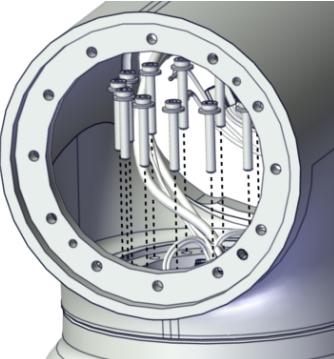
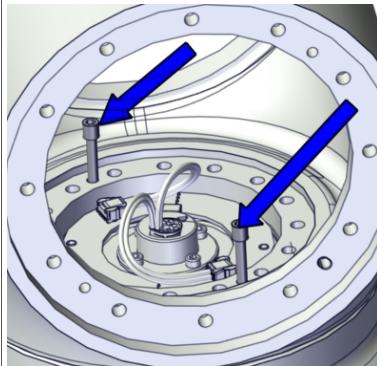
5.3.2 Replacing the axis-1 cabling

Continued

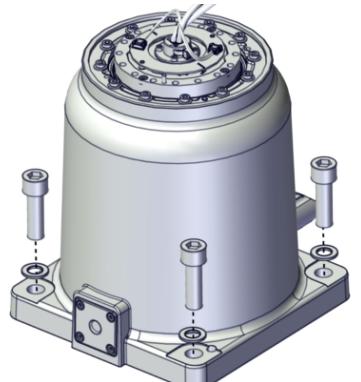
Action	Note
5 Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 xx2100000045
6 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2000002434
7 Remove the joint unit from the swing. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000001958
8 Remove the lifting aid and guide pins.	 xx2000001957

Continues on next page

Removing the swing

	Action	Note
1	Remove the swing attachment screws.	 xx2000001987
2	Use two fully threaded attachment screws as removal tools to press the swing out of position.	 xx2000002152
3	Lift away the swing.  CAUTION The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	

Loosening the base and removing the base cover

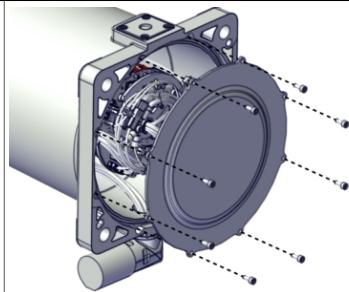
	Action	Note
1	Loosen the base from the foundation by removing the attachment screws and washers.	 xx2000002006

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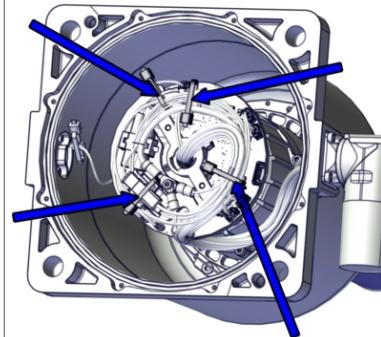
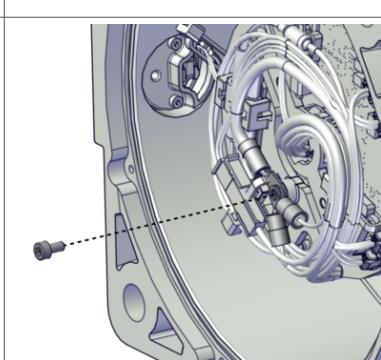
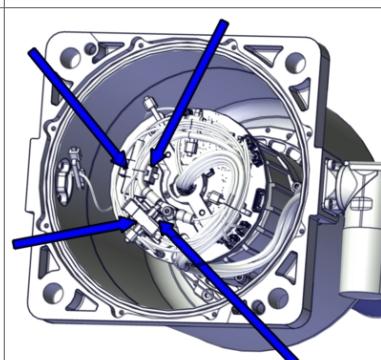
5 Repair

5.3.2 Replacing the axis-1 cabling

Continued

Action	Note
2 Tilt the base on to its side and remove the bottom cover by removing the attachment screws.	 xx2000002007

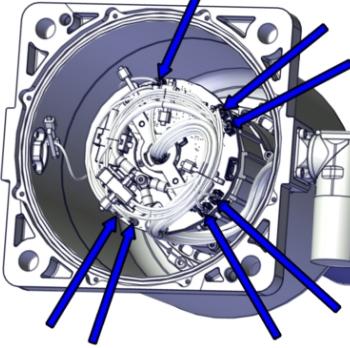
Disconnecting the axis-1 joint unit cabling

Action	Note
1 Cut the cable ties.	 xx2000002012
2 Remove the functional and protective earth cables by removing the screw.	 xx2000002011
3 Snap loose and disconnect the connectors: • J1.DC+ • J1.DC- • J1.CS • J1.CP	 xx2000002010

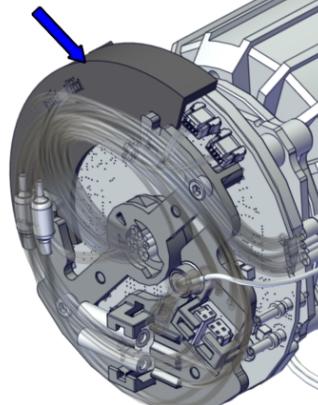
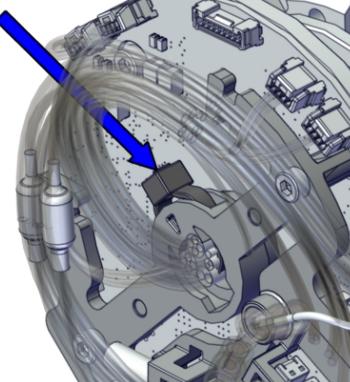
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5.3.2 Replacing the axis-1 cabling

Continued

Action	Note
<p>4 Disconnect the connectors from the drive board.</p> <ul style="list-style-type: none"> • D1.X1 from X1 • D1.DC+ from DC+ • D1.DC- from ground • D1.X4 from X4 • D1.X2 from X2 • D1.X5 from X5 • DR.X8 from X8 <p> CAUTION</p> <p>Use tweezers to unlock connectors and pull them off.</p>	 xx2000002009

Removing the joint cable

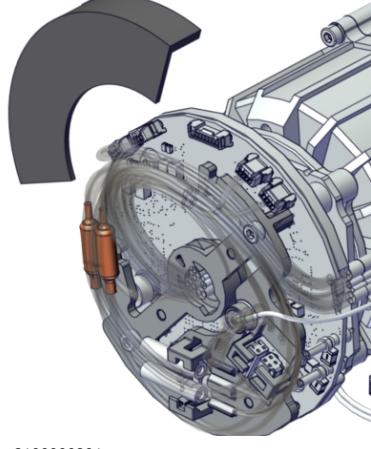
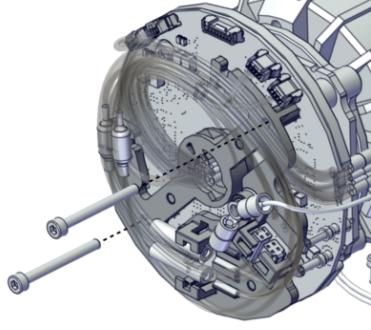
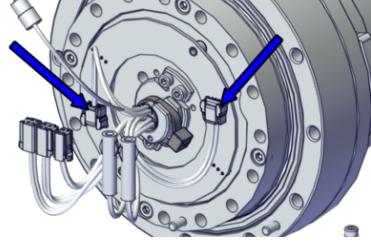
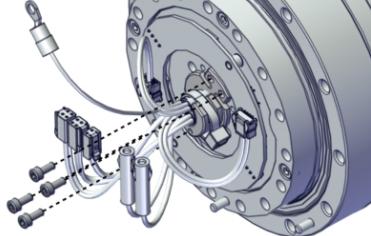
Action	Note
<p>1  ELECTROSTATIC DISCHARGE (ESD)</p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	
<p>2 Fit the protection plate to the drive board unit.</p> <p> Tip</p> <p>Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.</p>	Protection plate: 3HAC077790-001  xx2000002057
<p>3 Cut the cable tie at the drive board.</p>	 xx2000002058

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5 Repair

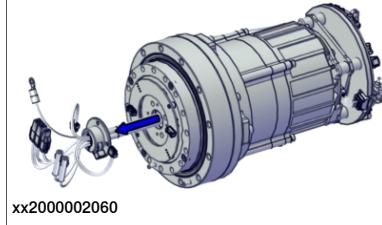
5.3.2 Replacing the axis-1 cabling

Continued

Action	Note
4 Remove the protection plate.	 xx2100000301
5 Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6 Disconnect the two connectors from the torque sensor board. <ul style="list-style-type: none"> • TQ.A • TQ.B 	 xx2000002053
7 Remove the cable plate by removing the attachment screws.	 xx2000002049

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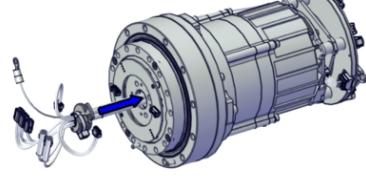
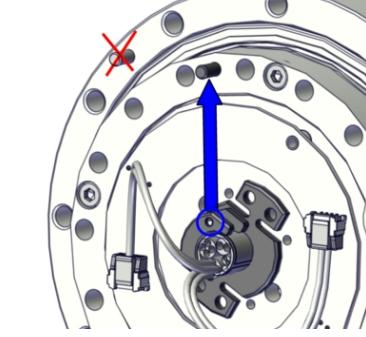
5.3.2 Replacing the axis-1 cabling
Continued

Action	Note
<p>8 Remove the joint cable from the hollow shaft from the torque sensor side.</p> <p>CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	

Refitting the joint cabling

Use these procedures to refit the joint-1 cabling.

Refitting the joint cable

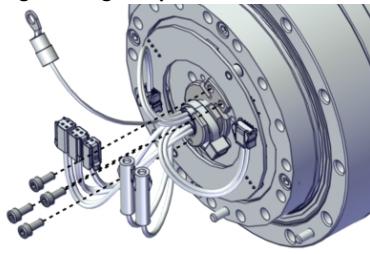
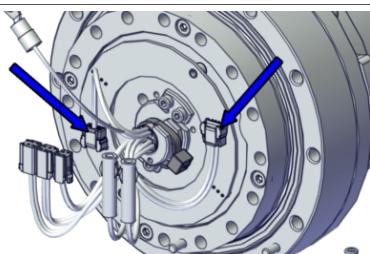
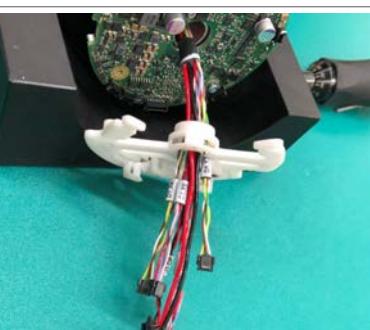
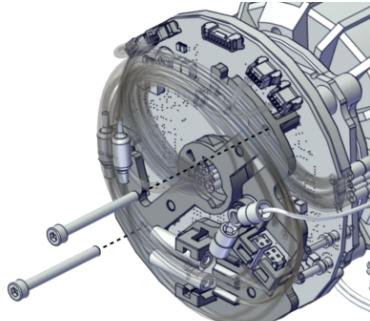
Action	Note
<p>1  ELECTROSTATIC DISCHARGE (ESD)</p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	
<p>2 Place the joint cable through the hollow shaft from the torque sensor side.</p> <p>CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	
<p>3 Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.</p>	

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5 Repair

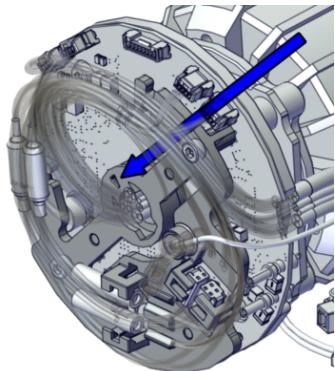
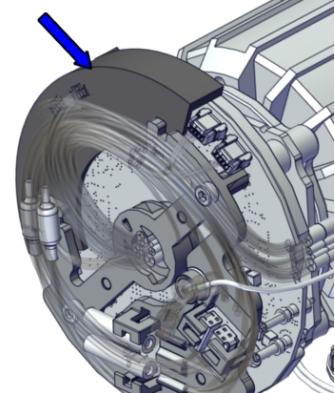
5.3.2 Replacing the axis-1 cabling

Continued

Action	Note
4 Secure the cable plate to the joint unit with the attachment screws.	<p>Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002049</p>
5 Connect the two connectors to the torque sensor board. <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 <p>xx2000002053</p>
6 Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 <p>xx2000002056</p> <p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002055</p>

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5.3.2 Replacing the axis-1 cabling
Continued

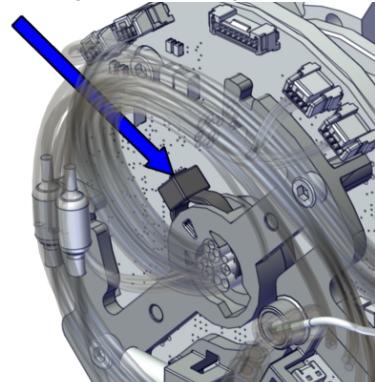
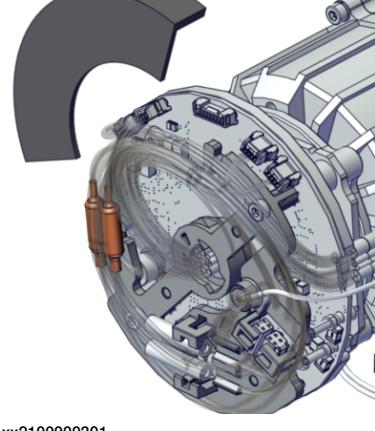
	Action	Note
7	<p>Keep the cabling loose, making sure not to twist or strain it.</p> <p>Use the cable tie to pre-fix the cable by hand.</p>	 xx2100000507
8	Fit the protection plate to the drive board unit.	<p>Protection plate: 3HAC077790-001</p>  xx2000002057

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5 Repair

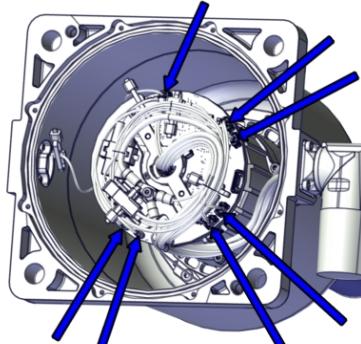
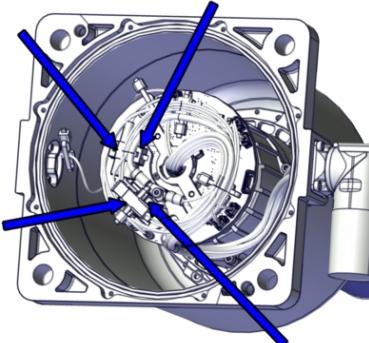
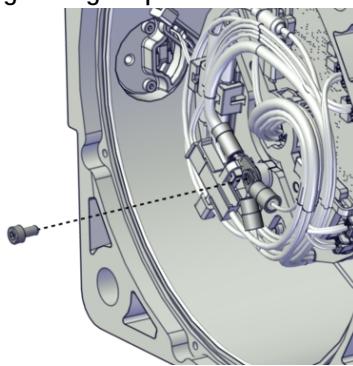
5.3.2 Replacing the axis-1 cabling

Continued

	Action	Note
9	<p>Secure the cables to the cable support with a cable tie, using a cable tie gun.</p> <p>Assembly direction for the cable tie is shown in the figure.</p>	<p>Cable tie: 3HAC075545-001. For securing joint unit cable.</p> <p>Cable tie gun EVO7</p> <p>Setting for cable tie gun: 6.75.</p>  xx2000002058
10	Remove the protection plate.	 xx2000002059
		 xx2100000301

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Connecting the axis-1 joint unit cabling

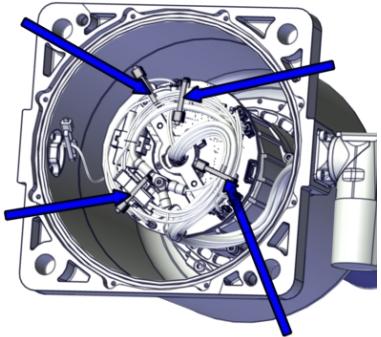
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D1.X1 to X1 • D1.DC+ to DC+ • D1.DC- to Ground • D1.X4 to X4 • D1.X2 to X2 • D1.X5 to X5 • DR.X8 to X8 	 xx2000002009
3	Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J1.DC+ to J1.DC+ • J1.DC- to J1.DC- • J1.CS to J1.CS • J1.CP to J1.CP 	 xx2000002010
4	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002011

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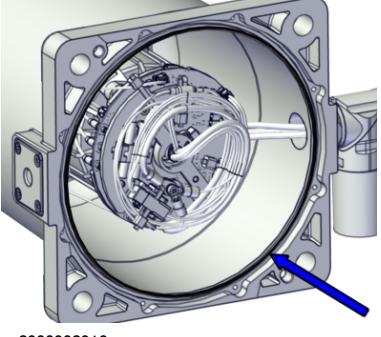
5 Repair

5.3.2 Replacing the axis-1 cabling

Continued

	Action	Note
5	Secure the cabling with cable ties.	Cable ties (4 pcs)  xx2000002012

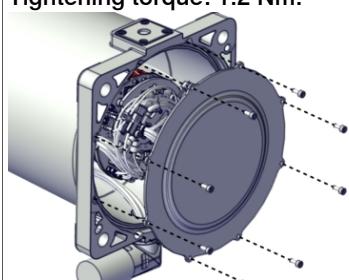
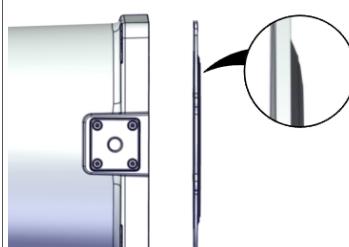
Refitting the base cover

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring, nitrile rubber: 3HAB3772-64 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016

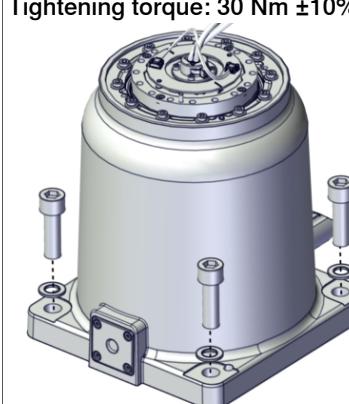
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5.3.2 Replacing the axis-1 cabling

Continued

Action	Note
<p>2 Refit the bottom cover with the attachment screws.</p> <p>Note</p> <p>Fit the cover in correct direction, the protrusion of the cover must face outwards.</p>	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.2 Nm.</p>  <p>xx2000002007</p>  <p>xx2100000268</p>

Securing the base

Action	Note
<p>1 Lift the base to standing and secure it to the foundation with the attachment screws and washers.</p>	<p>Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 30 Nm \pm10%.</p>  <p>xx2000002006</p>

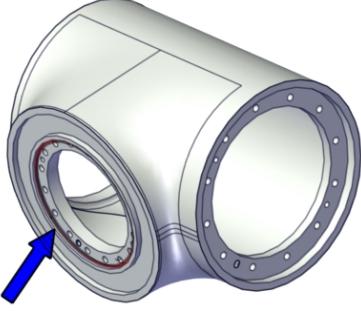
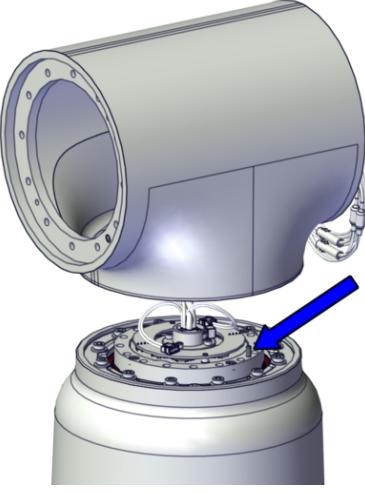
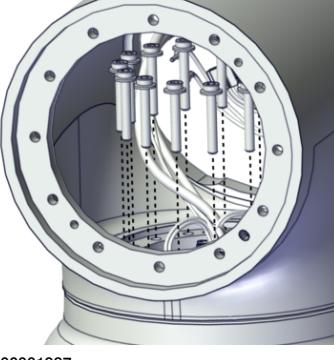
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5 Repair

5.3.2 Replacing the axis-1 cabling

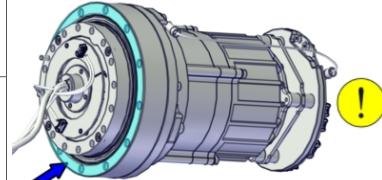
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Refitting the swing

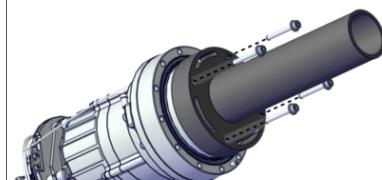
	Action	Note
1	<p>Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the base mounting surface, as pointed out in the figure.</p>	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000001990</p>
2	<p>Refit the swing to the base unit, aligning the pin with the pin hole.</p> <p>CAUTION</p> <p>The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000001989</p>
3	<p>Secure the swing with the attachment screws. Pre-tighten the screws crosswise firstly.</p>	<p>Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)</p>  <p>xx2000001987</p>
4	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.

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Preparations before fitting the joint unit

	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i> .	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i> .	

Refitting the axis-2 joint unit

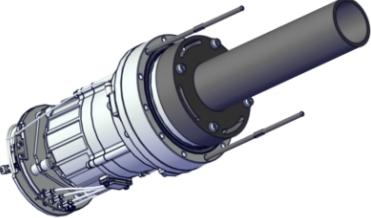
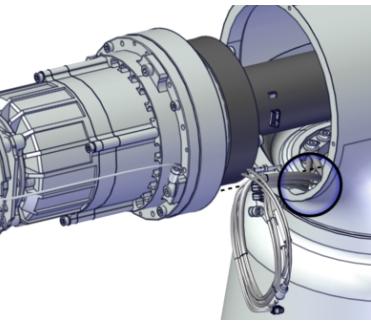
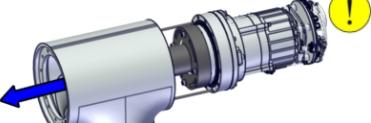
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i> .	
2	Fit the lifting aid to the joint unit.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957

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5 Repair

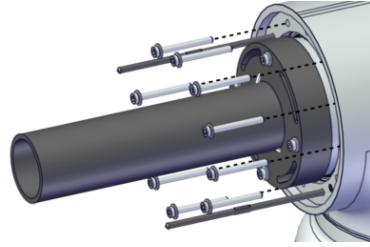
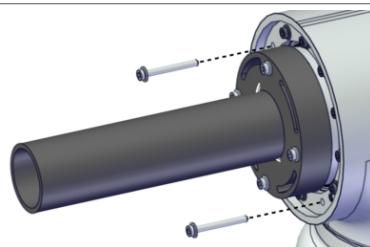
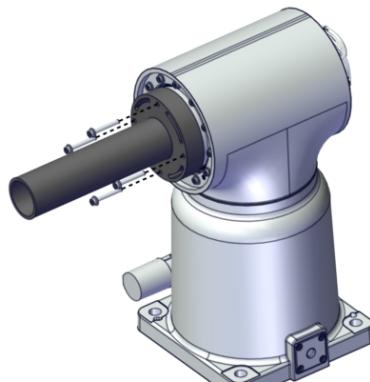
5.3.2 Replacing the axis-1 cabling

Continued

	Action	Note
3	Fit two guide pins to the joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002438</p>
4	<p>Place the axis-1 cabling at the notch in the swing.</p> <p>CAUTION</p> <p>The cabling is sensitive to mechanical damage. Handle it with care to avoid damage to the cabling or the connector, avoid any kind of tilt or skew.</p>	 <p>xx2000002153</p>
5	<p>Fit the joint unit to the swing, aligning the pin with the pin hole.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000001959</p>  <p>xx2000001961</p>

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5.3.2 Replacing the axis-1 cabling
Continued

Action	Note
6 Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+Pro-COat111, with NYPLAS glue , 12 pcs</p> <p>Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2000001943</p>
7 Remove the guide pins and secure the remaining two attachment screws.	 <p>xx2100000295</p>
8 Pre-tighten the screws crosswise.	
9 Torque tighten all screws crosswise.	Tightening torque: 4.3 Nm.
10 Remove the lifting aid by removing the screws.	 <p>xx2000001956</p>
11 Clean pushed-out flange sealant, if any.	

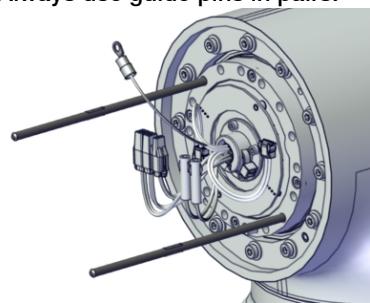
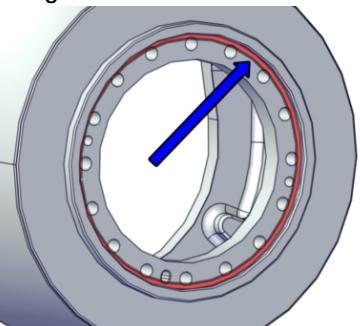
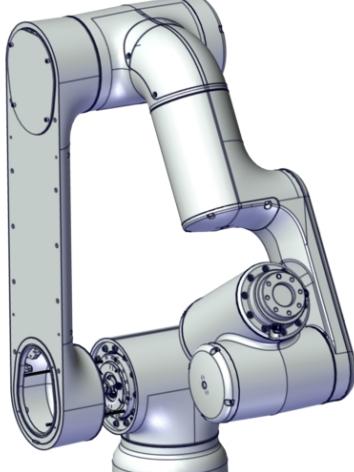
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5 Repair

5.3.2 Replacing the axis-1 cabling

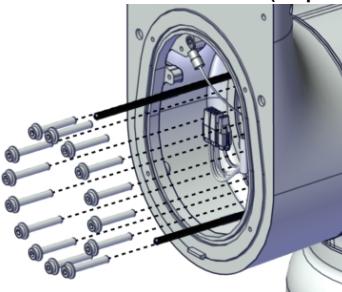
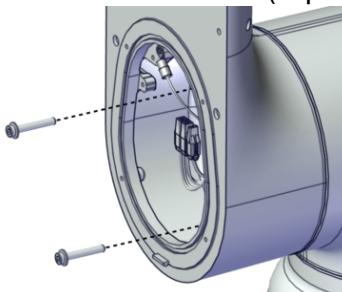
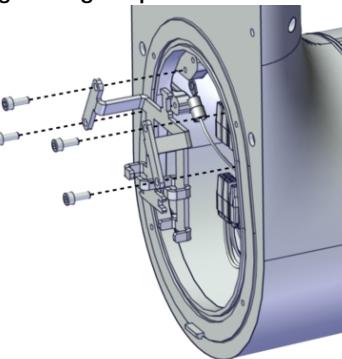
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Refitting the lower and upper arm assembled

	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.</p>  <p>xx2000001949</p>
2	<p>Remove any old residuals of flange sealant from the lower arm mounting surface and clean with isopropanol.</p> <p>Apply new flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.</p>	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000001963</p>
3	<p> CAUTION</p> <p>The weight of the complete upper and lower arm together is 18 kg</p>	
4	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	 <p>xx2000001941</p>

Continues on next page

5.3.2 Replacing the axis-1 cabling
Continued

Action	Note
5 Secure the lower arm to the swing with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+Pro-COat111 (16 pcs)  xx2000001940
6 Remove the guide pins and fasten the remaining two screws.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+Pro-COat111 (16 pcs)  xx2000001951
7 Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.
8 Refit the cable bracket with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm  xx2000001939

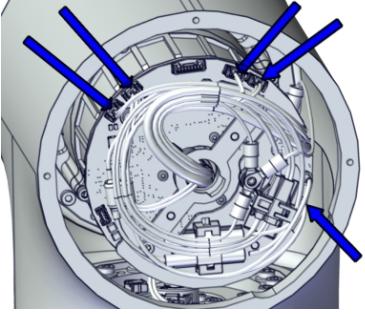
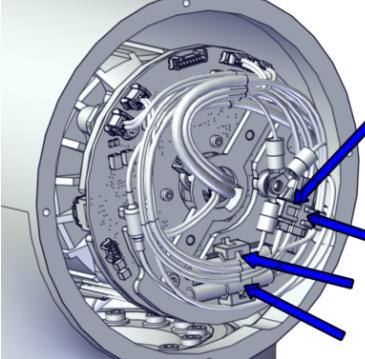
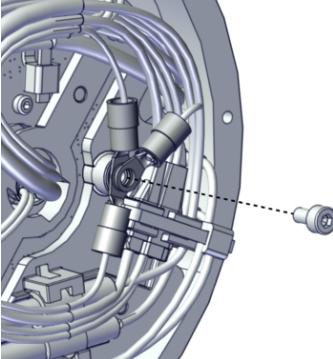
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5 Repair

5.3.2 Replacing the axis-1 cabling

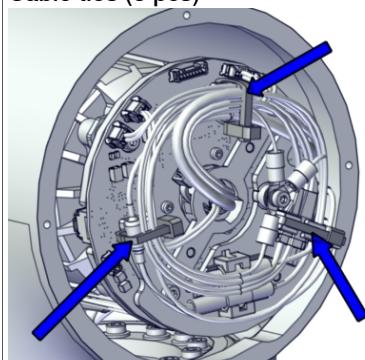
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Connecting the axis-2 joint unit cabling

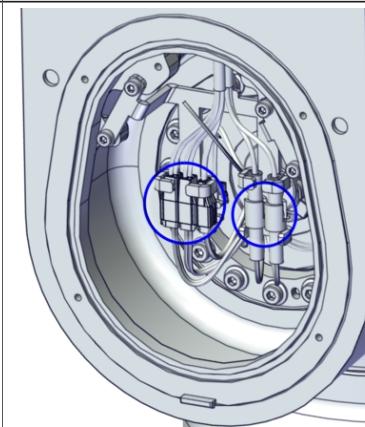
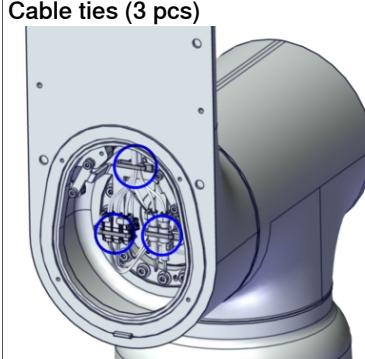
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D2.X1 to X1 • D2.DC+ to DC+ • D2.DC- to Ground • D2.X4 to X4 • D2.X2 to X2 • D2.X5 to X5 	 xx2000002013
3	Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP 	 xx2000001944
4	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000001945

Continues on next page

5.3.2 Replacing the axis-1 cabling
Continued

Action	Note
5 Secure the cabling with cable ties.	<p>Cable ties (3 pcs)</p>  <p>xx2000001946</p>

Connecting the cabling between the lower arm and swing

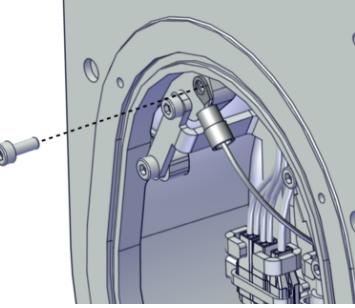
Action	Note
1 Connect the connectors to each other and snap them to the cable holders.	 <p>xx2000001938</p>
2 Secure the cabling with cable ties.	<p>Cable ties (3 pcs)</p>  <p>xx2000001937</p>

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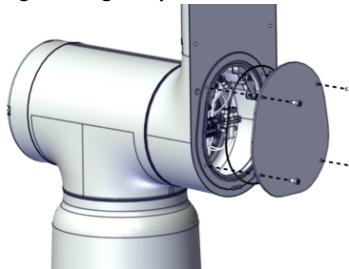
5 Repair

5.3.2 Replacing the axis-1 cabling

Continued

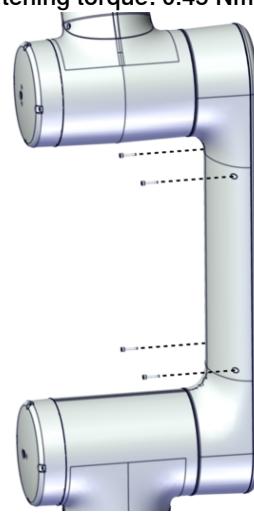
	Action	Note
3	Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

Refitting the lower arm covers

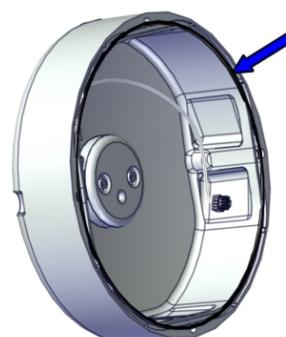
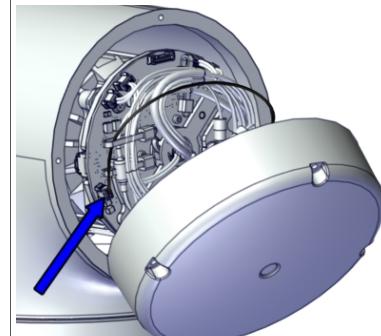
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001954
2	Refit the inner cover with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm.  xx2000001930

Continues on next page

5.3.2 Replacing the axis-1 cabling
Continued

Action	Note
3 Snap the lower arm cover into place.	Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.
4 Secure the cover with four screws.	 xx2000001929

Refitting the swing cover

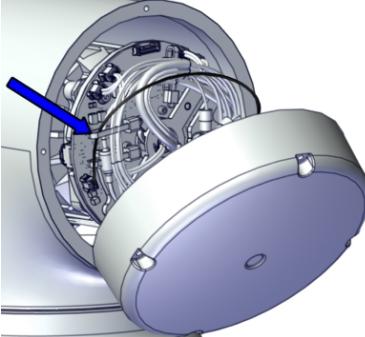
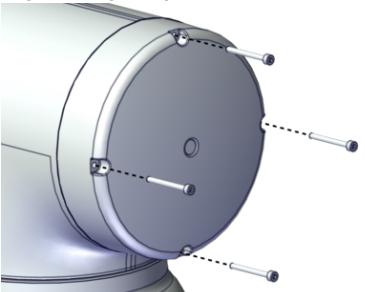
Action	Note
1 Fit the o-ring to its groove. Replace if damaged.	 O-ring: 3HAC061327-047 xx2000001962
2 Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000001932

Continues on next page

5 Repair

5.3.2 Replacing the axis-1 cabling

Continued

Action	Note
3 Secure the brake release cable with a cable tie.	Cable ties  xx2000001931
4 Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000001935

Concluding procedure

Action	Note
1 Calibrate the joint unit torque sensor.	See Calibration on page 719
2  DANGER Make sure all safety requirements are met when performing the first test run.	

5.3.3 Replacing the axis-2 cabling

Location of the cable harness

The cable harness is located as shown in the figure.



xx2100000058

Summary of the replacement procedure

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

- 1 Separate the cabling between the swing and the lower arm.
- 2 Remove the lower and upper arm undivided.
- 3 Remove the swing cover.
- 4 Remove the axis-2 joint unit.
- 5 Replace the cabling.

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Continues on next page

5 Repair

5.3.3 Replacing the axis-2 cabling

Continued

Spare part	Article number	Note
Cable harness, joint 2	3HAC073205-001	Also order new Cable tie: 3HAC075545-001.
Cable tie	3HAC075545-001	For securing joint unit cable.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3. Attachment screws M4x35 (4 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

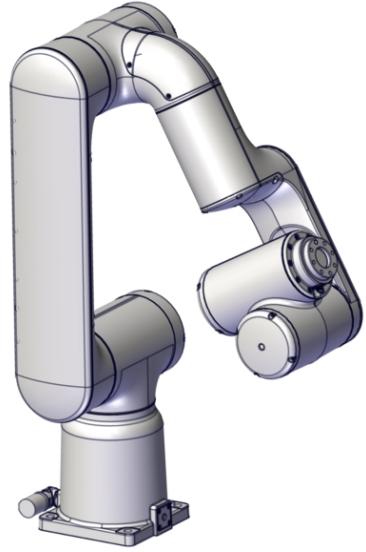
Consumable	Article number	Note
Cable ties	-	
O-ring	3HAC061327-044	Lower arm, inner cover. 1 pcs / cover. Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.
O-ring, nitrile rubber	3HAB3772-64	Base cover
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Grease	3HAC042536-001	Shell Gadus S2

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Removing the joint cabling

Use these procedures to remove the joint-2 cabling.

Preparations before removing the cabling

	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none"> • Axis 1: 0° • Axis 2: 0° (home position) • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	 xx2100000044
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

Removing the lower arm covers

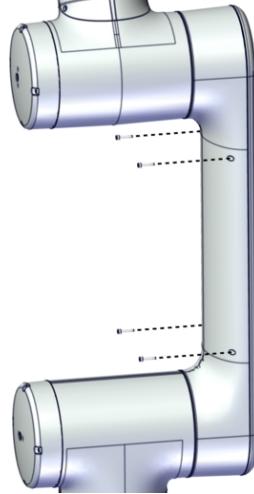
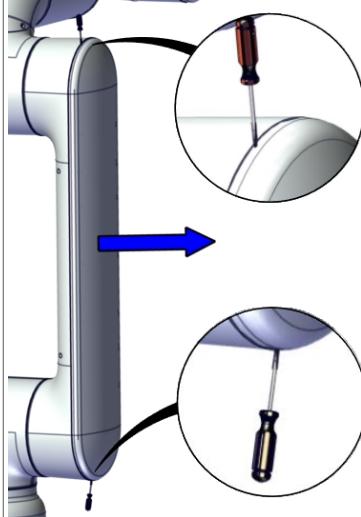
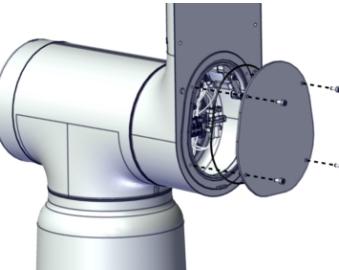
	Action	Note
1	<p>! CAUTION</p> <p>Make sure that all supplies for electrical power are turned off.</p>	

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5 Repair

5.3.3 Replacing the axis-2 cabling

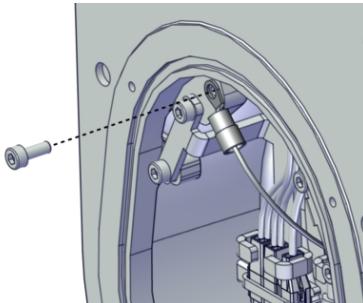
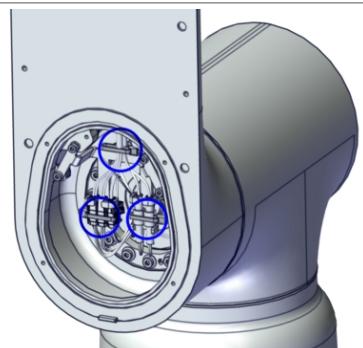
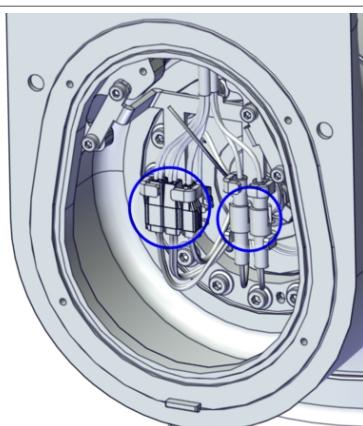
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Action	Note
2 Remove the four lower arm cover screws.	 xx2000001929
3 Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267
4 Remove the inner cover by removing the four screws.	 xx2000001930

Continues on next page

5.3.3 Replacing the axis-2 cabling
Continued

Disconnecting the cabling between the lower arm and the swing

Action	Note
1 Remove the functional earth cable by removing the screw.	 xx2000001936
2 Cut the cable ties.	 xx2000001937
3 Snap loose and disconnect all connectors.	 xx2000001938

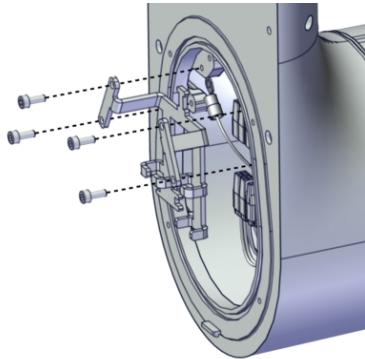
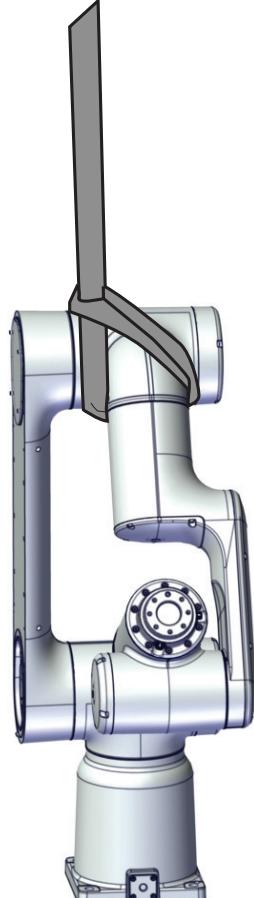
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5 Repair

5.3.3 Replacing the axis-2 cabling

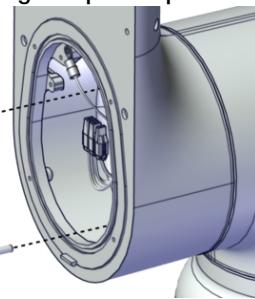
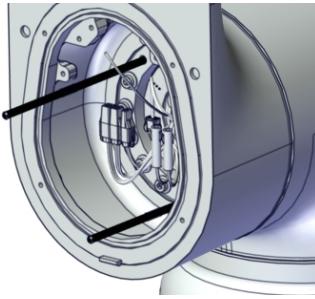
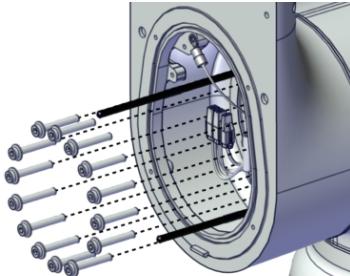
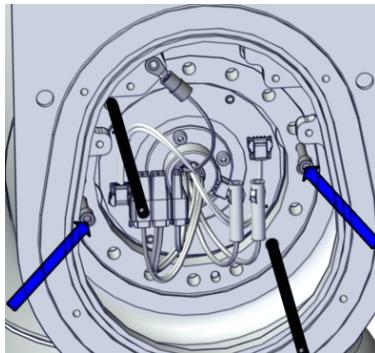
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Removing the lower and upper arm assembled

	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939
2	Secure the weight of the upper and lower arm.  CAUTION The weight of the complete upper and lower arm together is 18 kg	Suggestion with lifting sling and an overhead crane:  xx2100000294

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5.3.3 Replacing the axis-2 cabling
Continued

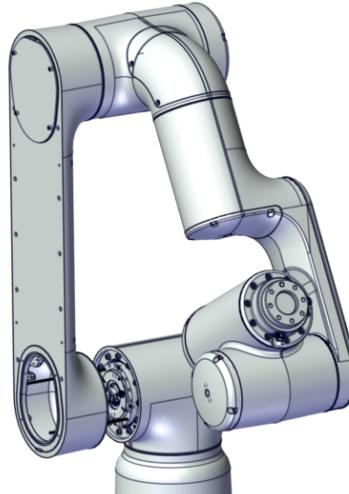
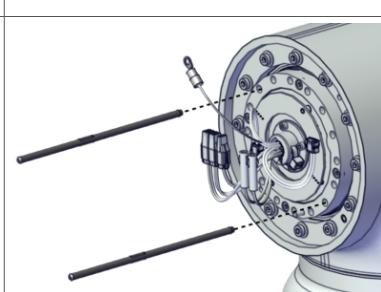
	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.</p>  <p>xx2000001951</p>  <p>xx2000001960</p>
4	Remove the lower arm attachment screws.	 <p>xx2000001940</p>
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 <p>xx2000002151</p>

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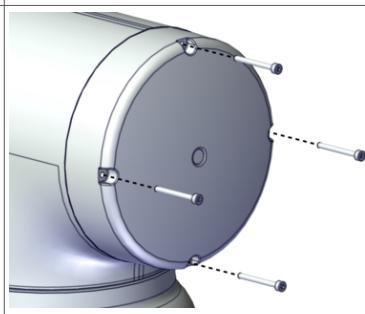
5 Repair

5.3.3 Replacing the axis-2 cabling

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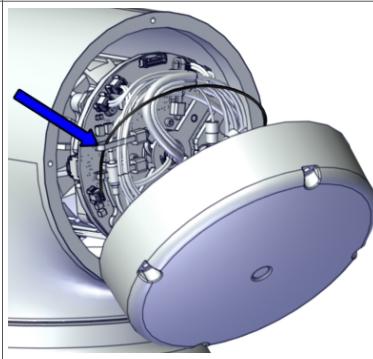
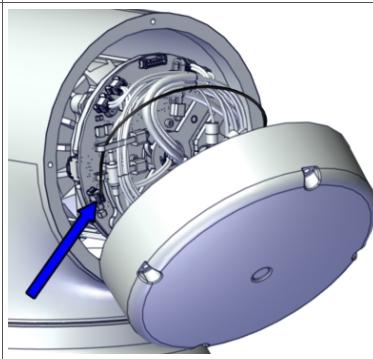
Action	Note
6 Remove the complete arm system from the swing.	 xx2000001941
7 Remove the guide pins.	 xx2000002432

Removing the swing cover

Action	Note
1  CAUTION Make sure that all supplies for electrical power are turned off.	
2 Remove the cover screws.	 xx2000001935

Continues on next page

5.3.3 Replacing the axis-2 cabling
Continued

Action	Note
<p>3</p> <p> CAUTION</p> <p>There is cabling connected between the cover and the joint unit drive board.</p> <p>Open the cover with care to avoid damage to the cabling or the connector(s).</p> <p>Do not leave the cover in location without being secured with the attachment screws.</p>	
<p>4</p> <p>Open the cover and cut the cable tie that holds the brake release cable.</p>	 <p>xx2000001931</p>
<p>5</p> <p>Disconnect the brake release connector DR.X8 from the drive board.</p> <p>Remove the cover.</p>	 <p>xx2000001932</p>

Disconnecting the axis-2 joint unit cabling

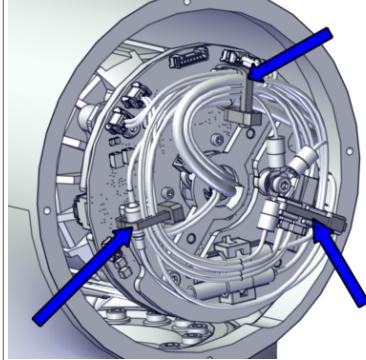
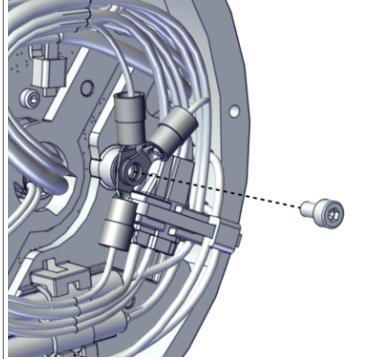
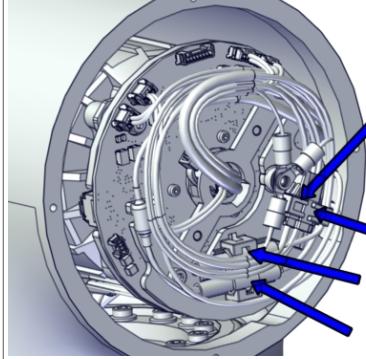
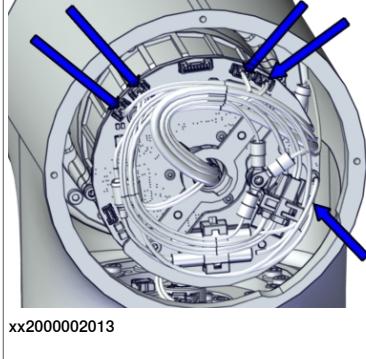
Action	Note
<p>1</p> <p> ELECTROSTATIC DISCHARGE (ESD)</p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	

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5 Repair

5.3.3 Replacing the axis-2 cabling

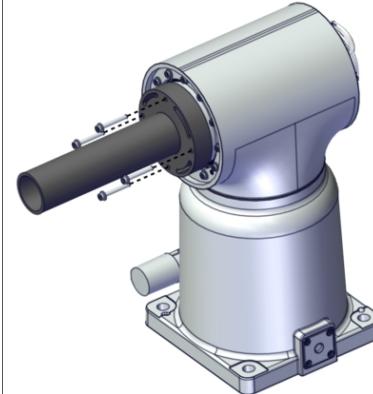
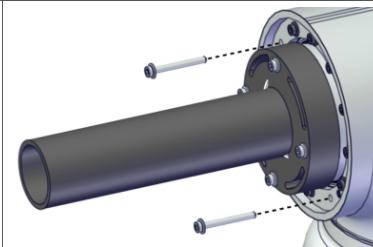
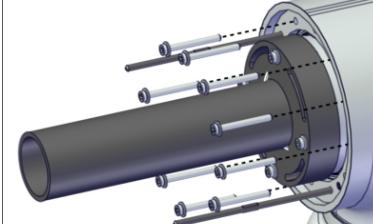
Continued

	Action	Note
2	Cut the cable ties.	 xx2000001946
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J2.DC+ • J2.DC- • J2.CS • J2.CP 	 xx2000001944
5	Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 <p> CAUTION</p> <p>Use tweezers to unlock connectors and pull them off.</p>	 xx2000002013

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5.3.3 Replacing the axis-2 cabling
Continued

Removing the axis-2 joint unit

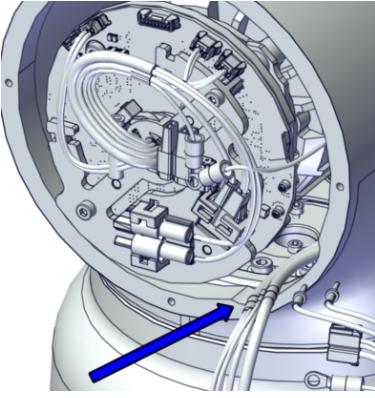
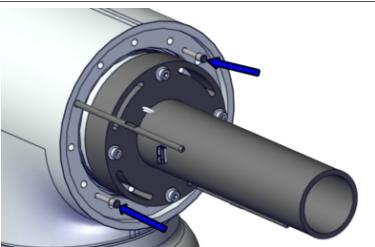
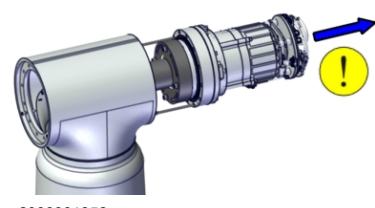
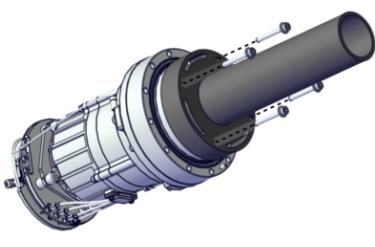
	Action	Note
1	<p>Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)</p>  <p>xx2000001956</p>
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx2100000295</p>
3	Fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002433</p>
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx2000001943</p>

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5 Repair

5.3.3 Replacing the axis-2 cabling

Continued

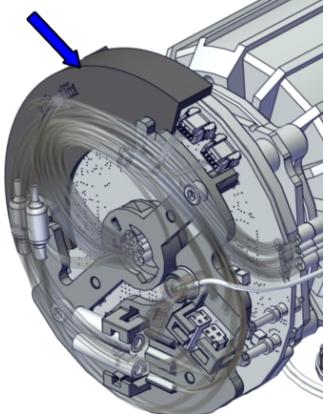
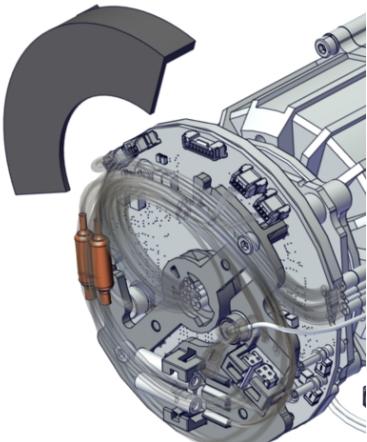
Action	Note
5 Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 xx2100000045
6 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2000002434
7 Remove the joint unit from the swing. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000001958
8 Remove the lifting aid and guide pins.	 xx2000001957

Removing the joint cable

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 44 .	

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5.3.3 Replacing the axis-2 cabling
Continued

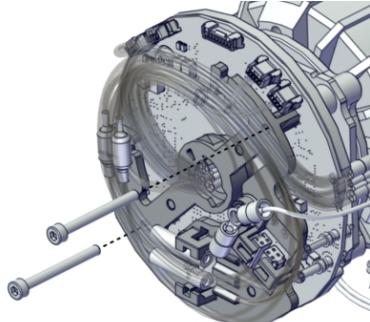
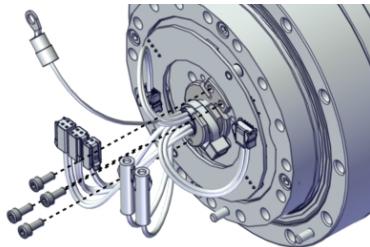
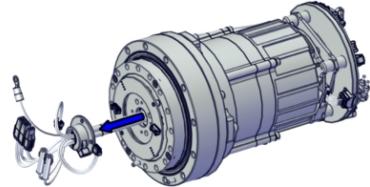
	Action	Note
2	<p>Fit the protection plate to the drive board unit.</p> <p> Tip</p> <p>Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.</p>	<p>Protection plate: 3HAC077790-001</p>  <p>xx2000002057</p>
3	Cut the cable tie at the drive board.	 <p>xx2000002058</p>
4	Remove the protection plate.	 <p>xx2100000301</p>

Continues on next page

5 Repair

5.3.3 Replacing the axis-2 cabling

Continued

Action	Note
5 Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6 Disconnect the two connectors from the torque sensor board. <ul style="list-style-type: none"> • TQ.A • TQ.B 	 xx2000002053
7 Remove the cable plate by removing the attachment screws.	 xx2000002049
8 Remove the joint cable from the hollow shaft from the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002060

Refitting the joint cabling

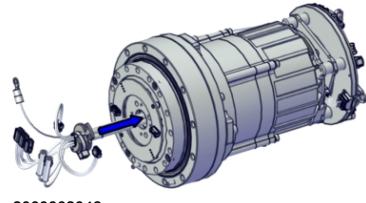
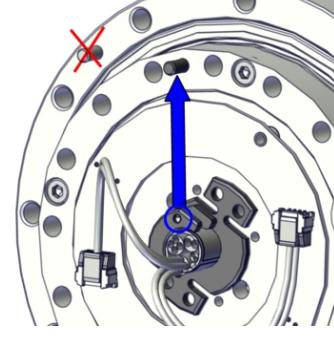
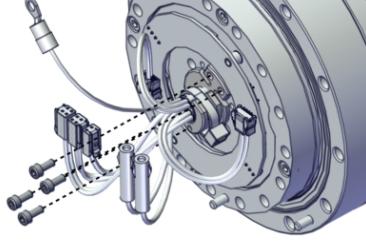
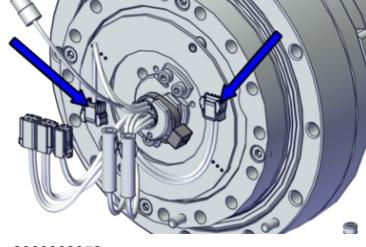
Use these procedures to refit the joint-2 cabling.

Refitting the joint cable

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 44 .	

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5.3.3 Replacing the axis-2 cabling
Continued

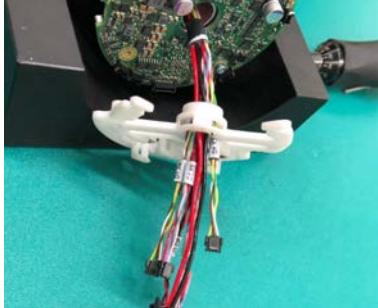
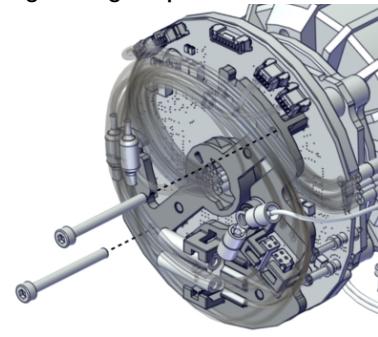
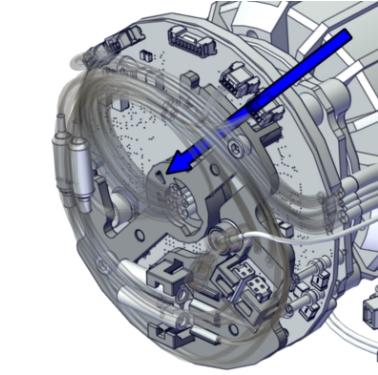
	Action	Note
2	<p>Place the joint cable through the hollow shaft from the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002048
3	<p>Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.</p>	 xx2000002051
4	<p>Secure the cable plate to the joint unit with the attachment screws.</p>	<p>Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs)</p> <p>Tightening torque: 0.45 Nm.</p>  xx2000002049
5	<p>Connect the two connectors to the torque sensor board.</p> <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 xx2000002053

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5 Repair

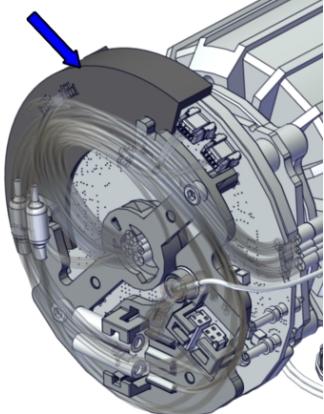
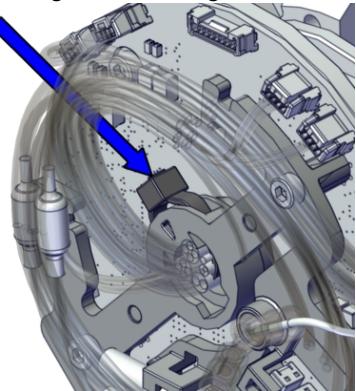
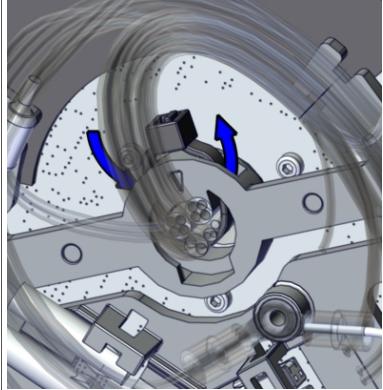
5.3.3 Replacing the axis-2 cabling

Continued

	Action	Note
6	Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 xx2000002056 Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.  xx2000002055
7	Keep the cabling loose, making sure not to twist or strain it. Use the cable tie to pre-fix the cable by hand.	 xx2100000507

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5.3.3 Replacing the axis-2 cabling
Continued

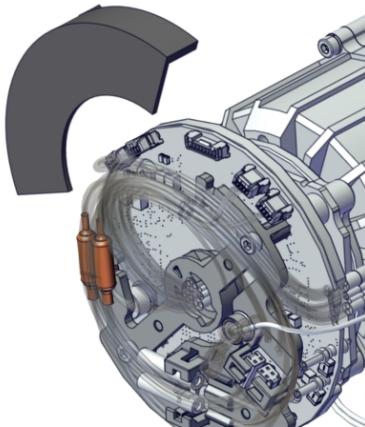
	Action	Note
8	Fit the protection plate to the drive board unit.	<p>Protection plate: 3HAC077790-001</p>  <p>xx2000002057</p>
9	<p>Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.</p>	<p>Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO7 Setting for cable tie gun: 6.75.</p>  <p>xx2000002058</p>  <p>xx2000002059</p>

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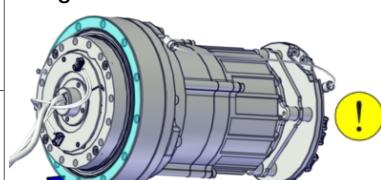
5 Repair

5.3.3 Replacing the axis-2 cabling

Continued

Action	Note
10 Remove the protection plate.	 xx2100000301

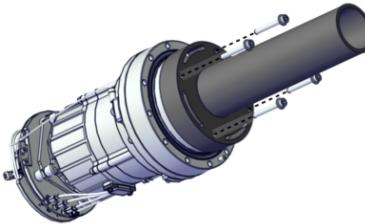
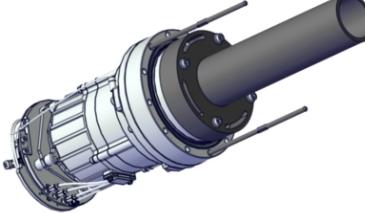
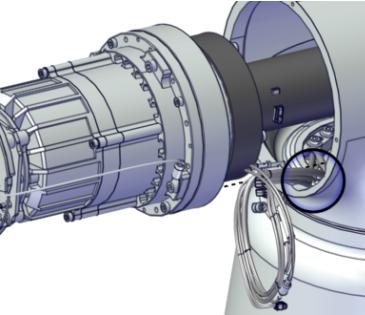
Preparations before fitting the joint unit

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 44 .	
2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574
3  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	 xx2000001860

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5.3.3 Replacing the axis-2 cabling
Continued

Refitting the axis-2 joint unit

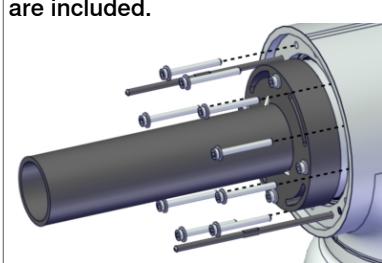
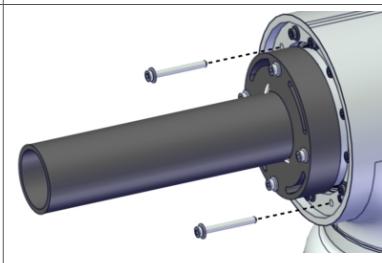
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44.</i>	
2	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957
3	Fit two guide pins to the joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.  xx2000002438
4	 CAUTION The cabling is sensitive to mechanical damage. Handle it with care to avoid damage to the cabling or the connector, avoid any kind of tilt or skew.	 xx2000002153

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5 Repair

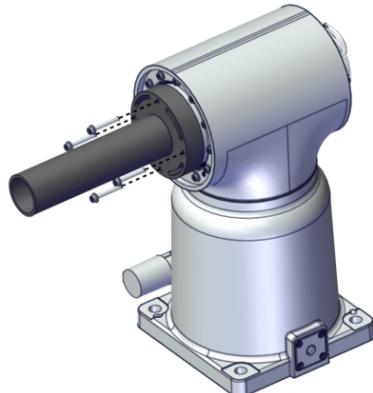
5.3.3 Replacing the axis-2 cabling

Continued

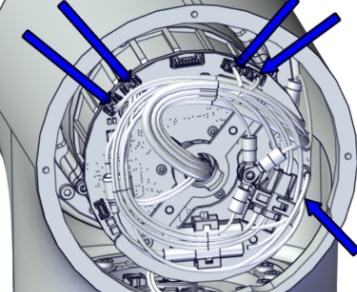
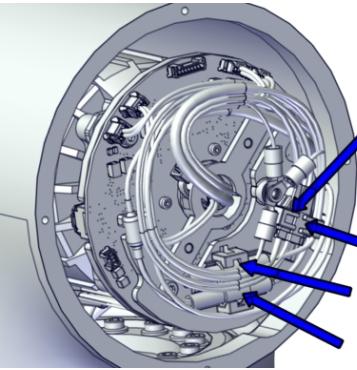
Action	Note
<p>5 Fit the joint unit to the swing, aligning the pin with the pin hole.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000001959  xx2000001961
<p>6 Secure the joint unit with new attachment screws.</p>	<p>Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs</p> <p>Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  xx2000001943
<p>7 Remove the guide pins and secure the remaining two attachment screws.</p>	 xx2100000295
<p>8 Pre-tighten the screws crosswise.</p>	
<p>9 Torque tighten all screws crosswise.</p>	Tightening torque: 4.3 Nm.

Continues on next page

5.3.3 Replacing the axis-2 cabling
Continued

Action	Note
10 Remove the lifting aid by removing the screws.	 xx2000001956
11 Clean pushed-out flange sealant, if any.	

Connecting the axis-2 joint unit cabling

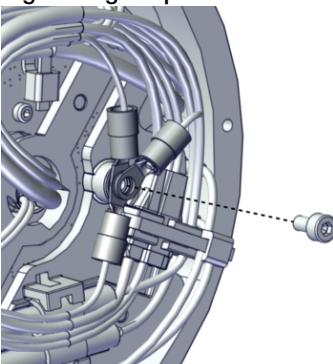
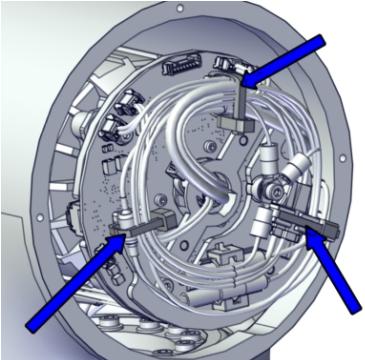
Action	Note
1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2 Reconnect the connectors to the drive board. <ul style="list-style-type: none">• D2.X1 to X1• D2.DC+ to DC+• D2.DC- to Ground• D2.X4 to X4• D2.X2 to X2• D2.X5 to X5	 xx2000002013
3 Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none">• J2.DC+ to J2.DC+• J2.DC- to J2.DC-• J2.CS to J2.CS• J2.CP to J2.CP	 xx2000001944

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5 Repair

5.3.3 Replacing the axis-2 cabling

Continued

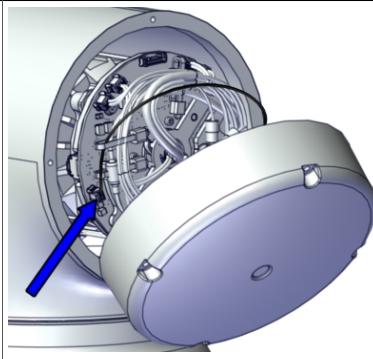
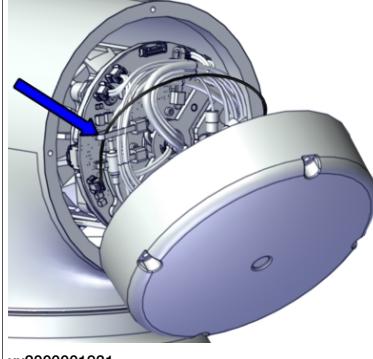
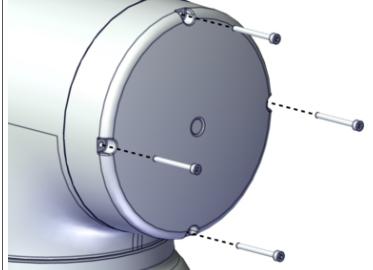
Action	Note
4 Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000001945
5 Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

Refitting the swing cover

Action	Note
1 Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962

Continues on next page

5.3.3 Replacing the axis-2 cabling
Continued

Action	Note
2 Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000001932
3 Secure the brake release cable with a cable tie.	Cable ties  xx2000001931
4 Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000001935

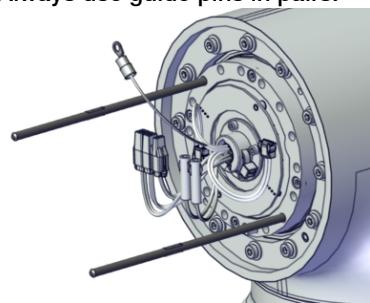
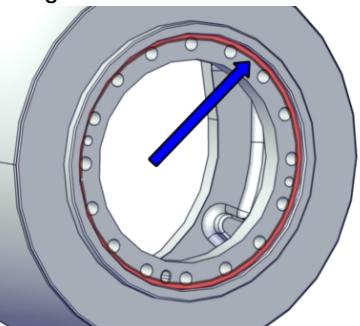
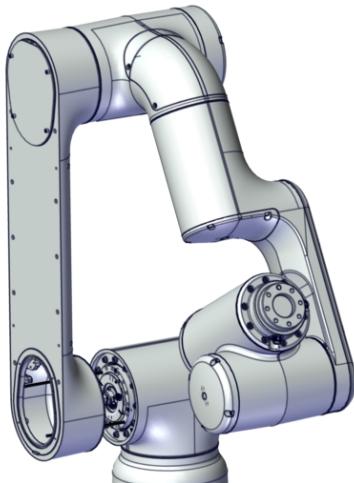
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5 Repair

5.3.3 Replacing the axis-2 cabling

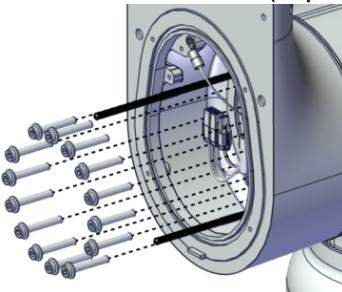
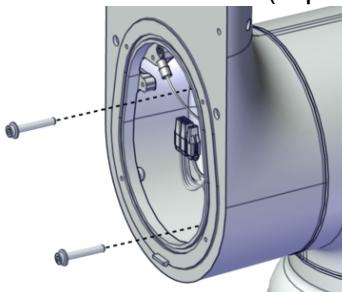
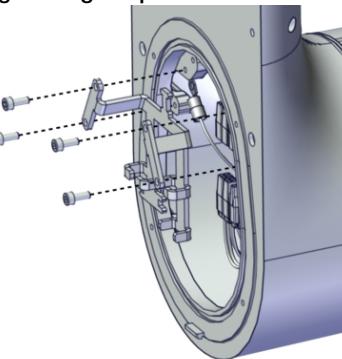
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Refitting the lower and upper arm assembled

	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.</p>  <p>xx2000001949</p>
2	<p>Remove any old residuals of flange sealant from the lower arm mounting surface and clean with isopropanol.</p> <p>Apply new flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.</p>	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000001963</p>
3	<p> CAUTION</p> <p>The weight of the complete upper and lower arm together is 18 kg</p>	
4	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	 <p>xx2000001941</p>

Continues on next page

5.3.3 Replacing the axis-2 cabling
Continued

Action	Note
5 Secure the lower arm to the swing with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+Pro-COat111 (16 pcs)  xx2000001940
6 Remove the guide pins and fasten the remaining two screws.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+Pro-COat111 (16 pcs)  xx2000001951
7 Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.
8 Refit the cable bracket with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm  xx2000001939

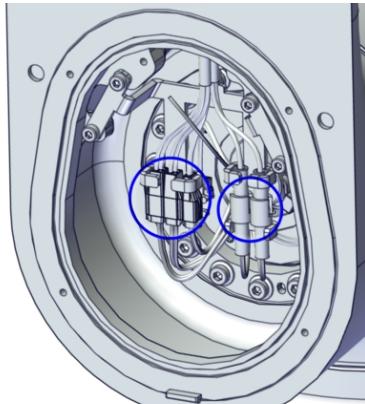
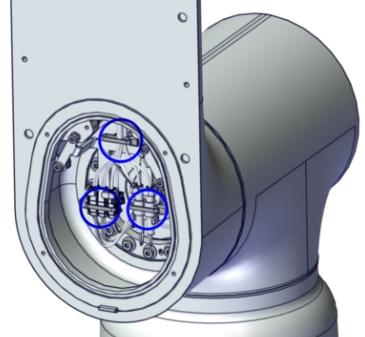
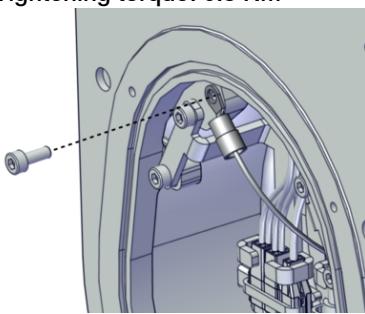
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5 Repair

5.3.3 Replacing the axis-2 cabling

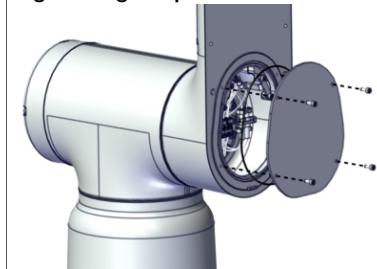
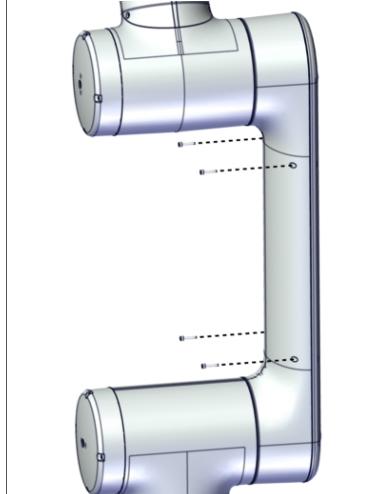
Continued

Connecting the cabling between the lower arm and swing

	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938
2	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937
3	Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

Continues on next page

Refitting the lower arm covers

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001954
2	Refit the inner cover with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm.  xx2000001930
3	Snap the lower arm cover into place.	Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.
4	Secure the cover with four screws.	 xx2000001929

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5 Repair

5.3.3 Replacing the axis-2 cabling

Continued

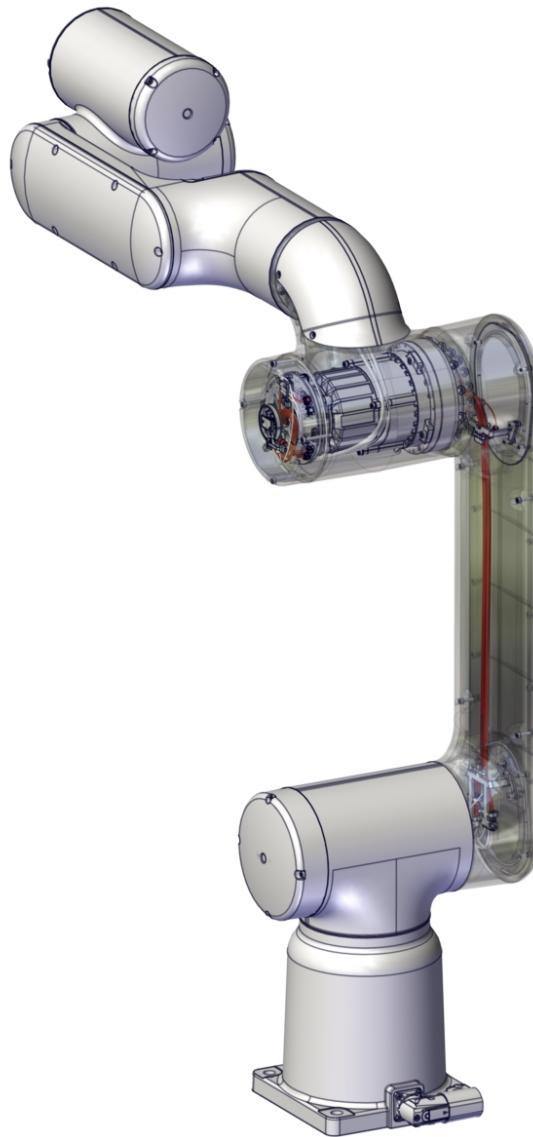
Concluding procedure

	Action	Note
1	Calibrate the joint unit torque sensor.	See Calibration on page 719
2	 DANGER Make sure all safety requirements are met when performing the first test run.	

5.3.4 Replacing the axis-3 cabling

Location of the cable harness

The cable harness is located as shown in the figure.



xx2100000059

Summary of the replacement procedure

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

- 1 Disconnect the cabling between the lower arm and the upper arm.
- 2 Remove the upper arm and place on a workbench.
- 3 Remove the housing cover.
- 4 Remove the axis-3 joint unit.
- 5 Replace the cabling.

Continues on next page

5 Repair

5.3.4 Replacing the axis-3 cabling

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Cable harness, joint 3	3HAC073207-001	Also order new Cable tie: 3HAC075545-001.
Cable tie	3HAC075545-001	For securing joint unit cable.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3. Attachment screws M4x35 (4 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

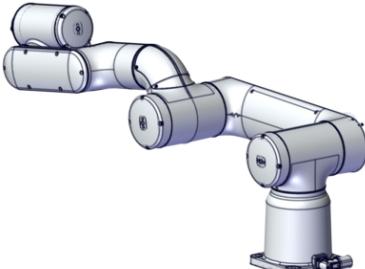
Consumable	Article number	Note
Cable ties	-	
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.
O-ring	3HAC061327-044	Lower arm, inner cover. 1 pcs / cover. Replace if damaged.
Grease	3HAC042536-001	Shell Gadus S2
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574

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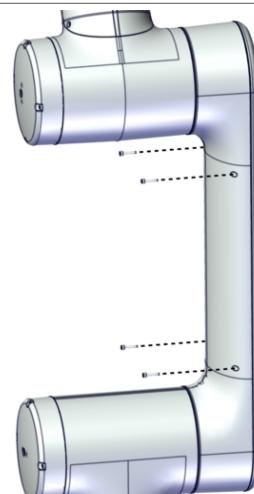
Removing the joint cabling

Use these procedures to remove the joint-3 cabling.

Preparations before removing the cabling

	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none"> • Axis 1: 0° • Axis 2: +90° (suggested position for convenient working position) • Axis 3: -80° (home position) • Axis 4: 0° • Axis 5: 0° • Axis 6: 0° <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	 xx2100000002
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

Removing the lower arm covers

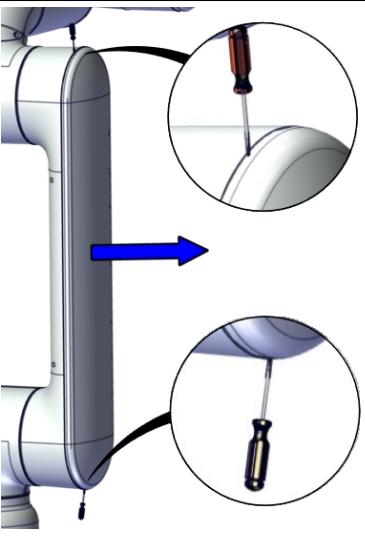
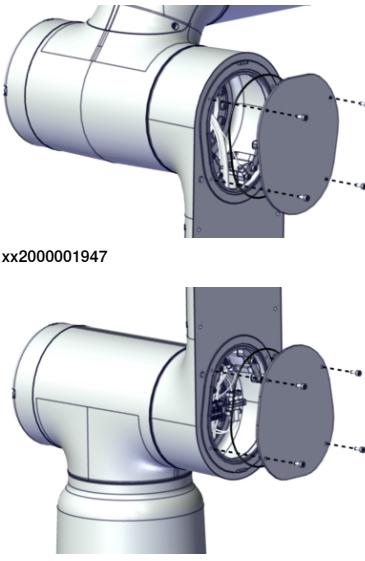
	Action	Note
1	<p>! CAUTION</p> <p>Make sure that all supplies for electrical power are turned off.</p>	
2	<p>Remove the four lower arm cover screws.</p>	 xx2000001929

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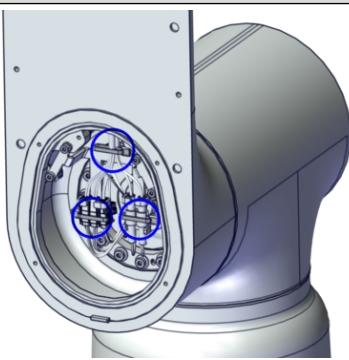
5 Repair

5.3.4 Replacing the axis-3 cabling

Continued

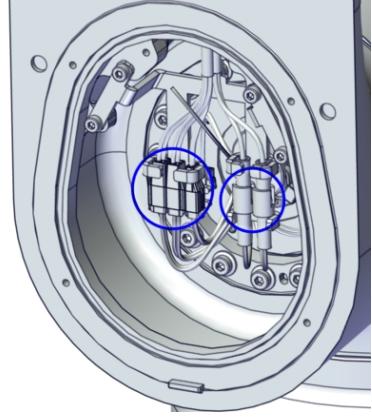
Action	Note
3 Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267
4 Remove the inner covers by removing the screws.	 xx2000001947 xx2000001930

Disconnecting the upper arm cabling

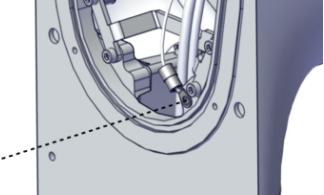
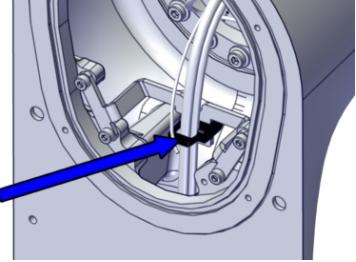
Action	Note
1 Cut the cable ties.	 xx2000001937

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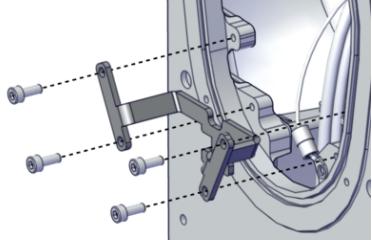
5.3.4 Replacing the axis-3 cabling
Continued

Action	Note
2 Snap loose and disconnect all connectors.	 xx2000001938

Loosening the cabling between the lower and upper arm

Action	Note
1 Remove the functional earth cable by removing the screw.	 xx2000001964
2 Cut the cable tie.	 xx2000001965

Removing the upper arm

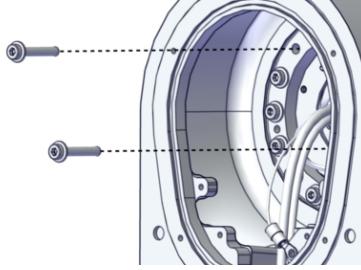
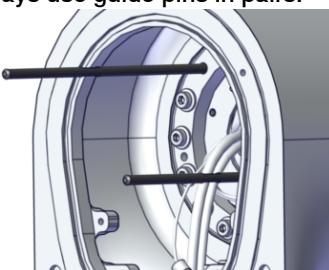
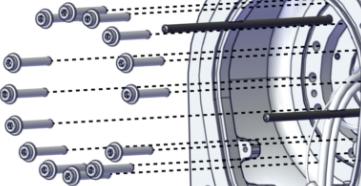
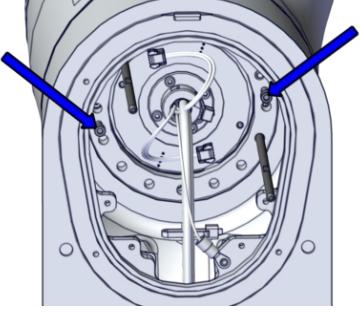
Action	Note
1 Remove the cable bracket by removing the four screws.	 xx2000001966

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5 Repair

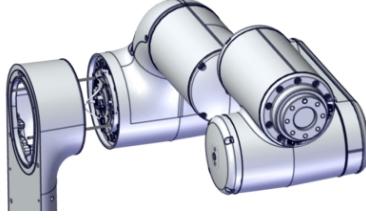
5.3.4 Replacing the axis-3 cabling

Continued

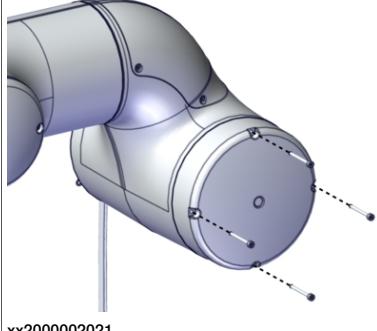
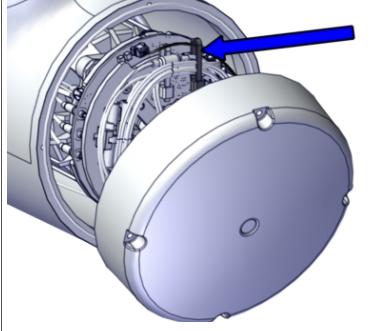
	Action	Note
2	<p>Secure the weight of the upper arm.</p> <p> CAUTION</p> <p>The weight of the complete upper arm is 14 kg.</p>	
3	Remove two attachment screws.	 xx2000001967
4	Fit two guide pins to the axis-3 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001</p> <p>Always use guide pins in pairs.</p>  xx2000001968
5	Remove the remaining attachment screws.	 xx2000001969
6	Press the upper arm out of position by using two fully threaded attachment screws as removal tools.	 xx2100000001

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5.3.4 Replacing the axis-3 cabling
Continued

	Action	Note
7	Remove the upper arm from the lower arm. Assist the cabling to be removed from the lower arm while lifting away the complete upper arm. Place the upper arm on a workbench.	 xx2000001970

Removing the housing cover

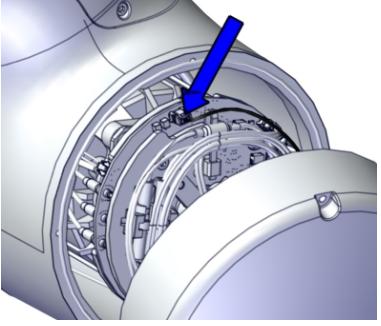
	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	Remove the cover screws.	 xx2000002021
3	 CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002022

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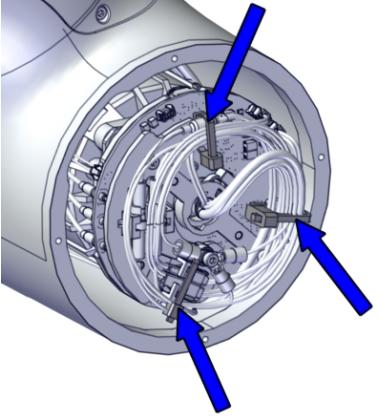
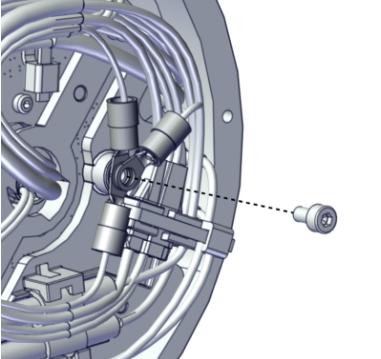
5 Repair

5.3.4 Replacing the axis-3 cabling

Continued

	Action	Note
5	Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002023

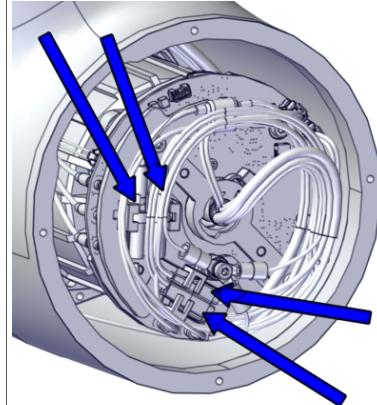
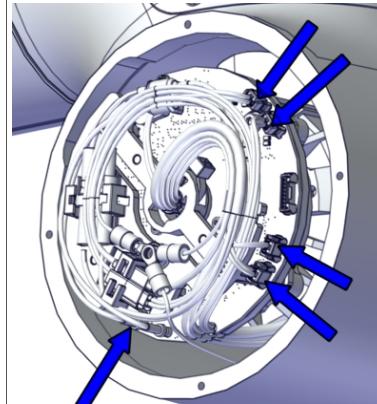
Disconnecting the axis-3 joint unit cabling

	Action	Note
1	Cut the cable ties.	 xx2000002066
2	Remove the functional and protective earth cables by removing the screw.	 xx2000001945

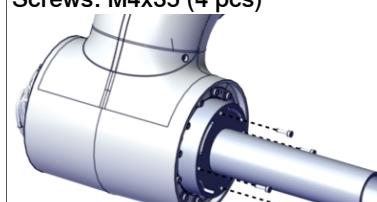
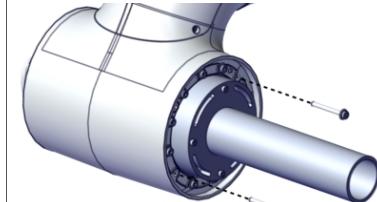
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5.3.4 Replacing the axis-3 cabling

Continued

Action	Note
3 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J4.DC+ • J4.DC- • J4.CS • J4.CP 	 xx2000002067
4 Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D3.X1 • D3/4.DC+ • D3/4.DC- • D3.X4 • D3/4.X2 • D3.X5 <p>! CAUTION Use tweezers to unlock connectors and pull them off.</p>	 xx2000002068

Removing the axis-3 joint unit

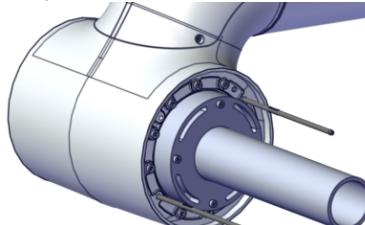
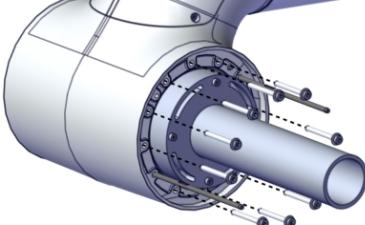
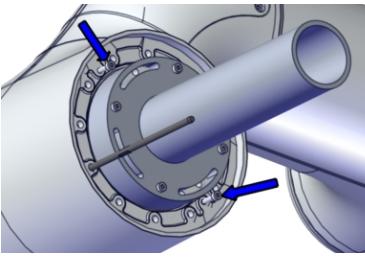
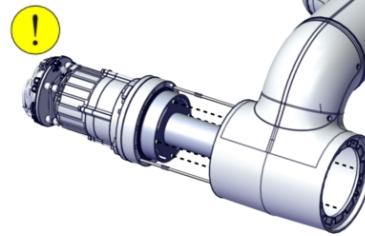
Action	Note
1 Fit the lifting aid to the joint unit, on the torque sensor side. ! CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000002069
2 Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2000002070

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5 Repair

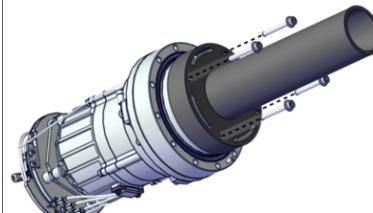
5.3.4 Replacing the axis-3 cabling

Continued

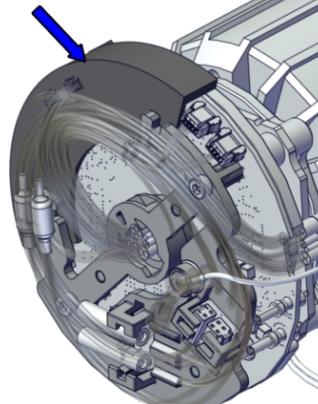
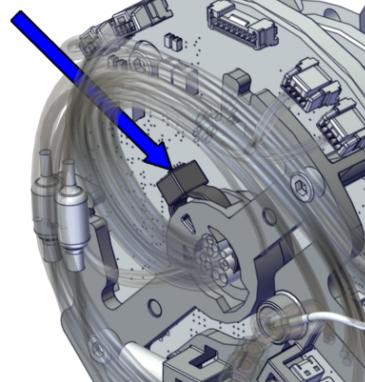
	Action	Note
3	Fit two guide pins to the axis-3 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002576</p>
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx2100000320</p>
5	Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 <p>xx2100000003</p>
6	Press the joint unit out of position using two of the previous attachment screws as removal tools.	 <p>xx2000002577</p>
7	<p>Remove the joint unit from the housing.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000002071</p>

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5.3.4 Replacing the axis-3 cabling
Continued

Action	Note
8 Remove the lifting aid and guide pins.	 xx2000001957

Removing the joint cable

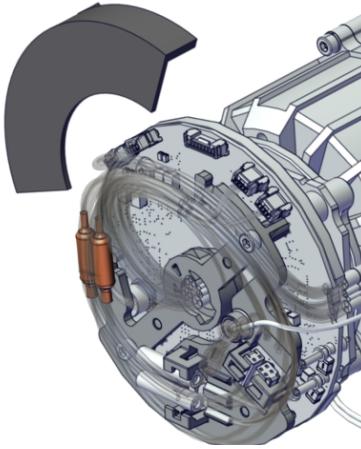
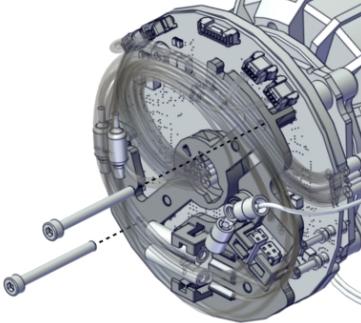
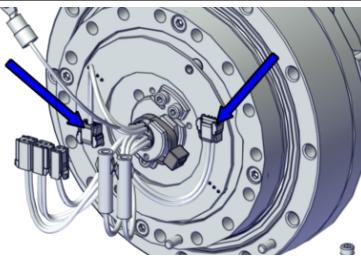
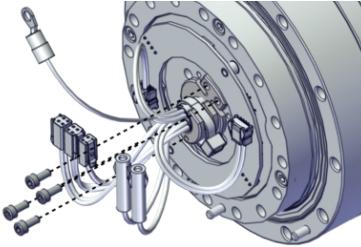
Action	Note
1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2 Fit the protection plate to the drive board unit.  Tip Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001  xx2000002057
3 Cut the cable tie at the drive board.	 xx2000002058

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5 Repair

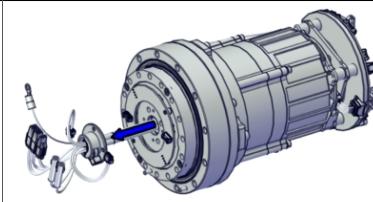
5.3.4 Replacing the axis-3 cabling

Continued

	Action	Note
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. <ul style="list-style-type: none"> • TQ.A • TQ.B 	 xx2000002053
7	Remove the cable plate by removing the attachment screws.	 xx2000002049

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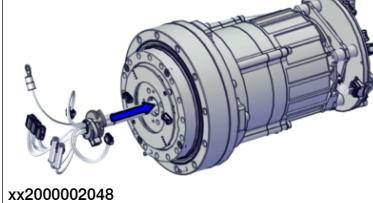
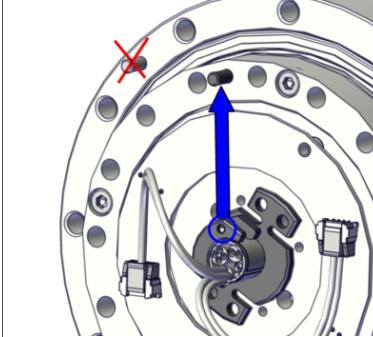
5.3.4 Replacing the axis-3 cabling
Continued

Action	Note
<p>8 Remove the joint cable from the hollow shaft from the torque sensor side.</p> <p>CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	

Refitting the joint cabling

Use these procedures to refit the joint-3 cabling.

Refitting the joint cable

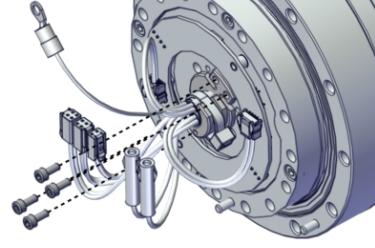
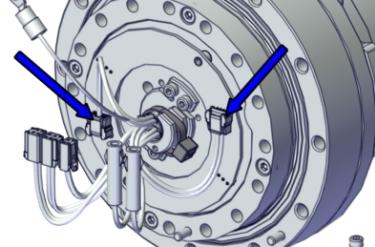
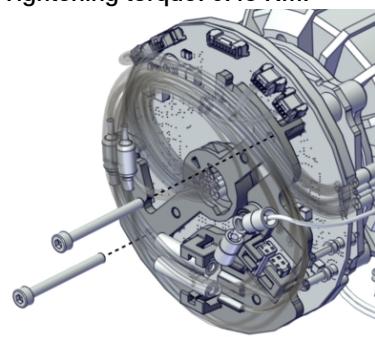
Action	Note
<p>1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	
<p>2 Place the joint cable through the hollow shaft from the torque sensor side.</p> <p>CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	
<p>3 Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.</p>	

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5 Repair

5.3.4 Replacing the axis-3 cabling

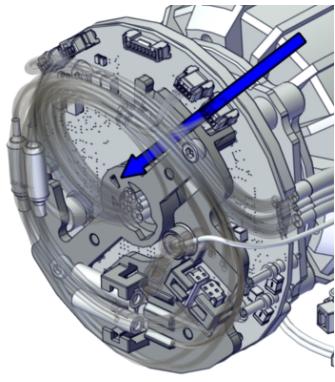
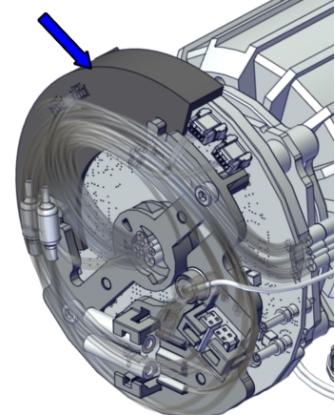
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Action	Note
4 Secure the cable plate to the joint unit with the attachment screws.	<p>Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002049</p>
5 Connect the two connectors to the torque sensor board. <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 <p>xx2000002053</p>
6 Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 <p>xx2000002056</p> <p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002055</p>

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5.3.4 Replacing the axis-3 cabling

Continued

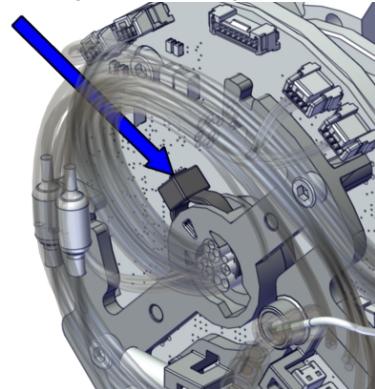
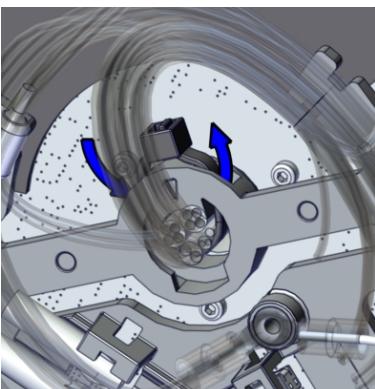
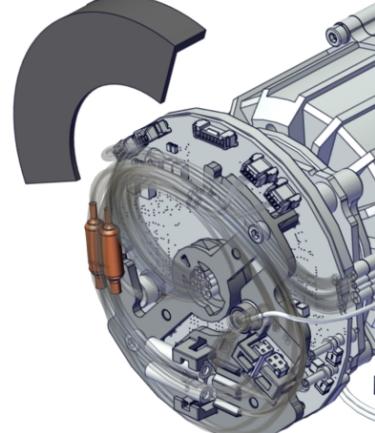
	Action	Note
7	<p>Keep the cabling loose, making sure not to twist or strain it.</p> <p>Use the cable tie to pre-fix the cable by hand.</p>	 xx2100000507
8	Fit the protection plate to the drive board unit.	<p>Protection plate: 3HAC077790-001</p>  xx2000002057

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5 Repair

5.3.4 Replacing the axis-3 cabling

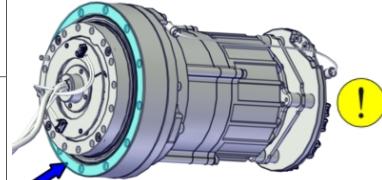
Continued

	Action	Note
9	<p>Secure the cables to the cable support with a cable tie, using a cable tie gun.</p> <p>Assembly direction for the cable tie is shown in the figure.</p>	<p>Cable tie: 3HAC075545-001. For securing joint unit cable.</p> <p>Cable tie gun EVO7</p> <p>Setting for cable tie gun: 6.75.</p>  <p>xx2000002058</p>  <p>xx2000002059</p>
10	Remove the protection plate.	 <p>xx2100000301</p>

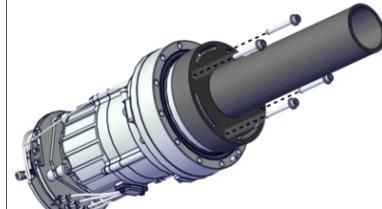
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5.3.4 Replacing the axis-3 cabling
Continued

Preparations before fitting the joint unit

	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i> .	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i> .	

Refitting the axis-3 joint unit

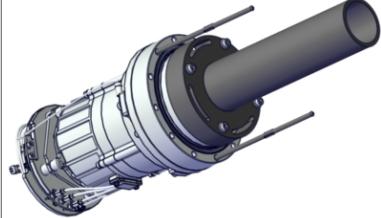
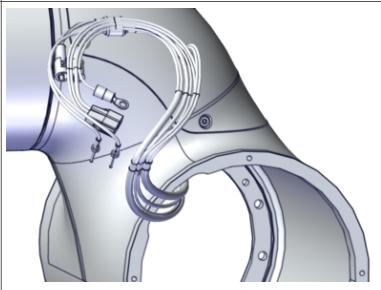
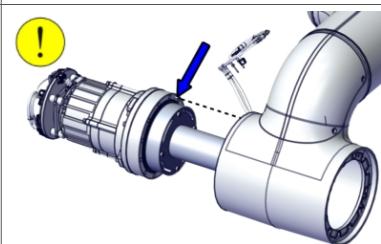
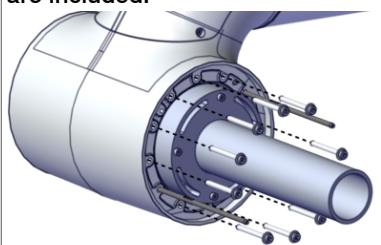
	Action	Note
1	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957

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5 Repair

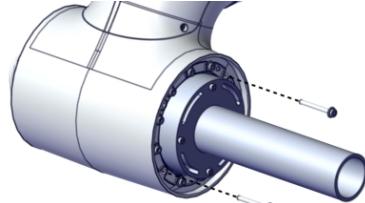
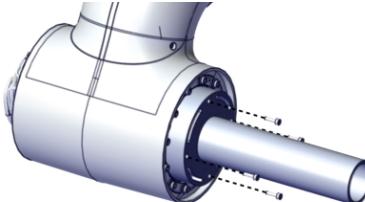
5.3.4 Replacing the axis-3 cabling

Continued

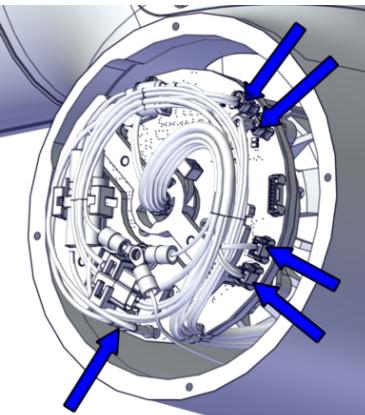
	Action	Note
2	Fit two guide pins to the joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002438</p>
3	Place the cabling at the slot before refitting the joint unit.	 <p>xx2100000004</p>
4	<p>Fit the joint unit to the housing, aligning the pin with the pin hole.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000002072</p>
5	Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2100000320</p>

Continues on next page

5.3.4 Replacing the axis-3 cabling
Continued

Action	Note
6 Remove the guide pins and secure the remaining two attachment screws.	 xx2000002070
7 Pre-tighten the screws crosswise.	
8 Torque tighten all screws crosswise.	Tightening torque: 4.3 Nm.
9 Remove the lifting aid by removing the screws.	 xx2000002069
10 Clean pushed-out flange sealant, if any.	

Connecting the axis-3 joint unit cabling

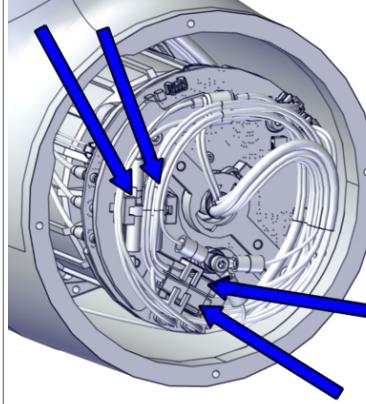
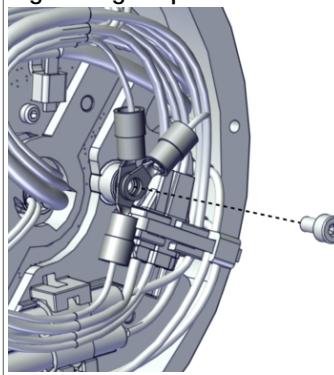
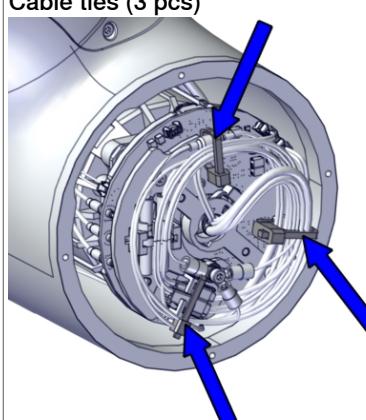
Action	Note
1 Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D3.X1 to X1 • D3/4.DC+ to DC+ • D3/4.DC- to Ground • D3.X4 to X4 • D3/4.X2 to X2 • D3.X5 to X5 	 xx2000002068

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5 Repair

5.3.4 Replacing the axis-3 cabling

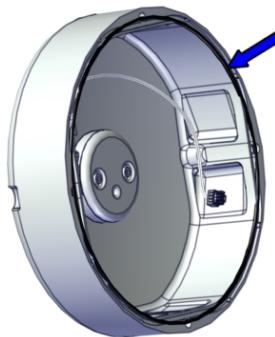
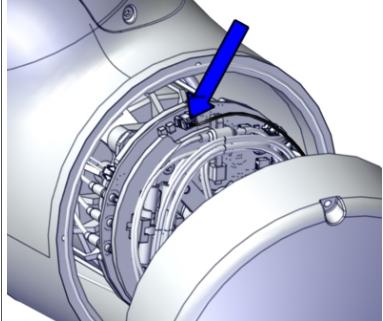
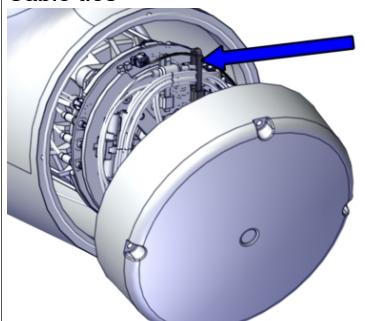
Continued

	Action	Note
2	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J4.DC+ to J4/5.DC+ • J4.DC- to J4/5.DC- • J4.CS to J4/5.CS • J4.CP to J4/5.CP 	 xx2000002067
3	<p>Secure the cables for functional earth and protective earth with a screw.</p>	<p>Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.</p>  xx2000001945
4	<p>Secure the cabling with cable ties.</p>	<p>Cable ties (3 pcs)</p>  xx2000002066

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5.3.4 Replacing the axis-3 cabling
Continued

Refitting the housing cover

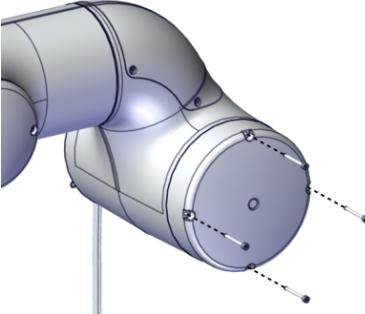
	Action	Note
1	<p>Fit the o-ring to its groove. Replace if damaged.</p>	<p>O-ring: 3HAC061327-047  xx2000001962</p>
2	<p>Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.</p>	 xx2000002023
3	<p>Secure the brake release cable with a cable tie.</p>	<p>Cable ties  xx2000002022</p>

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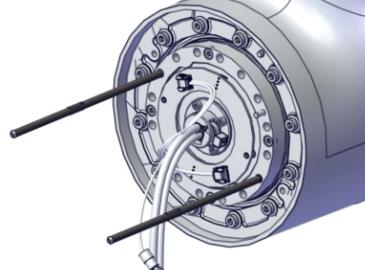
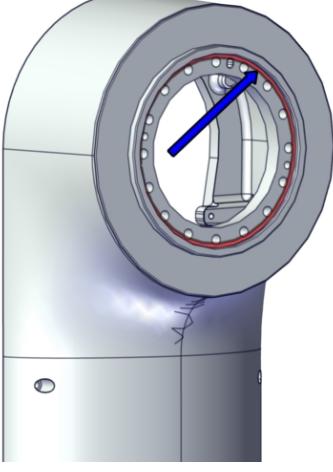
5 Repair

5.3.4 Replacing the axis-3 cabling

Continued

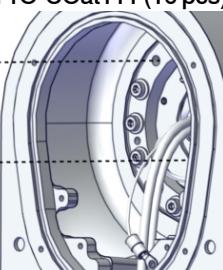
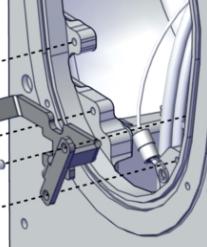
	Action	Note
4	Refit the cover with the four screws.	<p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm</p>  <p>xx2000002021</p>

Refitting the upper arm

	Action	Note
1	Fit two guide pins to the axis-3 joint.	 <p>xx2000001971</p>
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000001973</p>

Continues on next page

5.3.4 Replacing the axis-3 cabling
Continued

	Action	Note
3	Lift the upper arm into mounting position while inserting the cabling into the lower arm.	 xx2000001970
4	Slide the upper arm into place on the guide pins.	
5	Secure the upper arm to the lower arm with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001969
6	Remove the guide pins and fasten the remaining two screws.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001967
7	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.
8	Refit the cable bracket with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm  xx2000001966

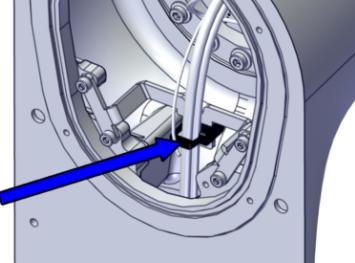
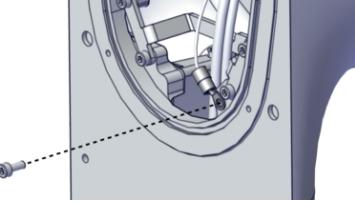
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5 Repair

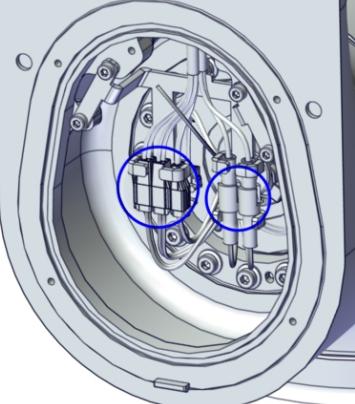
5.3.4 Replacing the axis-3 cabling

Continued

Fastening the cabling between the lower and upper arm

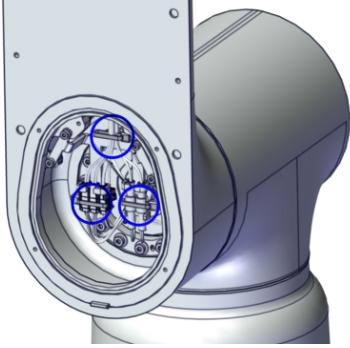
	Action	Note
1	Secure the cabling with the cable tie.	Cable ties  xx2000001965
2	Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001964

Connecting the upper arm cabling

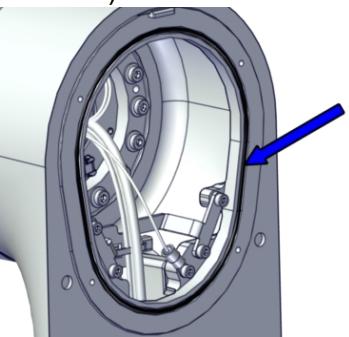
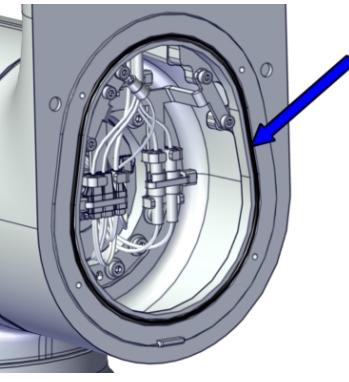
	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938

Continues on next page

5.3.4 Replacing the axis-3 cabling
Continued

Action	Note
2 Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937

Refitting the lower arm covers

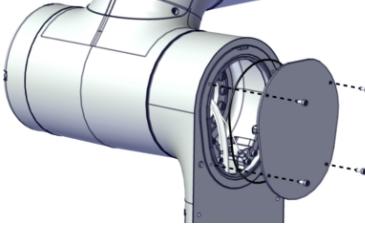
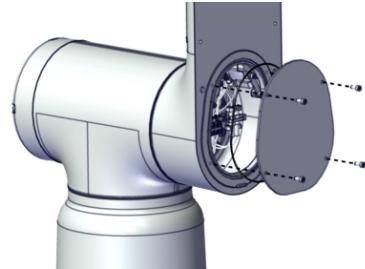
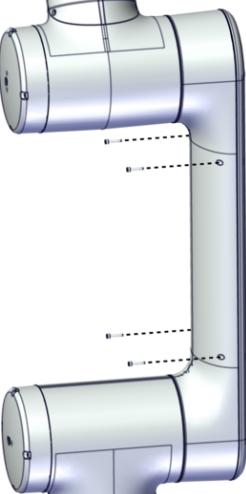
Action	Note
1 Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001955  xx2000001954

Continues on next page

5 Repair

5.3.4 Replacing the axis-3 cabling

Continued

Action	Note
2 Refit the inner covers with four screws each.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.4 Nm.</p>  <p>xx2000001947</p>  <p>xx2000001930</p>
3 Snap the lower arm cover into place.	
4 Secure the cover with four screws.	<p>Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000001929</p>

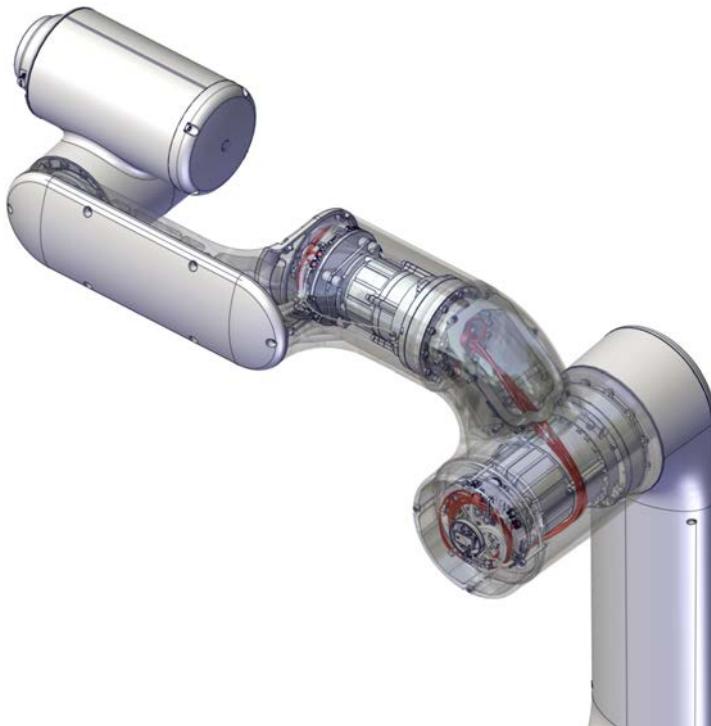
Concluding procedure

Action	Note
1 Calibrate the joint unit torque sensor.	See Calibration on page 719
2  DANGER Make sure all safety requirements are met when performing the first test run.	

5.3.5 Replacing the axis-4 cabling

Location of the cable harness

The cable harness is located as shown in the figure.



xx2100000060

Summary of the replacement procedure

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

- 1 Separate the cabling between the housing and the tubular (at the axis-3 joint unit).
- 2 Remove the tubular and place on a workbench.
- 3 Remove the axis-4 cover.
- 4 Remove the axis-4 joint unit.
- 5 Replace the cabling.

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Continues on next page

5 Repair

5.3.5 Replacing the axis-4 cabling

Continued

Spare part	Article number	Note
Cable harness, joint 4	3HAC073206-001	Also order new Cable tie: 3HAC075545-001.
Cable tie	3HAC075545-001	For securing joint unit cable.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077789-001	For joint units on axes 4, 5 and 6. Attachment screws M3x12 (4 pcs) are enclosed.
Guide pin, M3x110	3HAC077787-001	Always use guide pins in pairs. For joint units on axes 4, 5 and 6.
Tweezers	-	Used to handle drive board connectors.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

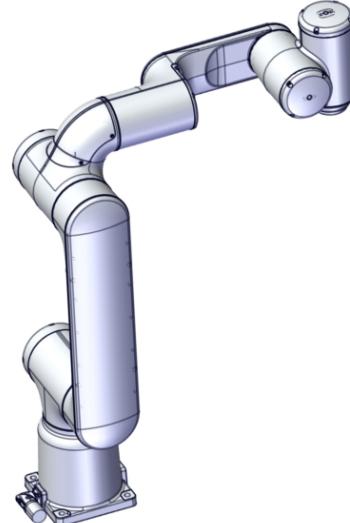
Consumable	Article number	Note
Cable ties	-	
O-ring	3HAC061327-051	Axis-4 cover Replace if damaged.
Gasket	3HAC075056-001	Cover inside housing Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.
O-ring	3HAC061327-043	Tubular cover Replace if damaged.
Flange socket head screw with glue	3HAB3413-312	M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included.
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574

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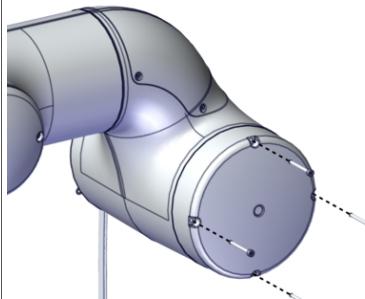
Removing the joint cabling

Use these procedures to remove the joint-4 cabling.

Preparations before removing the cabling

	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none"> • Axis 1: No significance. • Axis 2: 0° • Axis 3: 0° • Axis 4: 0° (home position) • Axis 5: +90° • Axis 6: No significance. <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	 xx2100000005
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

Removing the housing cover

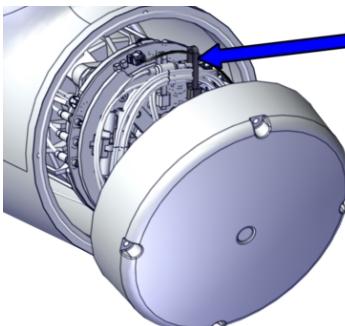
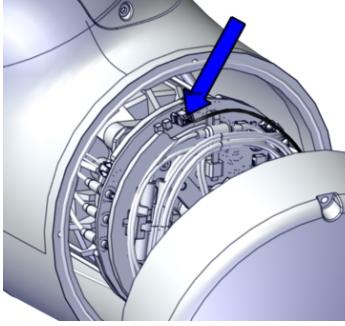
	Action	Note
1	<p>! CAUTION</p> <p>Make sure that all supplies for electrical power are turned off.</p>	
2	<p>Remove the cover screws.</p>	 xx2000002021

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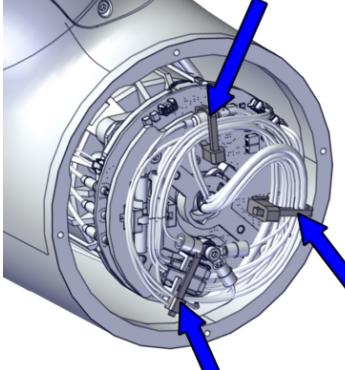
5 Repair

5.3.5 Replacing the axis-4 cabling

Continued

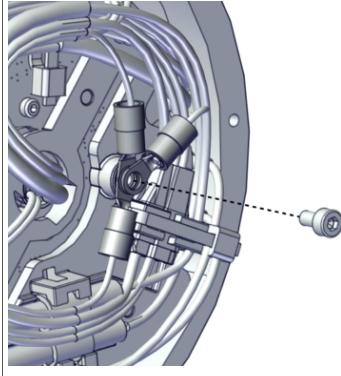
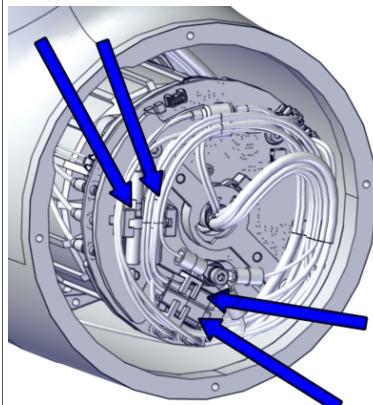
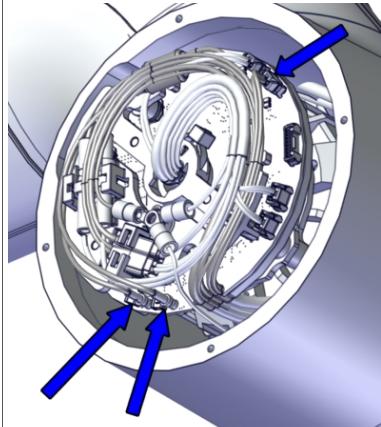
	Action	Note
3	 CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002022
5	Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002023

Separating the cabling between the housing and the tubular

	Action	Note
1	Cut the cable ties.	 xx2000002066

Continues on next page

5.3.5 Replacing the axis-4 cabling
Continued

Action	Note
2 Remove the functional and protective earth cables by removing the screw.	 xx2000001945
3 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP 	 xx2000002067
4 Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D3/4.X2 • D3/4.DC+ • D3/4.DC- 	 xx2000002120

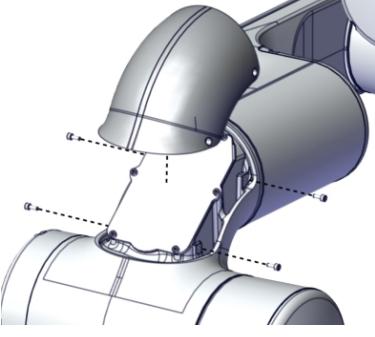
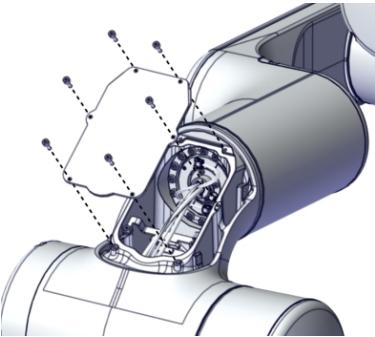
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5 Repair

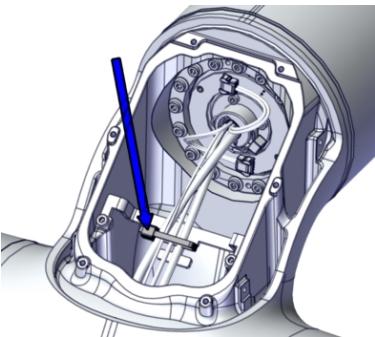
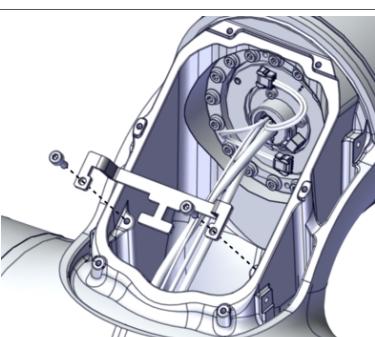
5.3.5 Replacing the axis-4 cabling

Continued

Opening the housing top cover

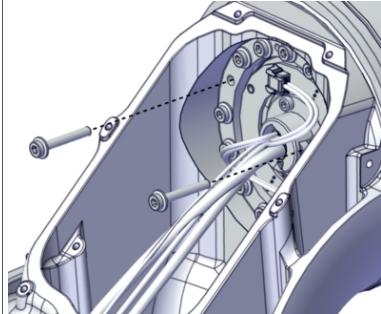
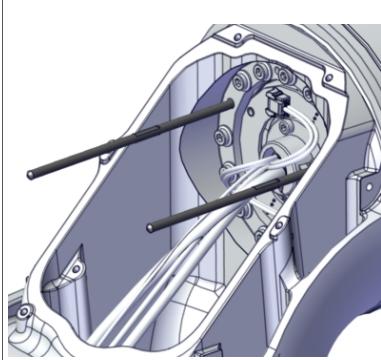
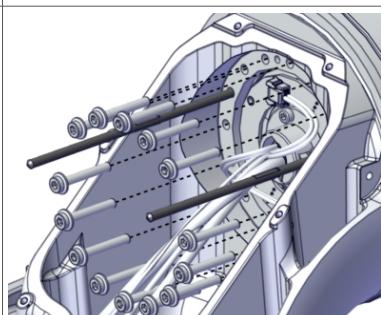
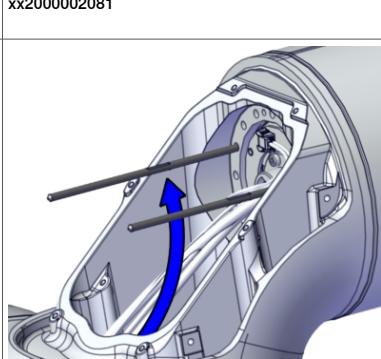
	Action	Note
1	Remove the cover by removing the four screws.	 xx2000002075
2	Remove the inner plate by removing the screws.	 xx2000002076

Removing the tubular

	Action	Note
1	Cut the cable tie.	 xx2000002077
2	Remove the cable bracket by removing the two screws.	 xx2000002078

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5.3.5 Replacing the axis-4 cabling
Continued

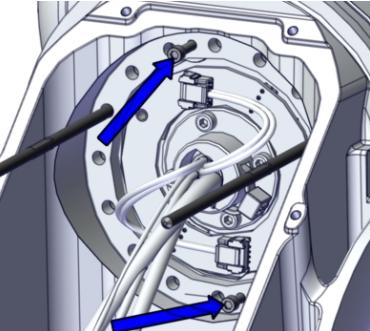
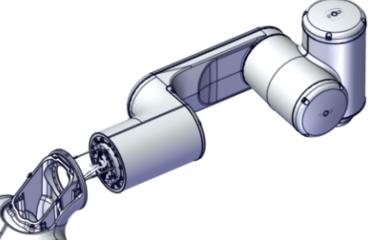
Action	Note
3 Remove two attachment screws and fit two guide pins to the axis-4 joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.</p>  <p>xx2000002079</p>  <p>xx2000002080</p>
4 Remove the remaining attachment screws.	 <p>xx2000002081</p>
5 Pull out the cabling carefully from the housing.	 <p>xx2000002127</p>

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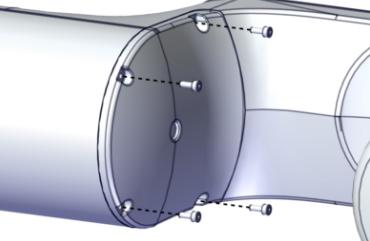
5 Repair

5.3.5 Replacing the axis-4 cabling

Continued

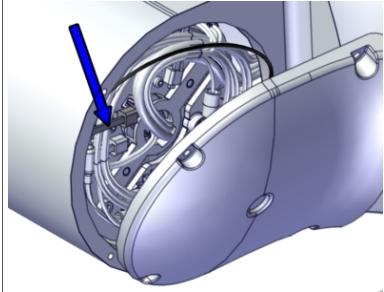
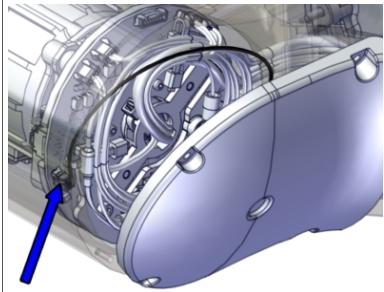
Action	Note
6 Use two fully threaded attachment screws as removal tools to press the housing out of position.	 xx2100000006
7 Remove the tubular from the housing. Assist the cabling to be removed from the housing while lifting away the complete tubular. Place the tubular on a workbench.	 xx2000002082

Removing the axis-4 cover

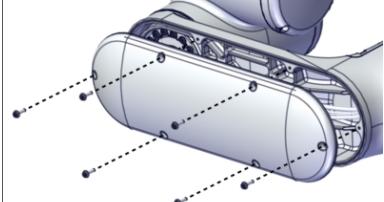
Action	Note
1 Remove the cover screws.	 xx2000002083
2  CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	

Continues on next page

5.3.5 Replacing the axis-4 cabling
Continued

Action	Note
3 Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002084
4 Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	Tweezers  xx2000002085

Removing the tubular cover

Action	Note
1 Remove the cover by removing the six screws. Dispose the screws. New screws must be used when refitting the cover. New screws are included in the spare part delivery of the joint unit.	 xx2000002123

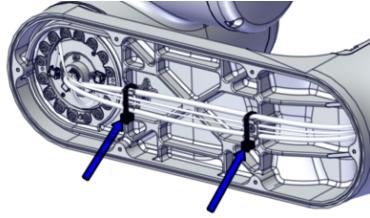
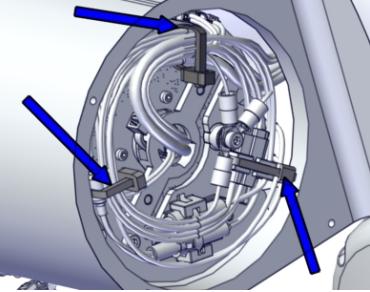
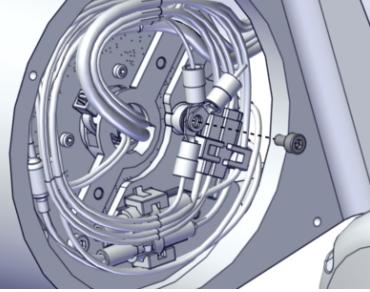
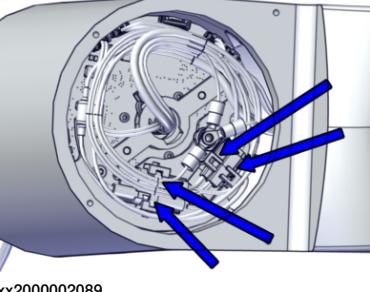
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5 Repair

5.3.5 Replacing the axis-4 cabling

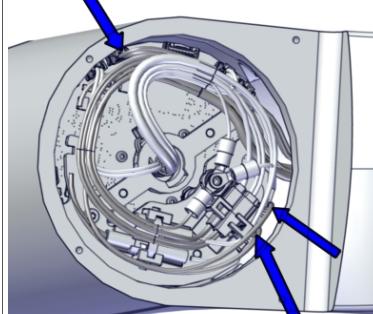
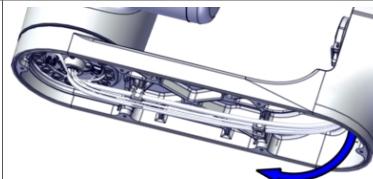
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Separating the cabling between the tubular and the tilt

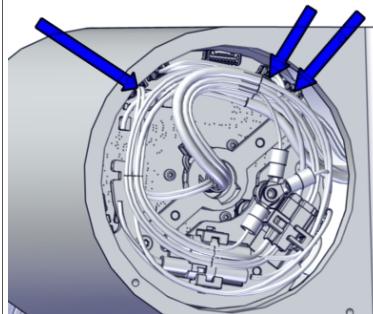
Action	Note
1 Cut the cable ties, if needed.	 xx2000002124  xx2000002086
2 Remove the functional and protective earth cables by removing the screw.	 xx2000002087
3 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP 	 xx2000002089

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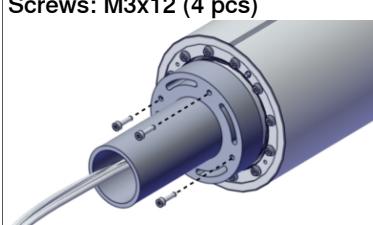
5.3.5 Replacing the axis-4 cabling Continued

	Action	Note
4	<p>Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board:</p> <ul style="list-style-type: none"> • D3/4.X2 • D3/4.DC- • D3/4.DC+ <p>Use tweezers, if needed.</p>	<p>Tweezers</p>  <p>xx2000002125</p>
5	Pull out the cabling carefully from the tubular.	 <p>xx2000002126</p>

Disconnecting the axis-4 joint unit cabling

	Action	Note
1	<p>Disconnect the connectors from the drive board.</p> <p>CAUTION</p> <p>Use tweezers to unlock connectors and pull them off.</p> <ul style="list-style-type: none"> • D4/5.X1 • D4/5.X4 • D4/5.X5 	<p>Tweezers</p>  <p>xx2000002088</p>

Removing the axis-4 joint unit

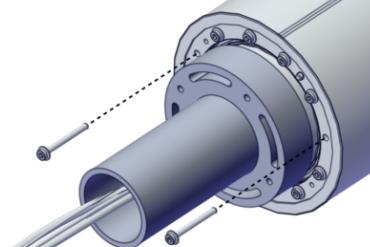
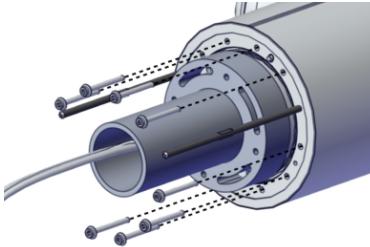
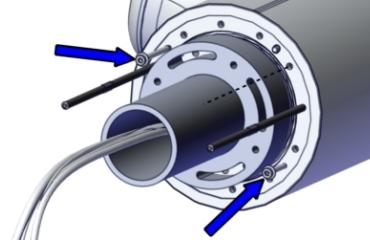
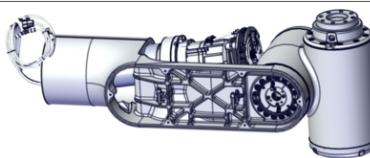
	Action	Note
1	<p>Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)</p>  <p>xx2000002090</p>

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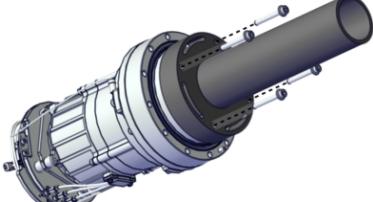
5 Repair

5.3.5 Replacing the axis-4 cabling

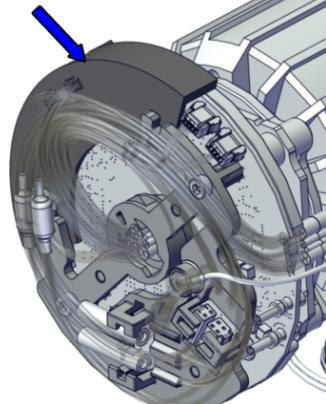
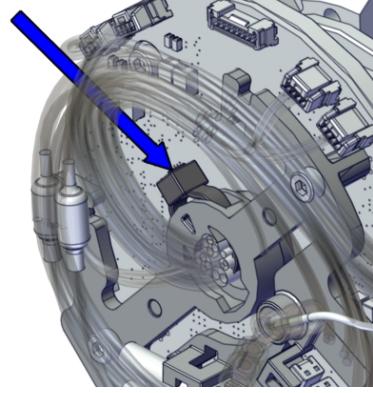
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Action	Note
<p>2 Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002091
<p>3 Fit two guide pins to the axis-4 joint unit.</p>	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  xx2000002578
<p>4 Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000326
<p>5 Press the joint unit out of position using two of the previous attachment screws as removal tools.</p>	 xx2100000327
<p>6 Remove the joint unit from the tubular.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002116

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	Action	Note
7	Remove the lifting aid and guide pins.	 xx2000001957

Removing the joint cable

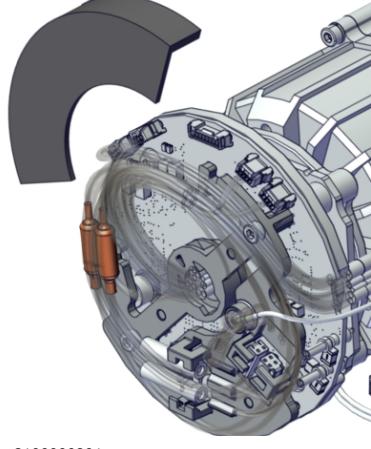
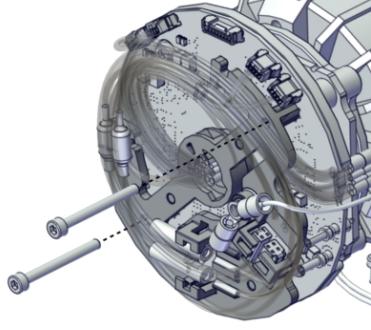
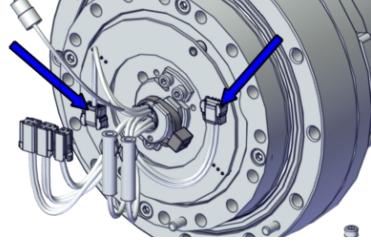
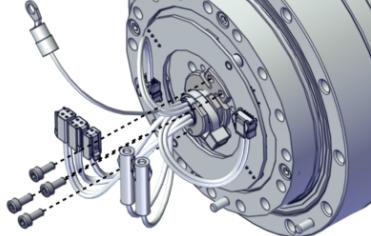
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2	 Tip Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001  xx2000002057
3	Cut the cable tie at the drive board.	 xx2000002058

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5 Repair

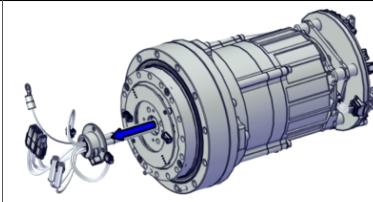
5.3.5 Replacing the axis-4 cabling

Continued

Action	Note
4 Remove the protection plate.	 xx2100000301
5 Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6 Disconnect the two connectors from the torque sensor board. <ul style="list-style-type: none"> • TQ.A • TQ.B 	 xx2000002053
7 Remove the cable plate by removing the attachment screws.	 xx2000002049

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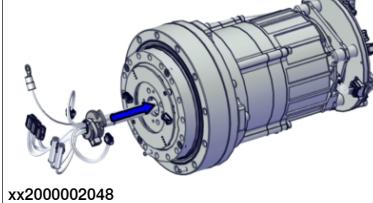
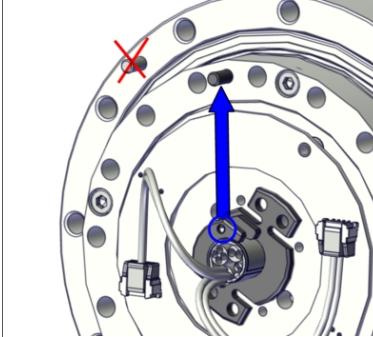
5.3.5 Replacing the axis-4 cabling
Continued

Action	Note
<p>8 Remove the joint cable from the hollow shaft from the torque sensor side.</p> <p>CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	

Refitting the joint cabling

Use these procedures to refit the joint-4 cabling.

Refitting the joint cable

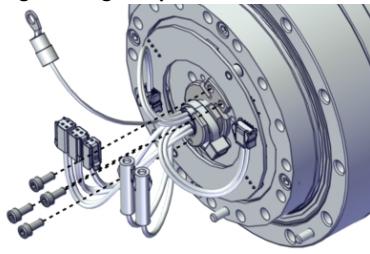
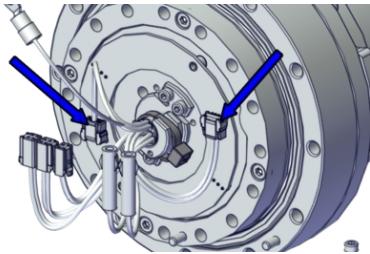
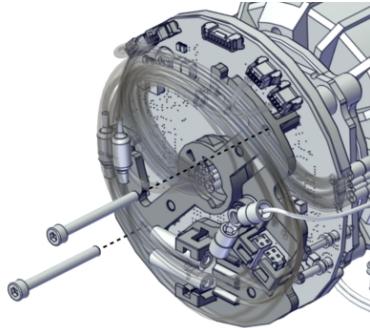
Action	Note
<p>1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	
<p>2 Place the joint cable through the hollow shaft from the torque sensor side.</p> <p>CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	
<p>3 Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.</p>	

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5 Repair

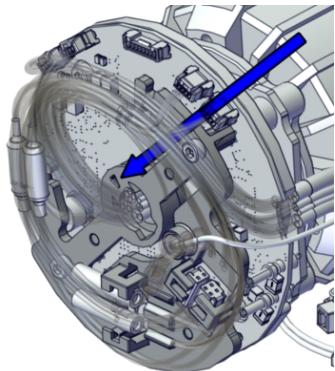
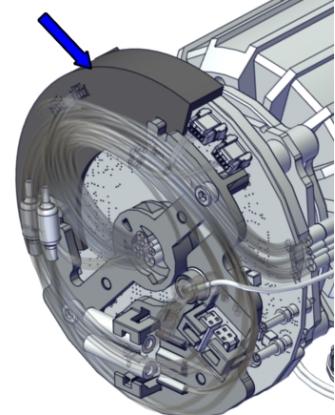
5.3.5 Replacing the axis-4 cabling

Continued

	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	<p>Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002049</p>
5	<p>Connect the two connectors to the torque sensor board.</p> <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 <p>xx2000002053</p>
6	Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 <p>xx2000002056</p> <p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002055</p>

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5.3.5 Replacing the axis-4 cabling
Continued

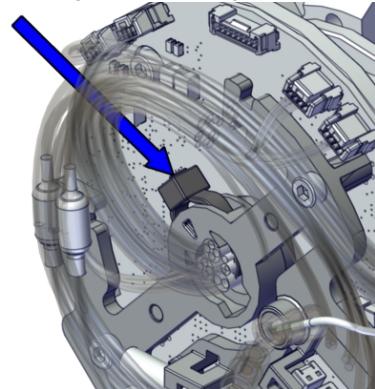
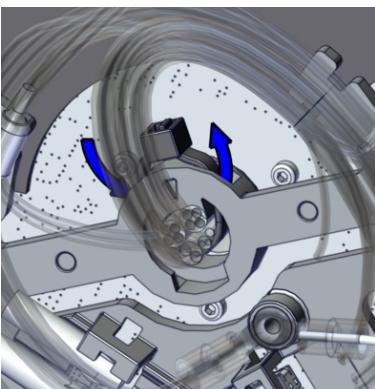
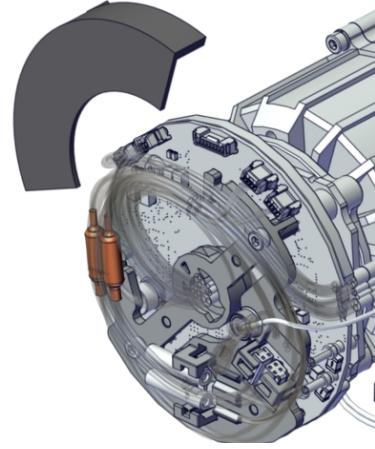
	Action	Note
7	<p>Keep the cabling loose, making sure not to twist or strain it.</p> <p>Use the cable tie to pre-fix the cable by hand.</p>	 xx2100000507
8	Fit the protection plate to the drive board unit.	<p>Protection plate: 3HAC077790-001</p>  xx2000002057

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5 Repair

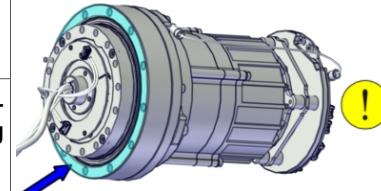
5.3.5 Replacing the axis-4 cabling

Continued

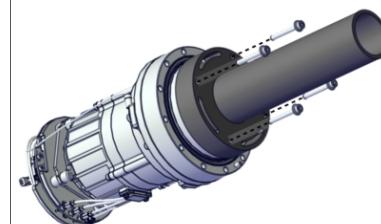
	Action	Note
9	<p>Secure the cables to the cable support with a cable tie, using a cable tie gun.</p> <p>Assembly direction for the cable tie is shown in the figure.</p>	<p>Cable tie: 3HAC075545-001. For securing joint unit cable.</p> <p>Cable tie gun EVO7</p> <p>Setting for cable tie gun: 6.75.</p>  <p>xx2000002058</p>  <p>xx2000002059</p>
10	Remove the protection plate.	 <p>xx2100000301</p>

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Preparations before fitting the joint 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 44 .	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	

Refitting the axis-4 joint unit

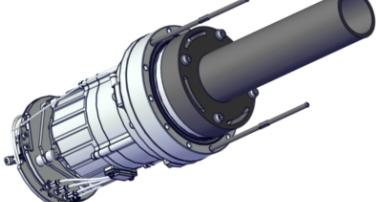
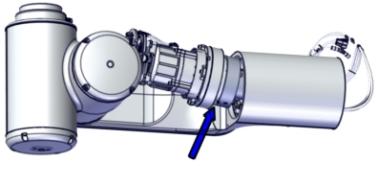
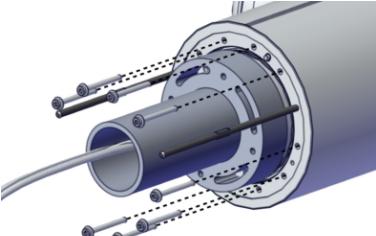
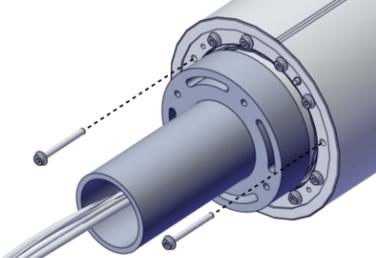
	Action	Note
1	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079143-001 Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957

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5 Repair

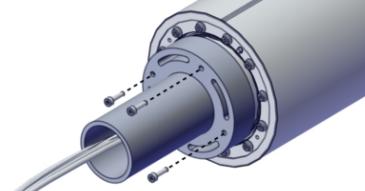
5.3.5 Replacing the axis-4 cabling

Continued

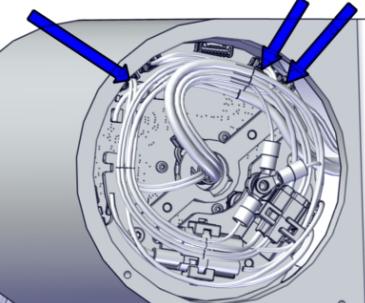
	Action	Note
2	Fit two guide pins to the joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  <p>xx2000002438</p>
3	<p>Fit the joint unit to the tubular, aligning the pin with the pin hole.</p> <p> CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000002117</p>
4	Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2100000326</p>
5	Remove the guide pins and secure the remaining two attachment screws.	 <p>xx2000002091</p>
6	Pre-tighten the screws crosswise.	
7	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm.

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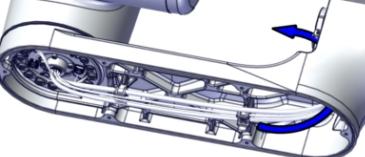
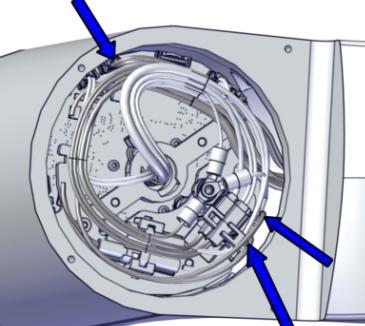
5.3.5 Replacing the axis-4 cabling
Continued

	Action	Note
8	Remove the lifting aid by removing the screws.	 xx2000002090
9	Clean pushed-out flange sealant, if any.	

Connecting the axis-4 joint unit cabling

	Action	Note
1	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D4/5.X1 to X1 • D4/5.X4 to X4 • D4/5.X5 to X5 	 xx2000002088

Connecting the tilt cabling

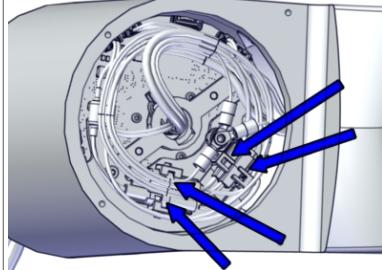
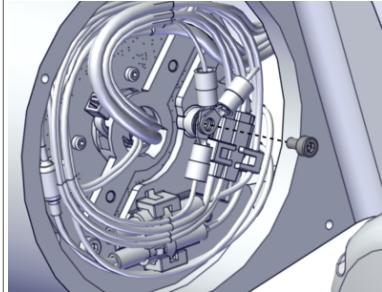
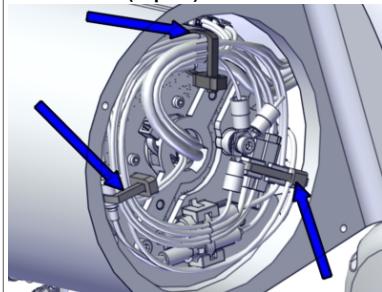
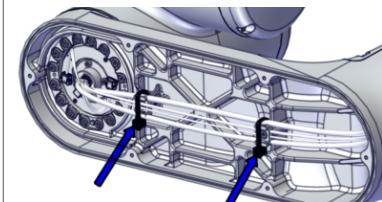
	Action	Note
1	Insert the cabling into the tubular.	 xx2000002148
2	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D3/4.X2 to X2 • D3/4.DC- to Ground • D3/4.DC+ to +DC 	 xx2000002125

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5 Repair

5.3.5 Replacing the axis-4 cabling

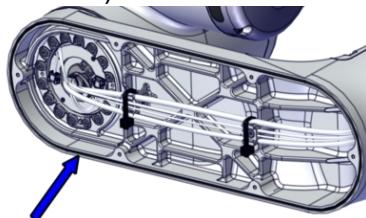
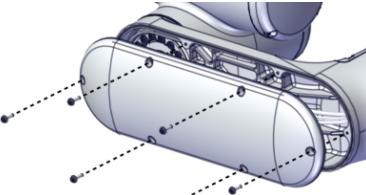
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	Action	Note
3	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J4/5.DC+ to J5/6.DC+ • J4/5.DC- to J5/6.DC- • J4/5.CS to J5/6.CS • J4/5.CP to J5/6.CP 	 xx2000002089
4	<p>Secure the cables for functional earth and protective earth with a screw.</p>	<p>Hex socket head cap screw: M3x6 (1 pcs).</p> <p>Tightening torque: 0.8 Nm.</p>  xx2000002087
5	<p>Secure the cabling with cable ties.</p>	<p>Cable ties (3 pcs)</p>  xx2000002086  xx2000002124

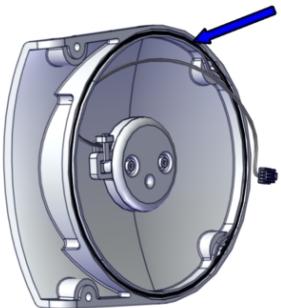
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5.3.5 Replacing the axis-4 cabling
Continued

Refitting the tubular cover

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-043 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002149
2	Refit the cover with new attachment screws.	Flange socket head screw with glue: 3HAB3413-312 M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included. Tightening torque: 1.6 Nm.  xx2000002123

Refitting the axis-4 cover

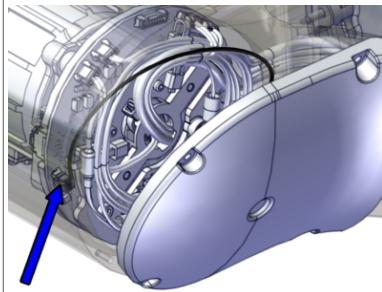
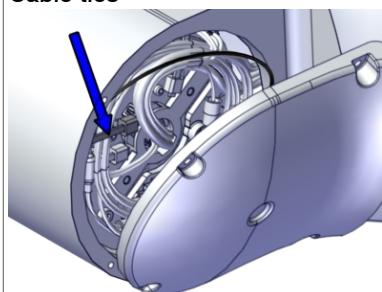
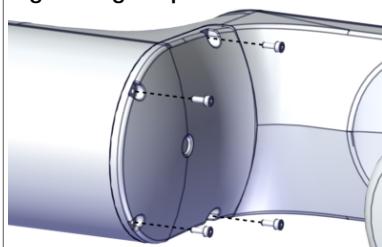
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002092

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5 Repair

5.3.5 Replacing the axis-4 cabling

Continued

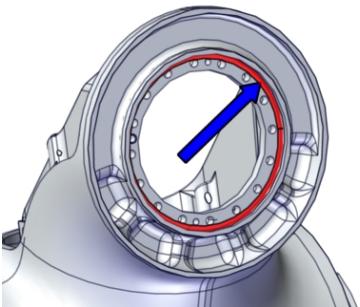
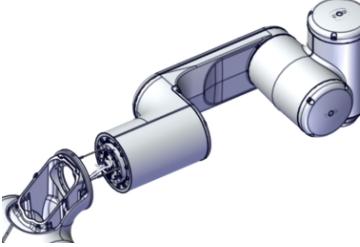
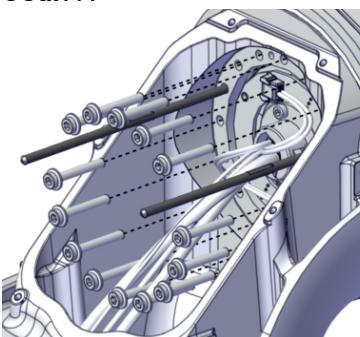
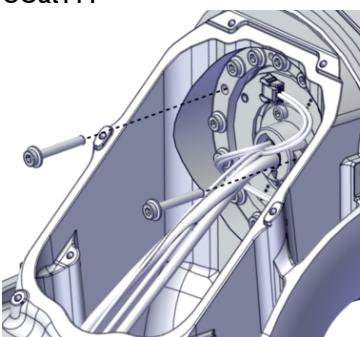
	Action	Note
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	Tweezers  xx2000002085
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000002084
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.2 Nm  xx2000002083

Refitting the tubular

	Action	Note
1	Fit two guide pins to the axis-4 joint.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002093

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5.3.5 Replacing the axis-4 cabling
Continued

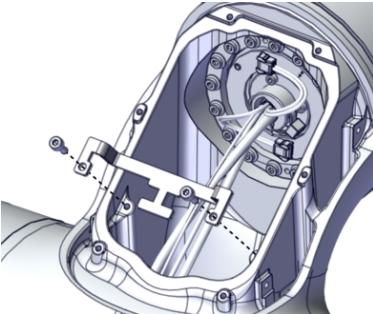
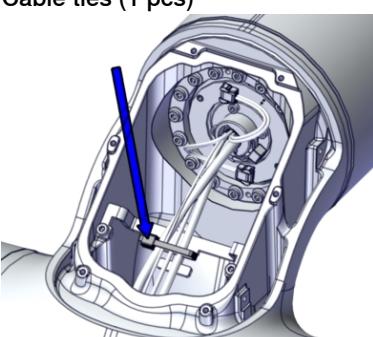
	Action	Note
2	<p>Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the housing mounting surface, as pointed out in the figure.</p>	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000002094</p>
3	Lift the tubular into mounting position while inserting the cabling into the housing.	
4	Slide the tubular into place on the guide pins.	 <p>xx2000002082</p>
5	<p>Secure the tubular to the housing with all attachment screws but two. Pre-tighten the screws crosswise firstly.</p>	<p>Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111</p>  <p>xx2000002081</p>
6	Remove the guide pins and fasten the remaining two screws.	<p>Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111</p>  <p>xx2000002079</p>

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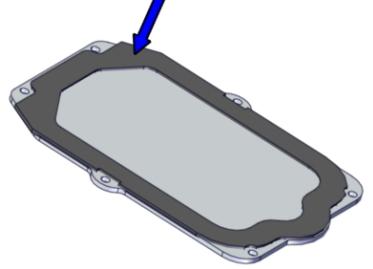
5 Repair

5.3.5 Replacing the axis-4 cabling

Continued

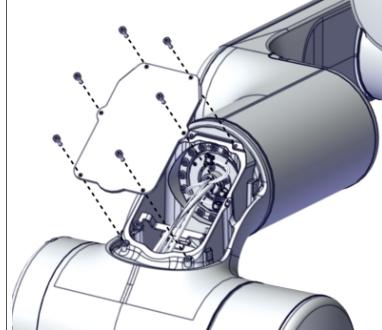
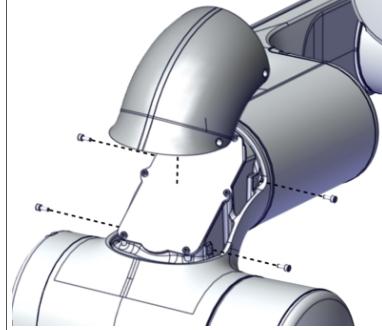
	Action	Note
7	Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.
8	Refit the cable bracket with the two screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm
		 xx2000002078
9	Secure the cabling with a cable tie.	Cable ties (1 pcs)
		 xx2000002077

Closing the housing top cover

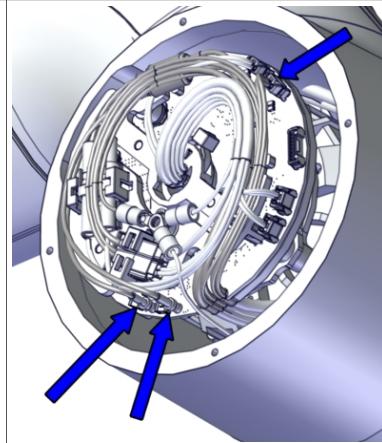
	Action	Note
1	Check the inner plate gasket. Replace if damaged.	Gasket: 3HAC075056-001  xx2000002095

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5.3.5 Replacing the axis-4 cabling
Continued

Action	Note
2 Refit the inner plate with the screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 1.4 Nm  xx2000002076
3 Refit the cover with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.45 Nm  xx2000002075

Connecting the tubular cabling

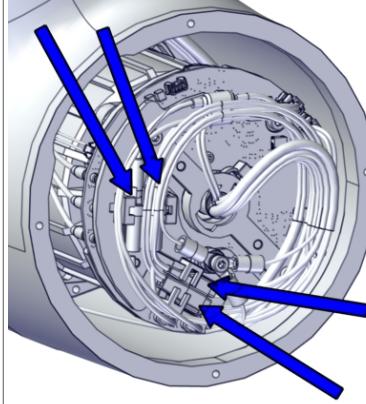
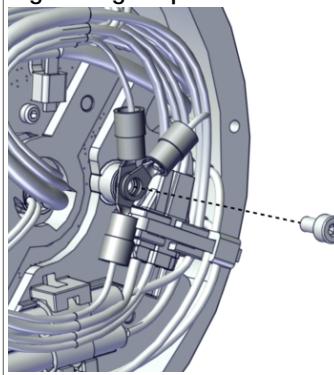
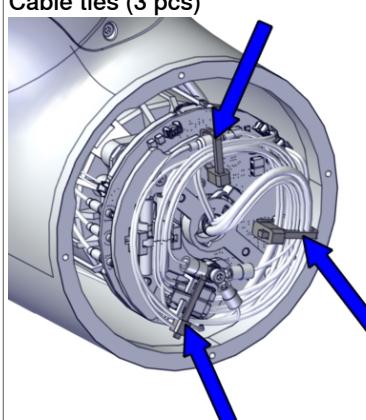
Action	Note
1 Reconnect the connectors to the drive board. • D3/4.DC+ to DC+ • D3/4.DC- to Ground • D3/4.X2 to X2	 xx2000002120

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5 Repair

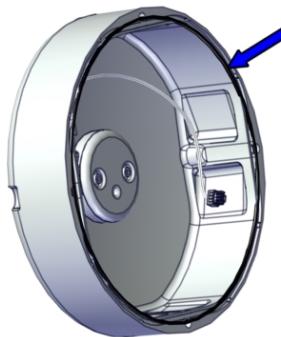
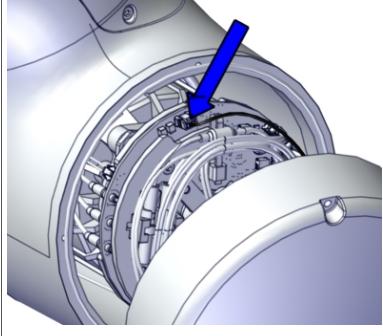
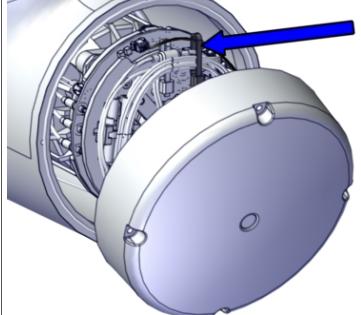
5.3.5 Replacing the axis-4 cabling

Continued

	Action	Note
2	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J3.DC+ to J3.DC+ • J3.DC- to J3.DC- • J3.CS to J3.CS • J3.CP to J3.CP 	 xx2000002067
3	<p>Secure the cables for functional earth and protective earth with a screw.</p>	<p>Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.</p>  xx2000001945
4	<p>Secure the cabling with cable ties.</p>	<p>Cable ties (3 pcs)</p>  xx2000002066

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Refitting the housing cover

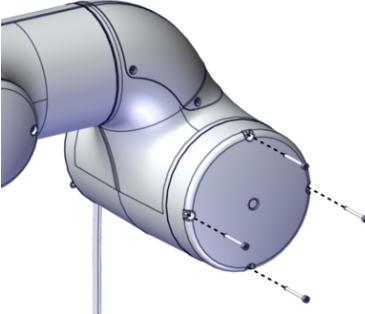
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000002023
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000002022

Continues on next page

5 Repair

5.3.5 Replacing the axis-4 cabling

Continued

	Action	Note
4	Refit the cover with the four screws.	<p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm</p>  <p>xx2000002021</p>

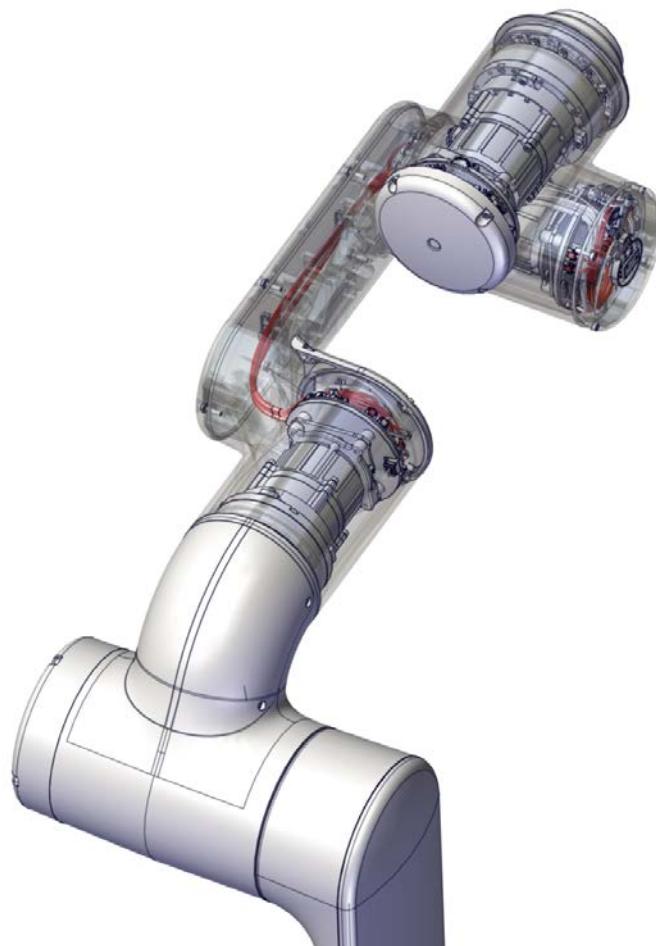
Concluding procedure

	Action	Note
1	Calibrate the joint unit torque sensor.	See Calibration on page 719
2	 DANGER Make sure all safety requirements are met when performing the first test run.	

5.3.6 Replacing the axis-5 cabling

Location of the cable harness

The cable harness is located as shown in the figure.



xx2100000061

Summary of the replacement procedure

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

- 1 Remove the tubular cover.
- 2 Separate the cabling between the tubular and the tilt (at the axis-4 joint unit).
- 3 Remove the tilt and place on a workbench.
- 4 Remove the axis-6 joint unit.
- 5 Remove the axis-5 cover.
- 6 Remove the axis-5 joint unit.
- 7 Replace the cabling.

Continues on next page

5 Repair

5.3.6 Replacing the axis-5 cabling

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Cable harness, joint 5	3HAC073206-001	Also order new Cable tie: 3HAC075545-001.
Cable tie	3HAC075545-001	For securing joint unit cable.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077789-001	For joint units on axes 4, 5 and 6. Attachment screws M3x12 (4 pcs) are enclosed.
Guide pin, M3x110	3HAC077787-001	Always use guide pins in pairs. For joint units on axes 4, 5 and 6.
Tweezers	-	Used to handle drive board connectors.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cable ties	-	
O-ring	3HAC061327-051	Axis-5 cover Replace if damaged.
O-ring	3HAC061327-051	Axis-4 cover Replace if damaged.
O-ring	3HAC061327-043	Tubular cover Replace if damaged.
O-ring	3HAC061327-051	Arm-side interface Replace if damaged.
Grease	3HAC042536-001	Shell Gadus S2

Continues on next page

Consumable	Article number	Note
Flange socket head screw with glue	3HAB3413-312	M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included.
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574

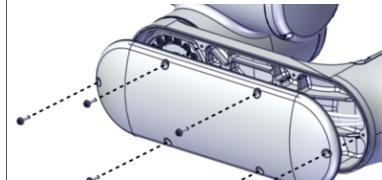
Removing the joint cabling

Use these procedures to remove the joint-5 cabling.

Preparations before removing the cabling

	Action	Note
1	Jog the robot to the specified position: <ul style="list-style-type: none"> • Axis 1: No significance. • Axis 2: No significance. • Axis 3: No significance. • Axis 4: No significance. • Axis 5: 0° (home position) • Axis 6: No significance. 	
2	 CAUTION Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the tubular cover

	Action	Note
1	Remove the cover by removing the six screws. Dispose the screws. New screws must be used when refitting the cover. New screws are included in the spare part delivery of the joint unit.	 xx2000002123

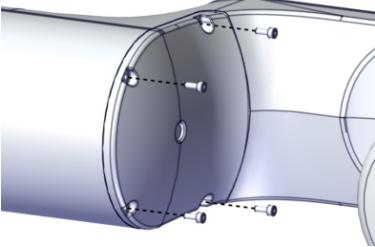
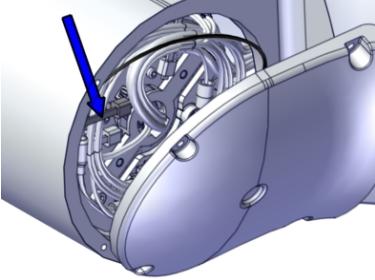
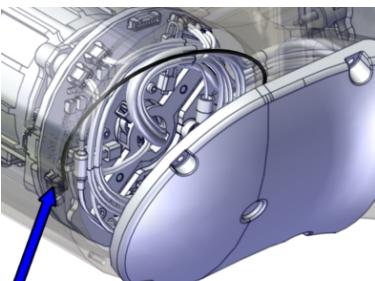
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5 Repair

5.3.6 Replacing the axis-5 cabling

Continued

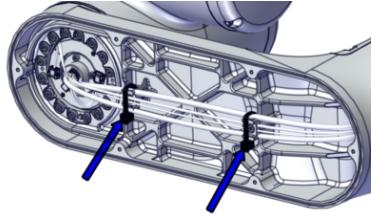
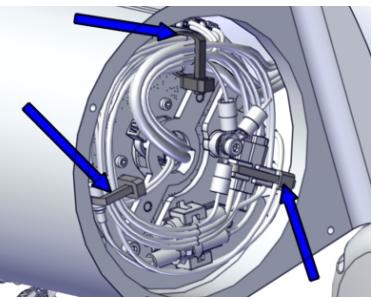
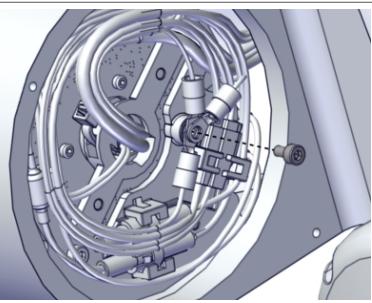
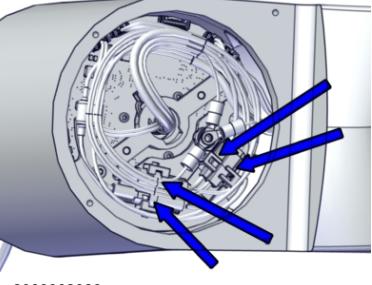
Removing the axis-4 cover

	Action	Note
1	Remove the cover screws.	 xx2000002083
2	! CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
3	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002084
4	Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	Tweezers  xx2000002085

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5.3.6 Replacing the axis-5 cabling
Continued

Separating the cabling between the tubular and the tilt

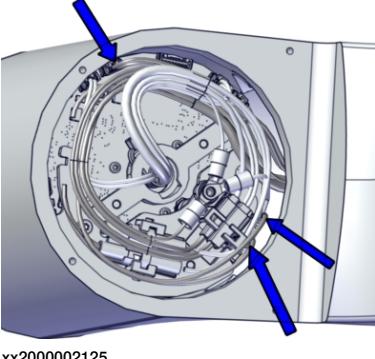
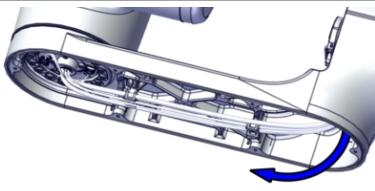
	Action	Note
1	Cut the cable ties, if needed.	 xx2000002124  xx2000002086
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002087
3	Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP 	 xx2000002089

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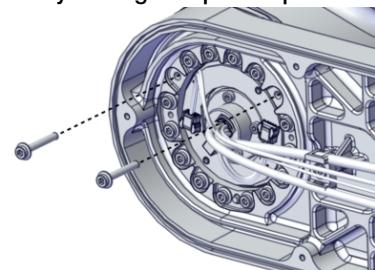
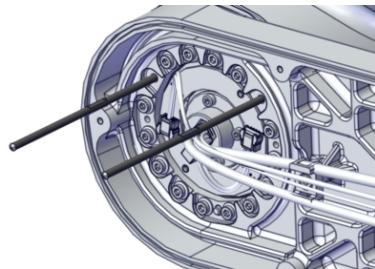
5 Repair

5.3.6 Replacing the axis-5 cabling

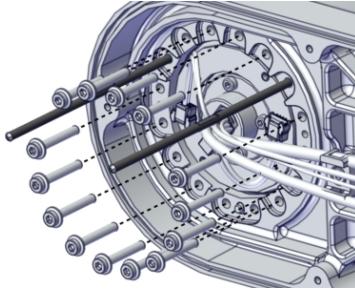
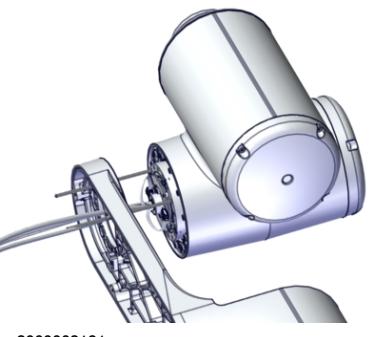
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Action	Note
<p>4 Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board:</p> <ul style="list-style-type: none"> • D3/4.X2 • D3/4.DC- • D3/4.DC+ <p>Use tweezers, if needed.</p>	<p>Tweezers</p> 
5 Pull out the cabling carefully from the tubular.	

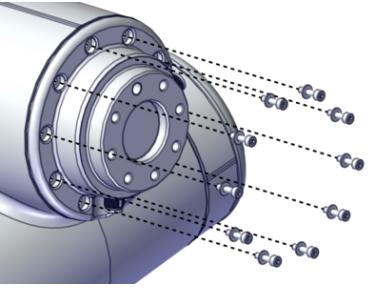
Removing the tilt

Action	Note
1 Remove two attachment screws and fit two guide pins to the axis-5 joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.</p>  

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Action	Note
2 Remove the remaining attachment screws.	 xx2000002130
3 Press the tilt out of position using two of the previous attachment screws as removal tools.	
4 Remove the tilt from the tubular. Assist the cabling to be removed while lifting away the complete tilt. Place the tilt on a workbench.	 xx2000002131

Removing the tool flange

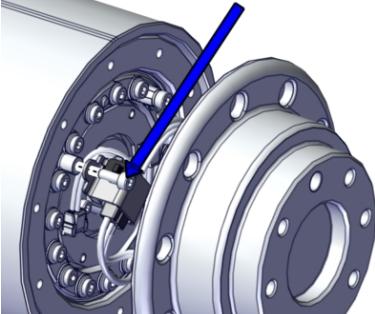
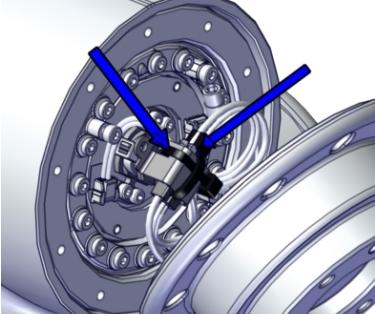
Action	Note
1 Remove the tool flange screws and washers.	 xx2000002155
2  CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	

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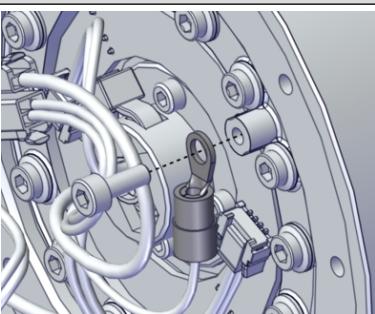
5 Repair

5.3.6 Replacing the axis-5 cabling

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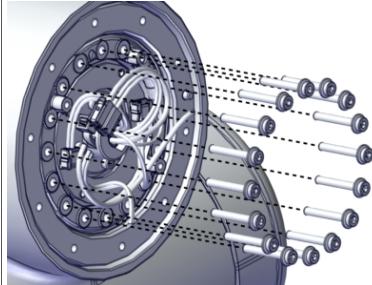
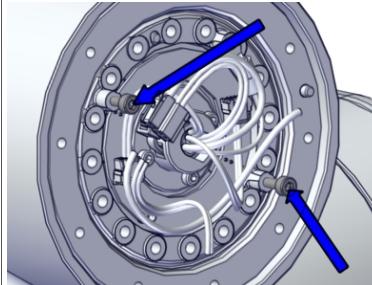
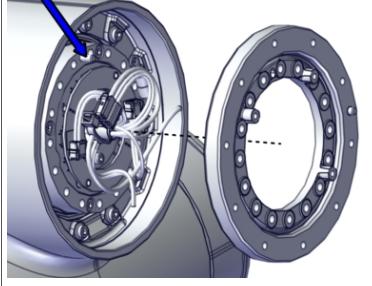
Action	Note
3 Loosen the tool flange and remove the cable bracket by removing the screw.	 xx2000002156
4 Cut the cable ties.	 xx2000002157
5 Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

Disconnecting the tool flange functional earth cable

Action	Note
1 Remove the functional earth cable by removing the screw.	 xx2000002159

Continues on next page

Removing the tool flange adapter

	Action	Note
1	Remove the tool flange adapter screws.	 xx2000002165
2	Press the adapter out of position by using two of the attachment screws as removal tools.	 xx2000002166
3	Remove the tool flange adapter.	 xx2000002167

Removing the arm-side interface

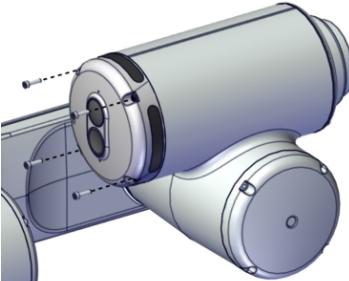
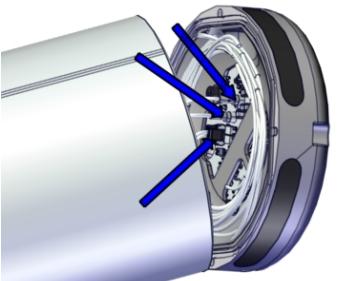
	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	 CAUTION There is cabling connected between the arm-side interface and the joint unit drive board. Open the arm-side interface with care to avoid damage to the cabling or the connector(s). Do not leave the arm-side interface in location without being secured with the attachment screws.	

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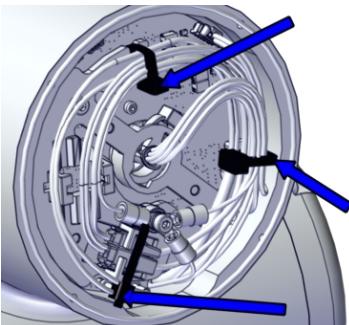
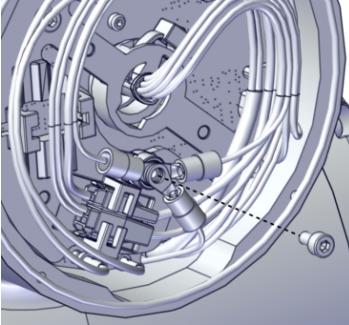
5 Repair

5.3.6 Replacing the axis-5 cabling

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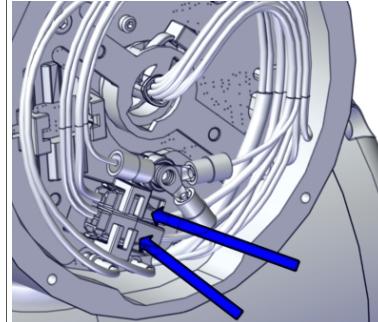
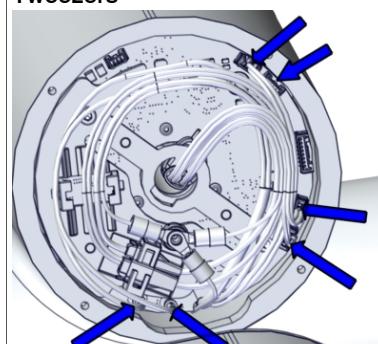
Action	Note
3 Remove the attachment screws.	 xx2000002550
4 Loosen the arm-side interface carefully and disconnect the connectors from it. <ul style="list-style-type: none"> • ASI.DC+ • ASI.DC- • ASI.X1 	 xx2100000335

Disconnecting the axis-6 joint unit cabling

Action	Note
1 Cut the cable ties.	 xx2000002161
2 Remove the functional and protective earth cables by removing the screw.	 xx2000002162

Continues on next page

5.3.6 Replacing the axis-5 cabling Continued

Action	Note
3 Snap loose and disconnect the connectors: • J7.CS • J7.CP	 xx2000002163
4 Disconnect the connectors from the drive board. • D6.X1 • D6.DC+ • D6.DC- • D6.X4 • D6.X2 • D6.X5	Tweezers  xx2000002164

Removing the axis-6 joint unit

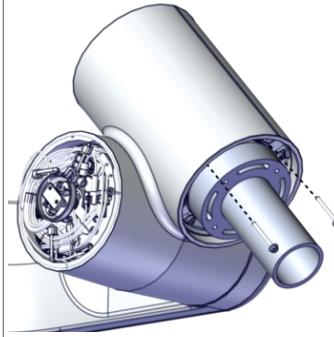
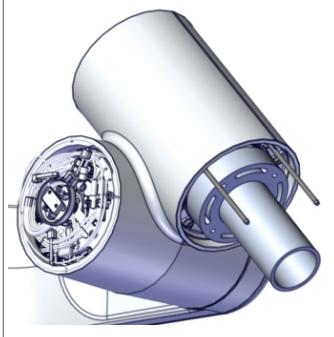
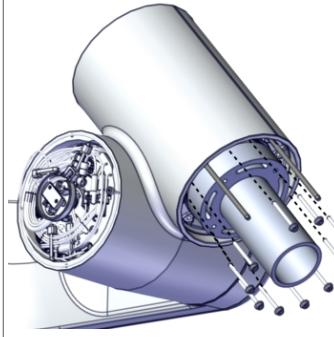
Action	Note
1 Fit the lifting aid to the joint unit, on the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002168 Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.

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5 Repair

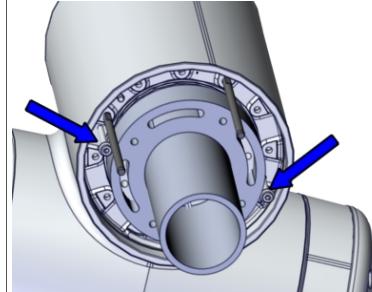
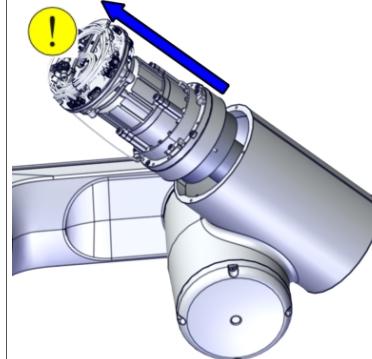
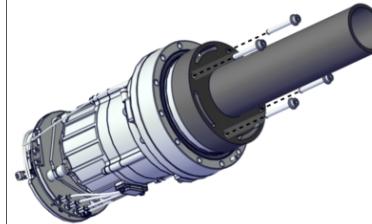
5.3.6 Replacing the axis-5 cabling

Continued

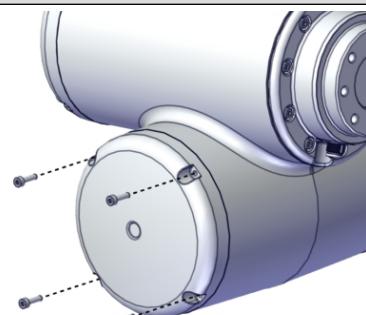
	Action	Note
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002170 <p>Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.</p>
3	<p>Fit two guide pins to the axis-6 joint unit.</p>	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  xx2100000328
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000329

Continues on next page

5.3.6 Replacing the axis-5 cabling
Continued

Action	Note
5 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2100000330
6 Remove the joint unit from the tubular. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002169 Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.
7 Remove the lifting aid and guide pins.	 xx2000001957

Removing the axis-5 cover

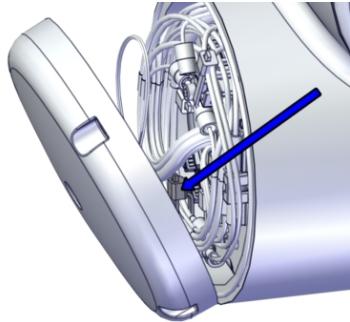
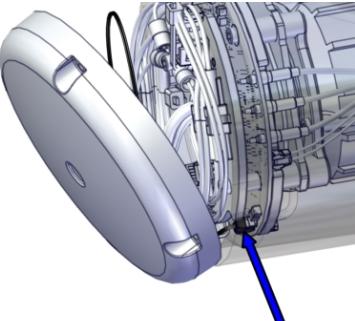
Action	Note
1 Remove the cover by removing the four screws.	 xx2000002132

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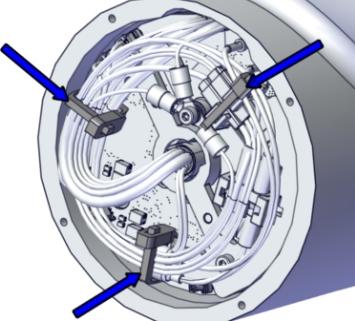
5 Repair

5.3.6 Replacing the axis-5 cabling

Continued

	Action	Note
2	 CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
3	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002133
4	Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002134

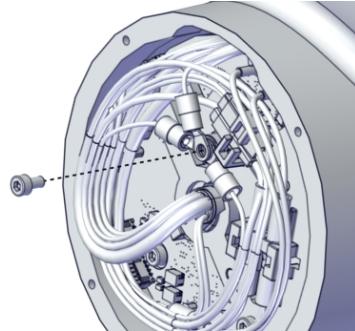
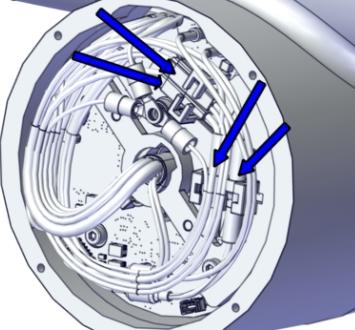
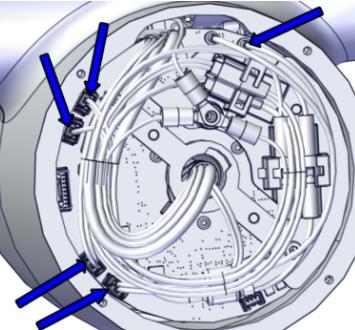
Disconnecting the axis-5 joint unit cabling

	Action	Note
1	Cut the cable ties.	 xx2000002135

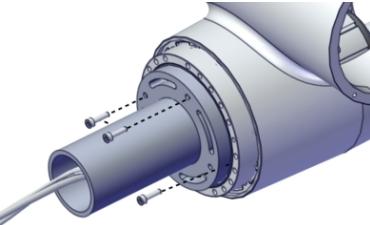
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5.3.6 Replacing the axis-5 cabling

Continued

Action	Note
2 Remove the functional and protective earth cables by removing the screw.	 xx2000002136
3 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J5/6.DC+ • J5/6.DC- • J5/6.CS • J5/6.CP 	 xx2000002137
4 Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D4/5.X1 • D5.DC+ • D5.DC- • D4/5.X4 • D5.X2 • D4/5.X5 <p> CAUTION Use tweezers to unlock connectors and pull them off.</p>	Tweezers  xx2000002138

Removing the axis-5 joint unit

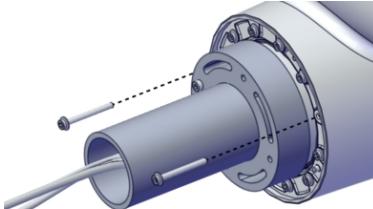
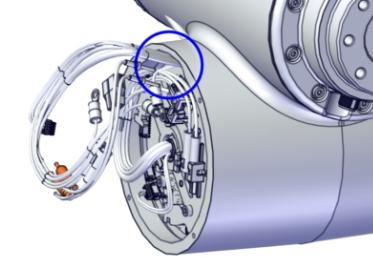
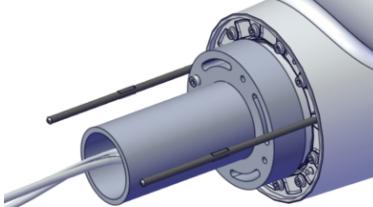
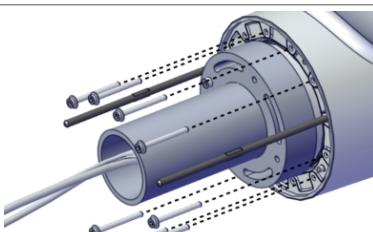
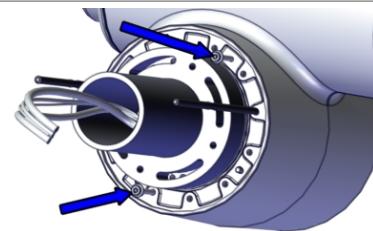
Action	Note
1 Fit the lifting aid to the joint unit, on the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002139

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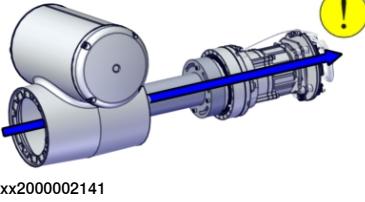
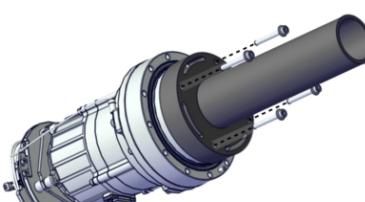
5 Repair

5.3.6 Replacing the axis-5 cabling

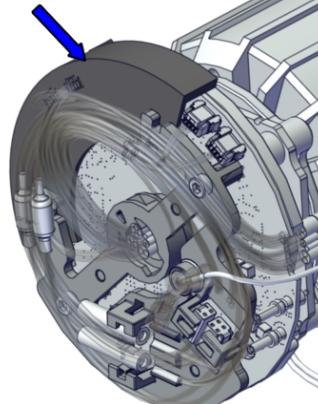
Continued

Action	Note
<p>2 Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002140
<p>3 Put the cabling at the slot in order not to squeeze it during removal of joint unit.</p>	 xx2100000284
<p>4 Fit two guide pins to the axis-5 joint unit.</p>	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2100000332
<p>5 Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000333
<p>6 Press the joint unit out of position using two of the previous attachment screws as removal tools.</p>	 xx2100000334

Continues on next page

Action	Note
7 Remove the joint unit from the tubular. ! CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002141
8 Remove the lifting aid and guide pins.	 xx2000001957

Removing the joint cable

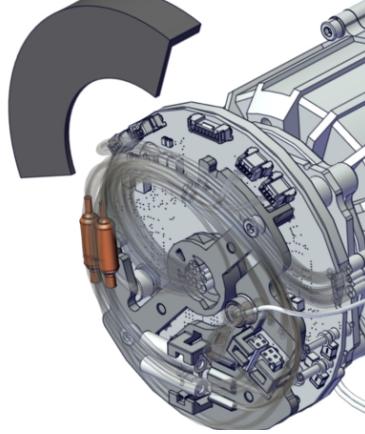
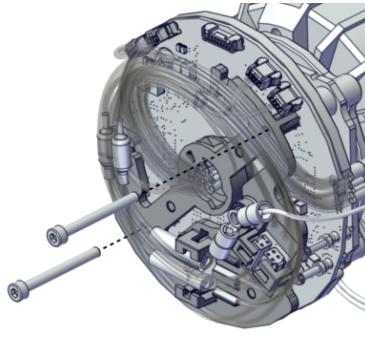
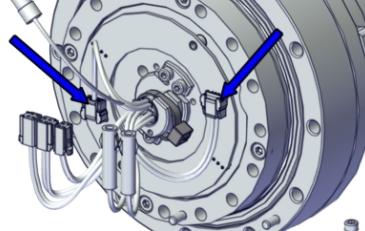
Action	Note
1 ! ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2 Fit the protection plate to the drive board unit. ! Tip Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001  xx2000002057

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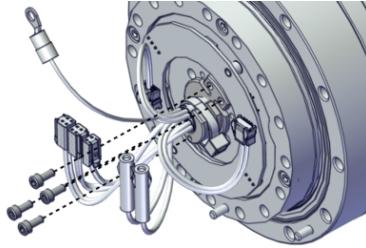
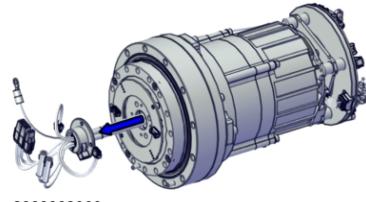
5 Repair

5.3.6 Replacing the axis-5 cabling

Continued

	Action	Note
3	Cut the cable tie at the drive board.	 xx2000002058
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. <ul style="list-style-type: none"> • TQ.A • TQ.B 	 xx2000002053

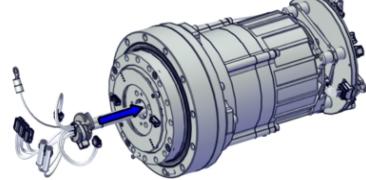
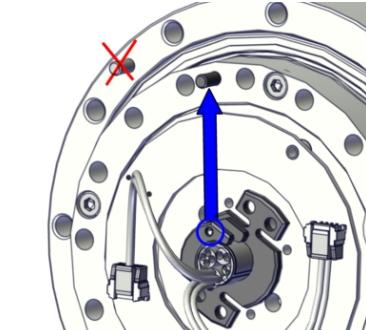
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	Action	Note
7	Remove the cable plate by removing the attachment screws.	 xx2000002049
8	Remove the joint cable from the hollow shaft from the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002060

Refitting the joint cabling

Use these procedures to refit the joint-5 cabling.

Refitting the joint cable

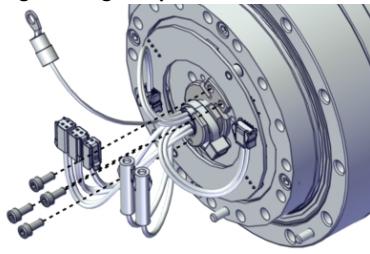
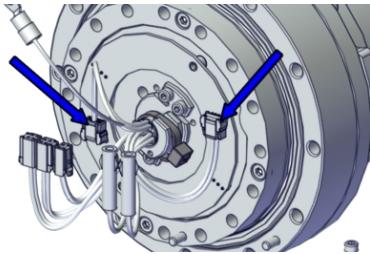
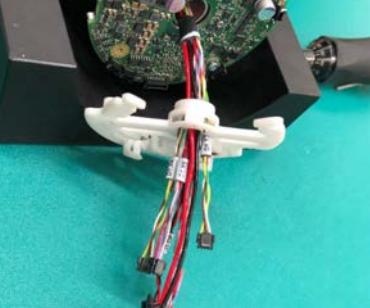
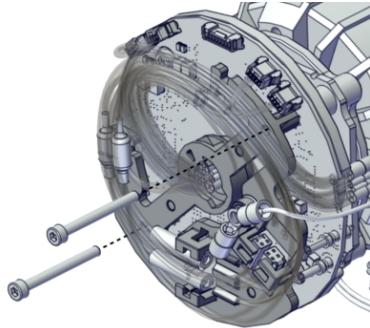
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2	Place the joint cable through the hollow shaft from the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002048
3	Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.	 xx2000002051

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5 Repair

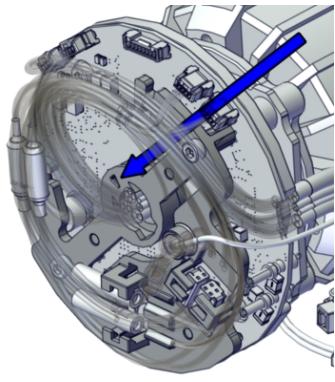
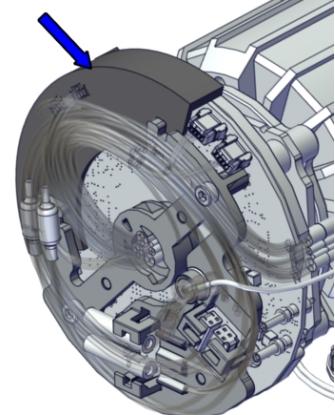
5.3.6 Replacing the axis-5 cabling

Continued

	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	<p>Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002049</p>
5	<p>Connect the two connectors to the torque sensor board.</p> <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 <p>xx2000002053</p>
6	Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 <p>xx2000002056</p> <p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002055</p>

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5.3.6 Replacing the axis-5 cabling
Continued

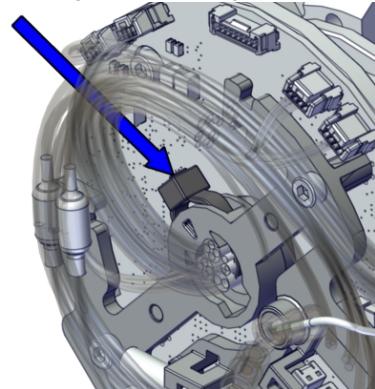
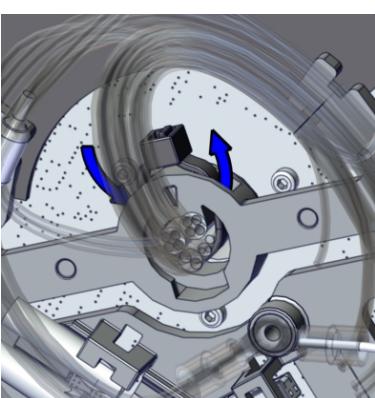
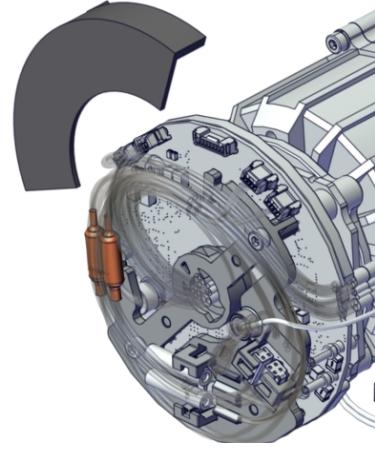
	Action	Note
7	<p>Keep the cabling loose, making sure not to twist or strain it.</p> <p>Use the cable tie to pre-fix the cable by hand.</p>	 xx2100000507
8	Fit the protection plate to the drive board unit.	<p>Protection plate: 3HAC077790-001</p>  xx2000002057

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5 Repair

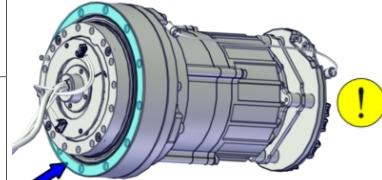
5.3.6 Replacing the axis-5 cabling

Continued

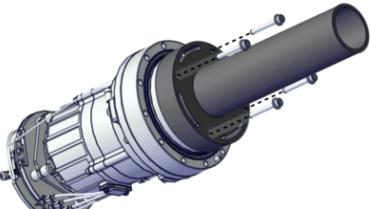
	Action	Note
9	<p>Secure the cables to the cable support with a cable tie, using a cable tie gun.</p> <p>Assembly direction for the cable tie is shown in the figure.</p>	<p>Cable tie: 3HAC075545-001. For securing joint unit cable.</p> <p>Cable tie gun EVO7</p> <p>Setting for cable tie gun: 6.75.</p>  xx2000002058  xx2000002059
10	Remove the protection plate.	 xx2100000301

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Preparations before fitting the joint unit

	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i> .	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i> .	

Refitting the axis-5 joint unit and transition cabling

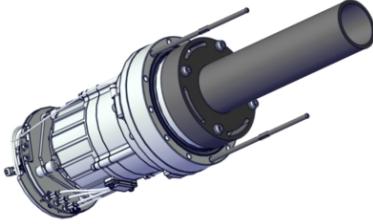
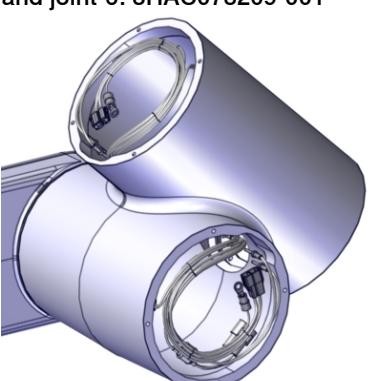
	Action	Note
1	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079143-001 Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957

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5 Repair

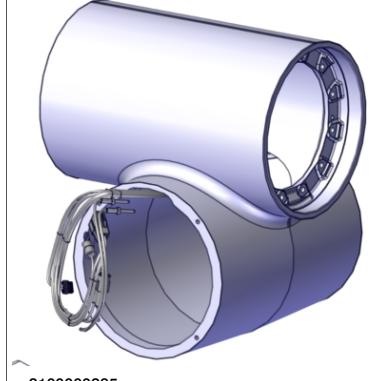
5.3.6 Replacing the axis-5 cabling

Continued

	Action	Note
2	Fit two guide pins to the joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  <p>xx2000002438</p>
3	Fit the transition cable between axis-5 and axis-6 joint units into the tilt.	<p>Cable harness, transition joint-5 and joint-6: 3HAC073209-001</p>  <p>xx2100000040</p>

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5.3.6 Replacing the axis-5 cabling
Continued

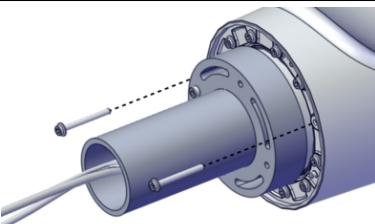
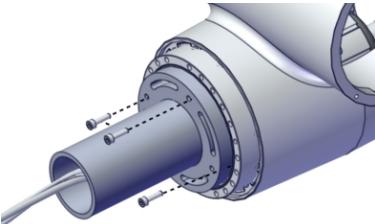
Action	Note
4 Place the cabling at the slot before refitting the joint unit.	 xx210000041
5 Fit the joint unit to the tilt, aligning the pin with the pin hole.	 xx2100000285
6 Secure the joint unit with new attachment screws.	CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.

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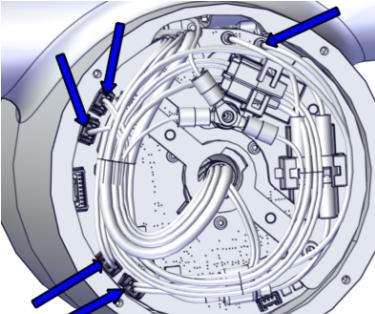
5 Repair

5.3.6 Replacing the axis-5 cabling

Continued

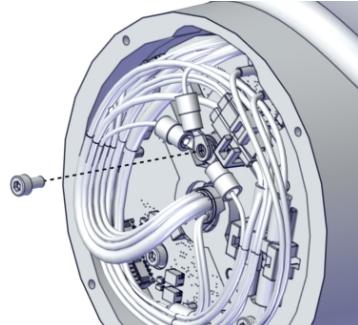
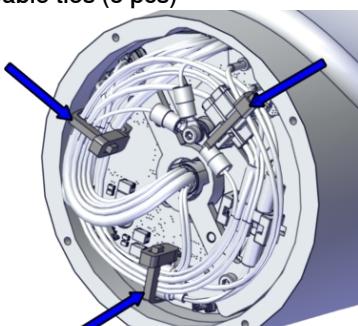
Action	Note
7 Remove the guide pins and secure the remaining two attachment screws.	 xx2000002140
8 Pre-tighten the screws crosswise.	
9 Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm.
10 Remove the lifting aid by removing the screws.	 xx2000002139
11 Clean pushed-out flange sealant, if any.	

Connecting the axis-5 joint unit cabling

Action	Note
1 Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D4/5.X1 to X1 • D5.DC+ to +DC • D5.DC- to Ground • D4/5.X4 to X4 • D5/4.X2 to X2 • D4/5.X5 to X5 	 xx2000002138
2 Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J5/6.DC+ to J6.DC+ • J5/6.DC- to J6.DC- • J5/6.CS to J6.CS • J5/6.CP to J6.CP 	 xx2000002137

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5.3.6 Replacing the axis-5 cabling
Continued

Action	Note
3 Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002136
4 Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002135

Preparations before fitting the joint unit

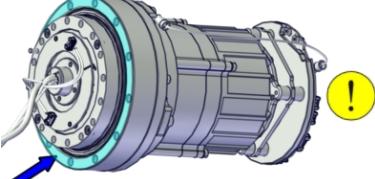
Action	Note
1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	

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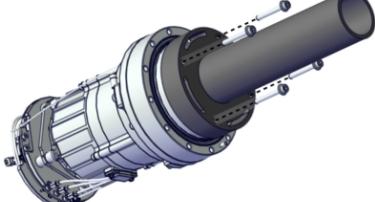
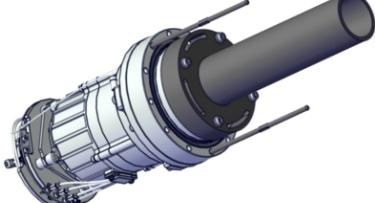
5 Repair

5.3.6 Replacing the axis-5 cabling

Continued

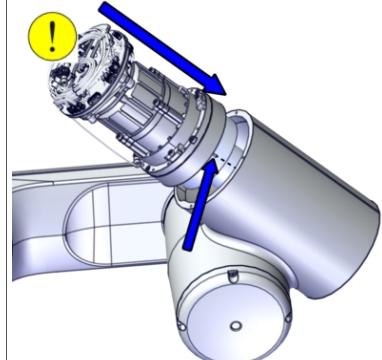
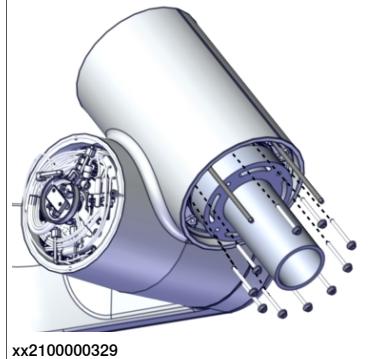
Action	Note
2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3 Apply a thin layer of flange sealant to the mounting surface. Do not contaminate the radial sealing with sealant.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i> .	

Refitting the axis-6 joint unit

Action	Note
1 Fit the lifting aid to the joint unit.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079143-001 Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
2 Fit two guide pins to the joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2000002438

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5.3.6 Replacing the axis-5 cabling
Continued

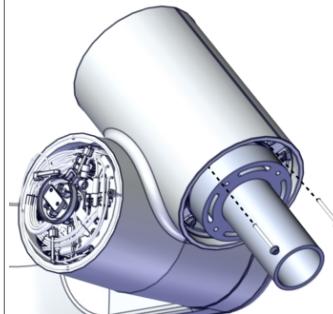
Action	Note
3 Place the cabling at the slot before refitting the joint unit.	 xx210000041
4 Fit the joint unit to the tilt, aligning the pin with the pin hole. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002195
5 Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+Pro-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx210000329

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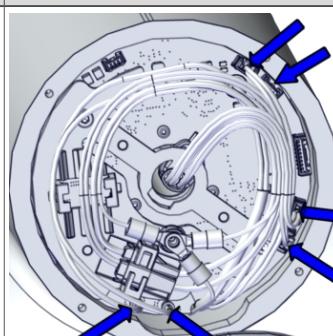
5 Repair

5.3.6 Replacing the axis-5 cabling

Continued

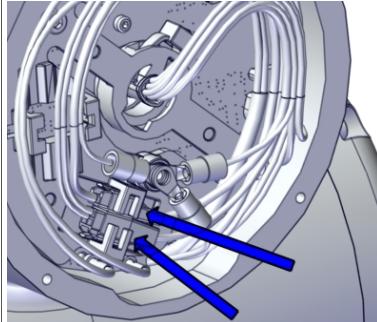
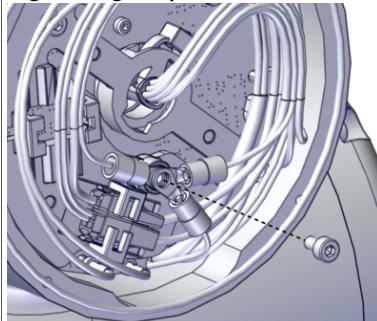
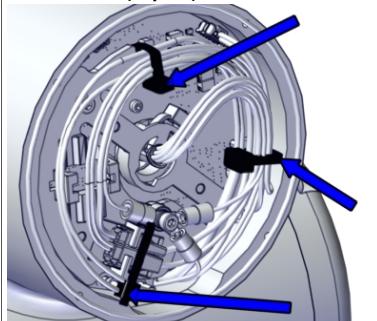
Action	Note
6 Remove the guide pins and secure the remaining two attachment screws.	 xx2000002170
7 Pre-tighten the screws crosswise.	
8 Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm.
9 Remove the lifting aid by removing the screws.	 xx2000002168
10 Clean pushed-out flange sealant, if any.	

Connecting the axis-6 joint unit cabling

Action	Note
1 Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D6.X1 to X1 • D6.DC+ to +DC • D6.DC- to Ground • D6.X4 to X4 • D6.X2 to X2 • D6.X5 to X5 	 xx2000002164

Continues on next page

5.3.6 Replacing the axis-5 cabling
Continued

Action	Note
2 Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J7.CS to J7.CS • J7.CP to J7.CP 	 xx2000002163
3 Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002162
4 Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002161

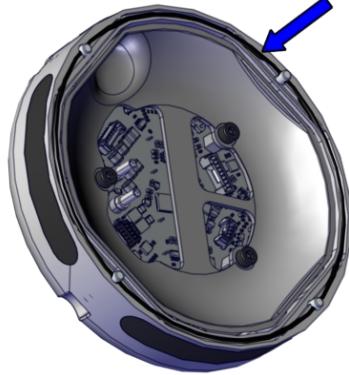
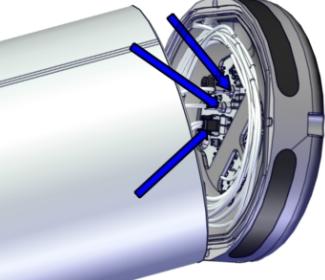
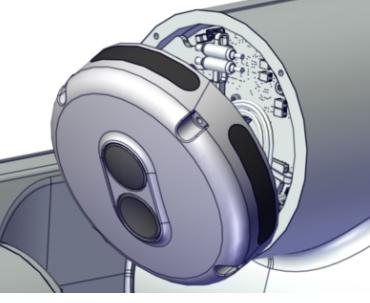
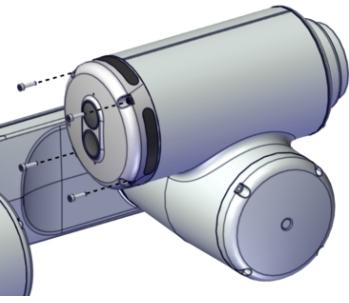
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5 Repair

5.3.6 Replacing the axis-5 cabling

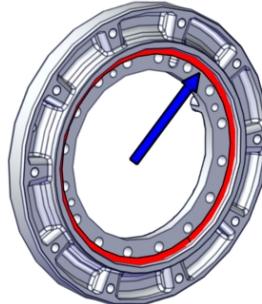
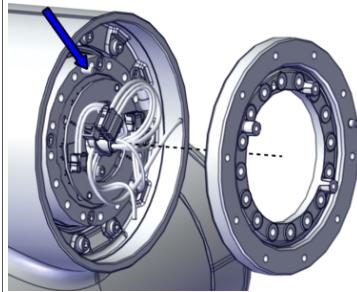
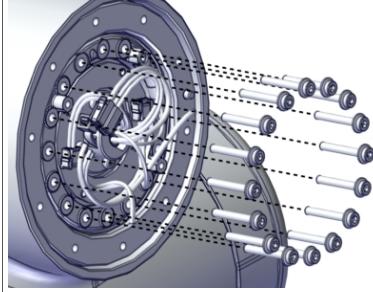
Continued

Refitting the arm-side interface

	Action	Note
1	<p>Fit the o-ring to its groove. Replace if damaged.</p>	<p>O-ring: 3HAC061327-051</p>  <p>xx2000002551</p>
2	<p>Place the arm-side interface at mounting position and reconnect the connectors.</p> <ul style="list-style-type: none"> • ASI.DC+ • ASI.DC- • ASI.X1 <p>The correct orientation of the arm-side interface is with the convex button in upper position.</p> <p> Note</p> <p>Do not leave the arm-side interface in location without being secured with the attachment screws.</p>	 <p>xx2100000335</p>  <p>xx2100000336</p>
3	Refit the arm-side interface with four screws.	<p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm</p>  <p>xx2000002550</p>

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Refitting the tool flange adapter

	Action	Note
1	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the adapter mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000002196
2	Refit the tool flange adapter, aligning the pin with the pin hole.	Axis-6 inner flange: 3HAC073952-001  xx2000002167
3	Secure with screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) Tightening torque: 1.8 Nm.  xx2000002165

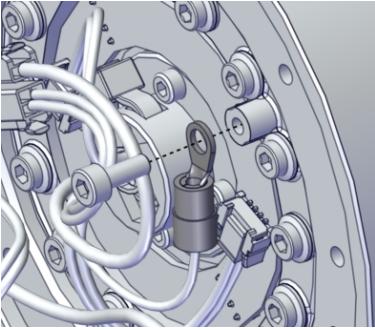
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5 Repair

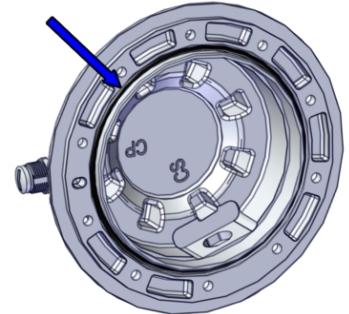
5.3.6 Replacing the axis-5 cabling

Continued

Connecting the tool flange functional earth cable

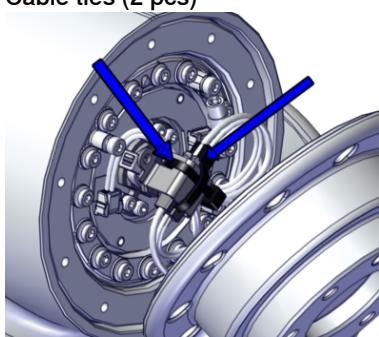
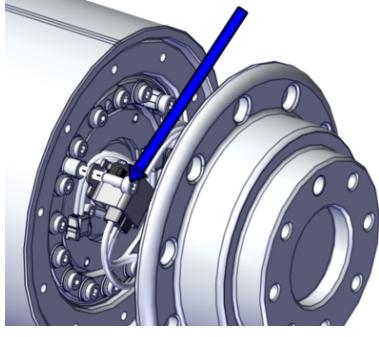
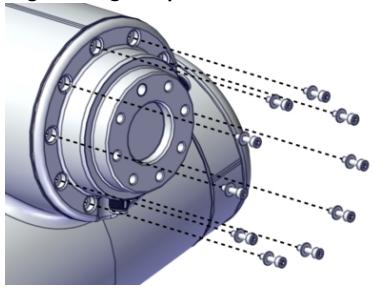
	Action	Note
1	Secure the cable for functional earth to the tool flange adapter with a screw.	 xx2000002159

Refitting the tool flange

	Action	Note
1	Check the o-ring on the tool flange and lubricate with grease. Replace if damaged.	Axis-6 flange: 3HAC073953-001 O-ring: 3HAB3772-182 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002197
2	Place the tool flange at mounting position and reconnect the CP/CS connectors.	 xx2000002158

Continues on next page

5.3.6 Replacing the axis-5 cabling
Continued

	Action	Note
3	Fit the connectors to the cable bracket and secure the connectors with two cable ties.	<p>Cable ties (2 pcs)</p>  <p>xx2000002157</p>
4	Refit the cable bracket with the screw.	<p>Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (1 pcs) Tightening torque: 0.8 Nm.</p>  <p>xx2000002156</p>
5	Refit and secure the tool flange with screws and washers.	<p>Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (10 pcs) Spring washer: 7x3.2x0.6 Steel (10 pcs) Tightening torque: 1.8 Nm.</p>  <p>xx2000002155</p>

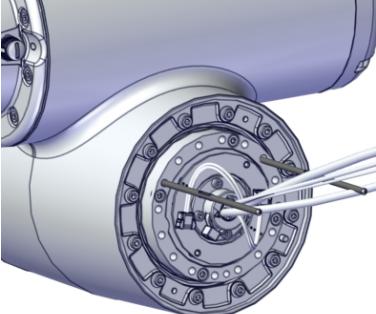
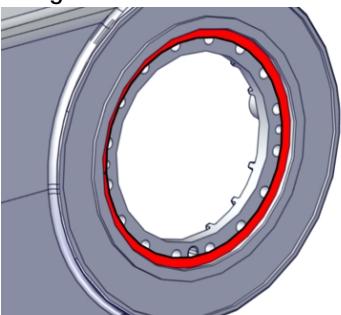
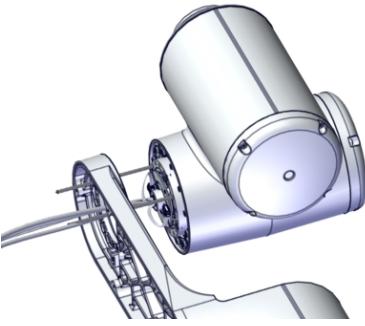
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5 Repair

5.3.6 Replacing the axis-5 cabling

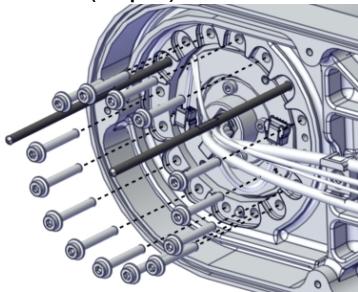
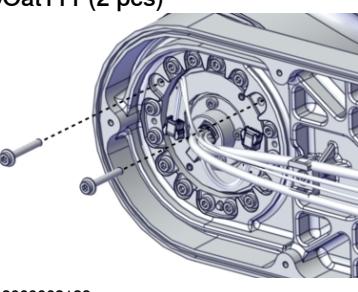
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Refitting the tilt

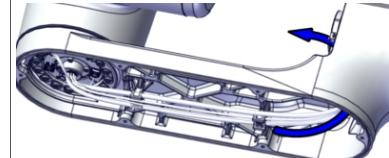
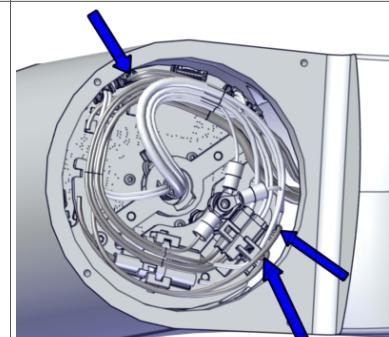
	Action	Note
1	Fit two guide pins to the axis-5 joint.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002146
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the tubular mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000002147
3	Lift the tilt into mounting position while inserting the cabling into the tubular.	
4	Slide the tilt into place on the guide pins.	 xx2000002131

Continues on next page

5.3.6 Replacing the axis-5 cabling
Continued

	Action	Note
5	Secure the tilt to the tubular with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (14 pcs)  xx2000002130
6	Remove the guide pins and fasten the remaining two screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (2 pcs)  xx2000002128
7	Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.

Connecting the tilt cabling

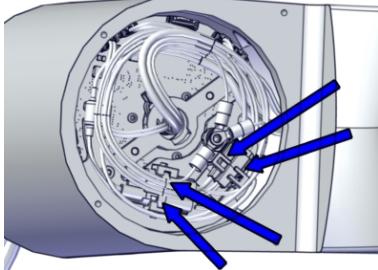
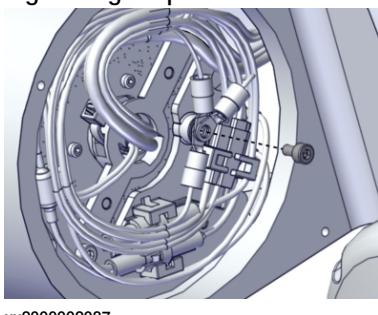
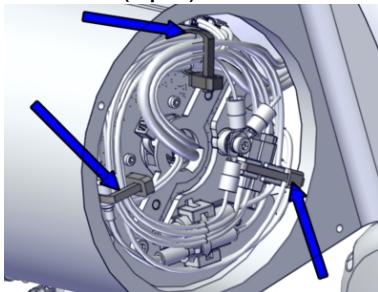
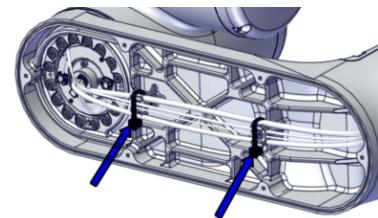
	Action	Note
1	Insert the cabling into the tubular.	 xx2000002148
2	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D3/4.X2 to X2 • D3/4.DC- to Ground • D3/4.DC+ to +DC 	 xx2000002125

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5 Repair

5.3.6 Replacing the axis-5 cabling

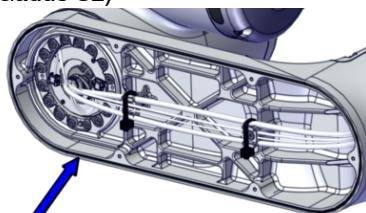
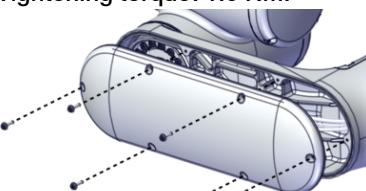
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	Action	Note
3	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J4/5.DC+ to J5/6.DC+ • J4/5.DC- to J5/6.DC- • J4/5.CS to J5/6.CS • J4/5.CP to J5/6.CP 	 xx2000002089
4	Secure the cables for functional earth and protective earth with a screw.	<p>Hex socket head cap screw: M3x6 (1 pcs).</p> <p>Tightening torque: 0.8 Nm.</p>  xx2000002087
5	Secure the cabling with cable ties.	<p>Cable ties (3 pcs)</p>  xx2000002086  xx2000002124

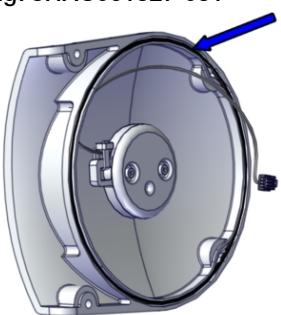
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5.3.6 Replacing the axis-5 cabling
Continued

Refitting the tubular cover

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-043 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002149
2	Refit the cover with new attachment screws.	Flange socket head screw with glue: 3HAB3413-312 M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included. Tightening torque: 1.6 Nm.  xx2000002123

Refitting the axis-4 cover

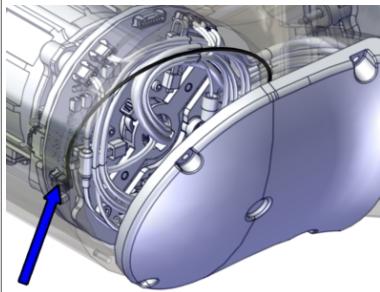
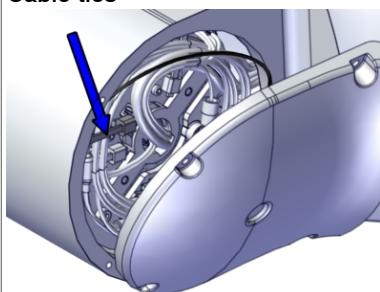
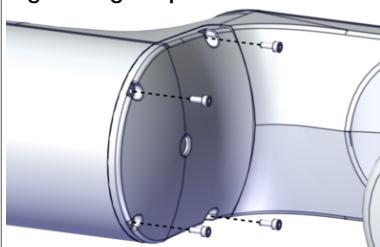
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002092

Continues on next page

5 Repair

5.3.6 Replacing the axis-5 cabling

Continued

	Action	Note
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	Tweezers  xx2000002085
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000002084
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.2 Nm  xx2000002083

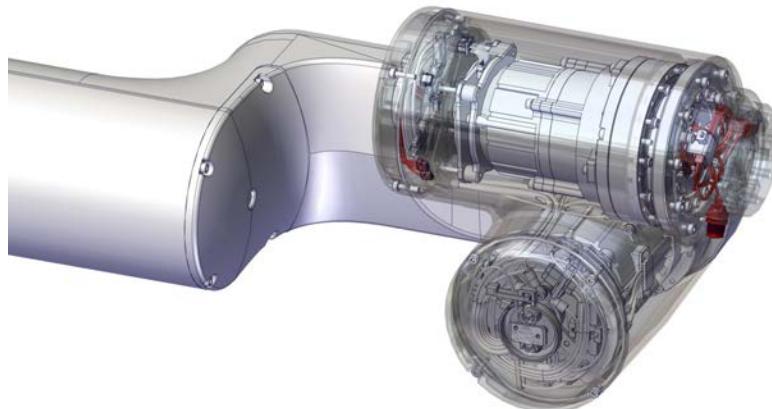
Concluding procedure

	Action	Note
1	Calibrate the joint unit torque sensor.	See Calibration on page 719
2	 DANGER Make sure all safety requirements are met when performing the first test run.	

5.3.7 Replacing the axis-6 cabling

Location of the cable harness

The cable harness is located as shown in the figure.



xx2100000062

Summary of the replacement procedure

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

- 1 Remove the tool flange.
- 2 Remove the tool flange adapter.
- 3 Remove the axis-6 cover.
- 4 Remove the axis-6 joint unit.
- 5 Replace the cabling.

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Cable harness, joint 6	3HAC073208-001	Also order new Cable tie: 3HAC075545-001.
Cable tie	3HAC075545-001	For securing joint unit cable.

Continues on next page

5 Repair

5.3.7 Replacing the axis-6 cabling

Continued

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077789-001	For joint units on axes 4, 5 and 6. Attachment screws M3x12 (4 pcs) are enclosed.
Guide pin, M3x110	3HAC077787-001	Always use guide pins in pairs. For joint units on axes 4, 5 and 6.
Tweezers	-	Used to handle drive board connectors.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

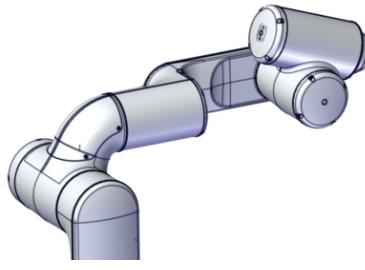
Required consumables

Consumable	Article number	Note
Cable ties	-	
O-ring	3HAC061327-051	Arm-side interface Replace if damaged.
O-ring	3HAB3772-182	Tool flange
Grease	3HAC042536-001	Shell Gadus S2
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574

Removing the joint cabling

Use these procedures to remove the joint-6 cabling.

Preparations before removing the cabling

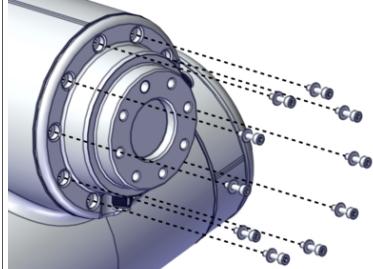
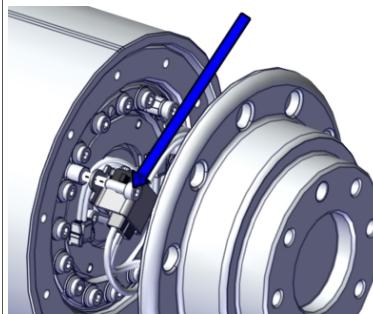
	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none">• Axis 1: No significance.• Axis 2: No significance.• Axis 3: No significance.• Axis 4: No significance.• Axis 5: approximately +20°• Axis 6: 0° (home position) <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	 xx2100000043

Continues on next page

5.3.7 Replacing the axis-6 cabling
Continued

Action	Note
2  CAUTION Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the tool flange

Action	Note
1 Remove the tool flange screws and washers.	 xx2000002155
2  CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
3 Loosen the tool flange and remove the cable bracket by removing the screw.	 xx2000002156
4 Cut the cable ties.	 xx2000002157

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5 Repair

5.3.7 Replacing the axis-6 cabling

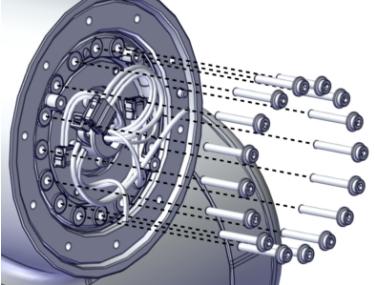
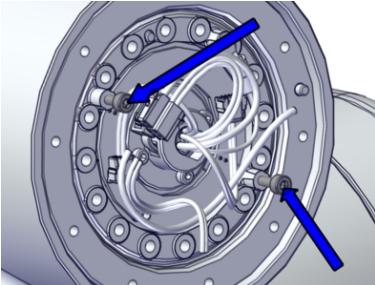
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Action	Note
5 Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

Disconnecting the tool flange functional earth cable

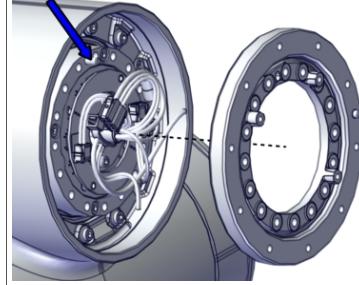
Action	Note
1 Remove the functional earth cable by removing the screw.	 xx2000002159

Removing the tool flange adapter

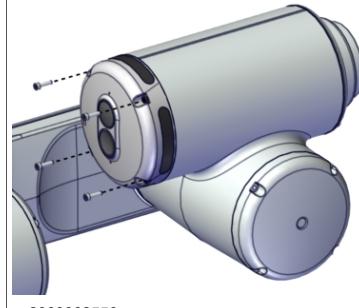
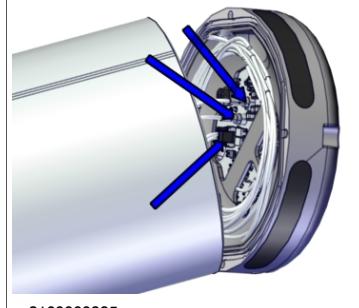
Action	Note
1 Remove the tool flange adapter screws.	 xx2000002165
2 Press the adapter out of position by using two of the attachment screws as removal tools.	 xx2000002166

Continues on next page

5.3.7 Replacing the axis-6 cabling
Continued

Action	Note
3 Remove the tool flange adapter.	 xx2000002167

Removing the arm-side interface

Action	Note
1  CAUTION Make sure that all supplies for electrical power are turned off.	
2  CAUTION There is cabling connected between the arm-side interface and the joint unit drive board. Open the arm-side interface with care to avoid damage to the cabling or the connector(s). Do not leave the arm-side interface in location without being secured with the attachment screws.	
3 Remove the attachment screws.	 xx2000002550
4 Loosen the arm-side interface carefully and disconnect the connectors from it. <ul style="list-style-type: none"> • ASI.DC+ • ASI.DC- • ASI.X1 	 xx2100000335

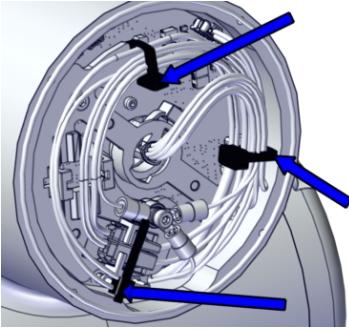
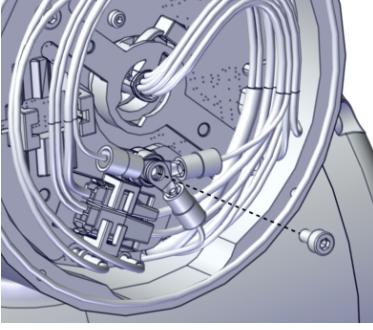
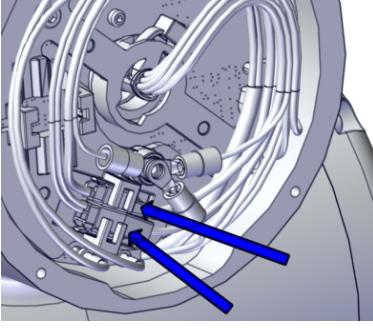
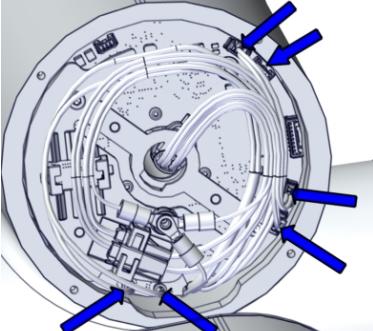
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5 Repair

5.3.7 Replacing the axis-6 cabling

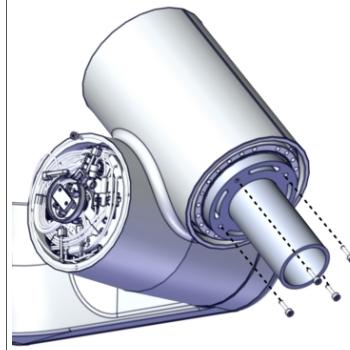
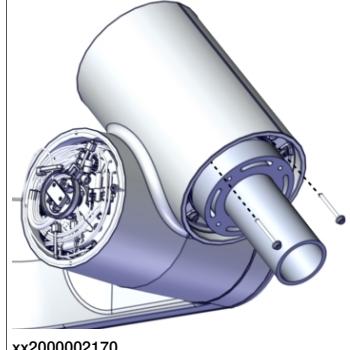
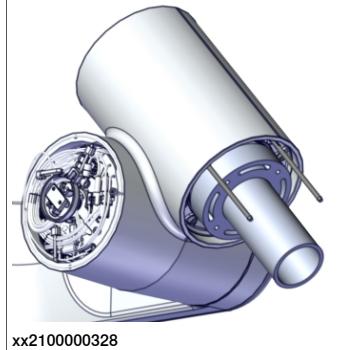
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Disconnecting the axis-6 joint unit cabling

	Action	Note
1	Cut the cable ties.	 xx2000002161
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002162
3	Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J7.CS • J7.CP 	 xx2000002163
4	Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D6.X1 • D6.DC+ • D6.DC- • D6.X4 • D6.X2 • D6.X5 <p> CAUTION Use tweezers to unlock connectors and pull them off.</p>	Tweezers  xx2000002164

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Removing the axis-6 joint unit

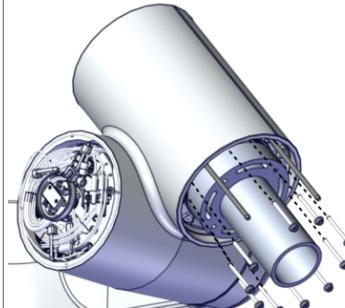
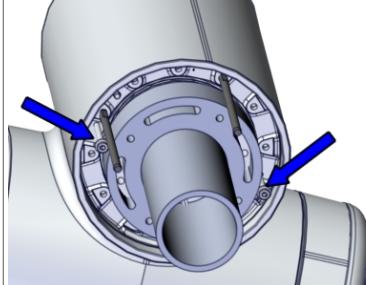
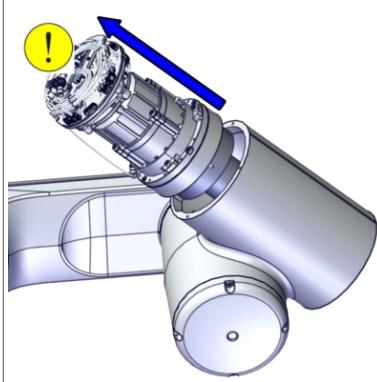
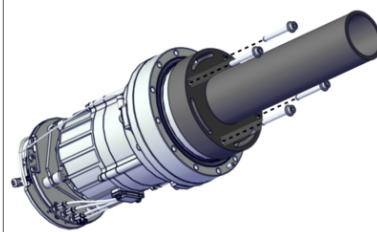
	Action	Note
1	<p>Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)</p>  <p>xx2000002168</p> <p>Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.</p>
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx2000002170</p> <p>Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.</p>
3	Fit two guide pins to the axis-6 joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  <p>xx2100000328</p>

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5 Repair

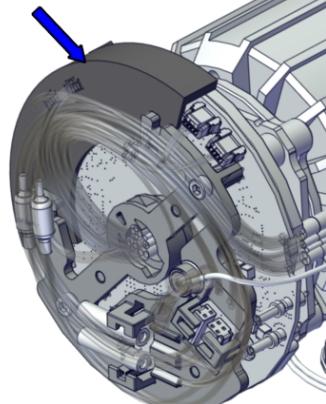
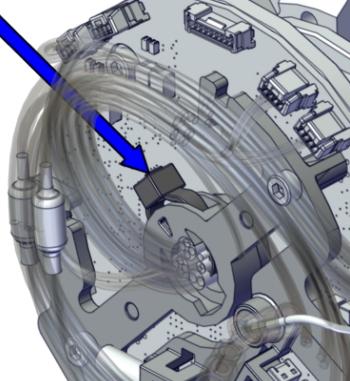
5.3.7 Replacing the axis-6 cabling

Continued

	Action	Note
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000329
5	<p>Press the joint unit out of position using two of the previous attachment screws as removal tools.</p>	 xx2100000330
6	<p>Remove the joint unit from the tubular.</p> <p>CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002169 Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.
7	<p>Remove the lifting aid and guide pins.</p>	 xx2000001957

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Removing the joint cable

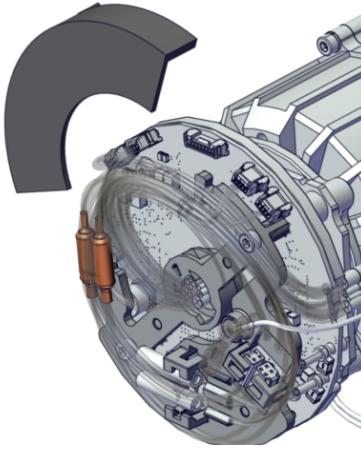
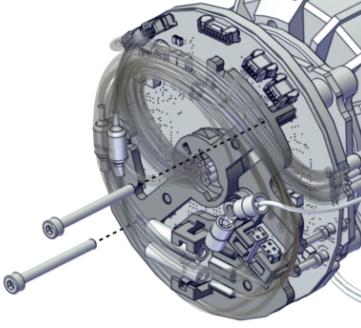
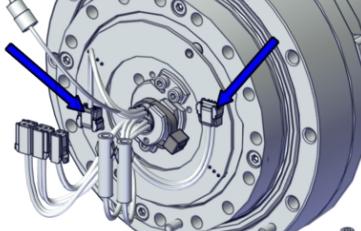
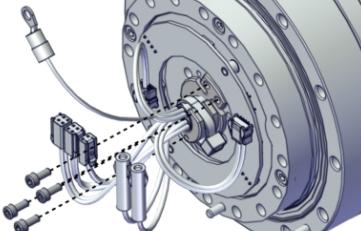
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44.</i>	
2	 Tip Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001  xx2000002057
3	Cut the cable tie at the drive board.	 xx2000002058

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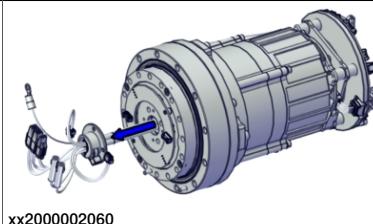
5 Repair

5.3.7 Replacing the axis-6 cabling

Continued

	Action	Note
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. <ul style="list-style-type: none"> • TQ.A • TQ.B 	 xx2000002053
7	Remove the cable plate by removing the attachment screws.	 xx2000002049

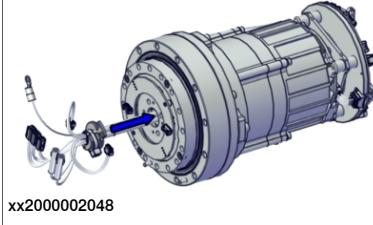
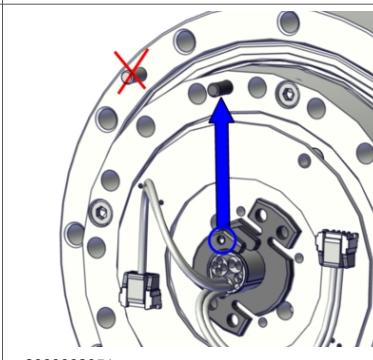
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	Action	Note
8	<p>Remove the joint cable from the hollow shaft from the torque sensor side.</p> <p>! CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	

Refitting the joint cabling

Use these procedures to refit the joint-6 cabling.

Refitting the joint cable

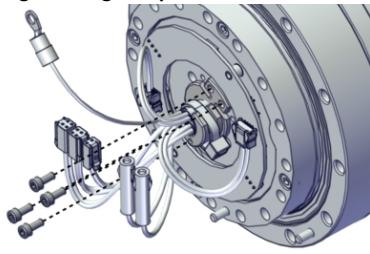
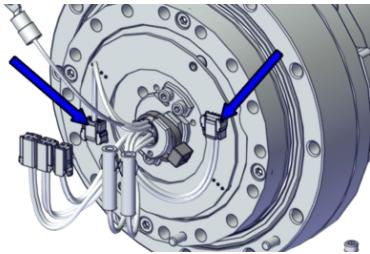
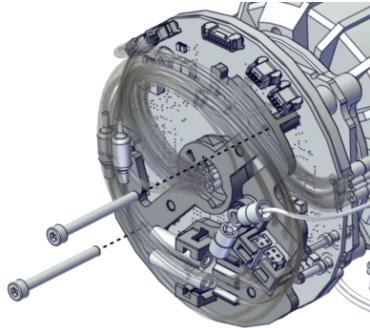
	Action	Note
1	<p>! ELECTROSTATIC DISCHARGE (ESD)</p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	
2	<p>Place the joint cable through the hollow shaft from the torque sensor side.</p> <p>! CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	
3	<p>Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.</p>	

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5 Repair

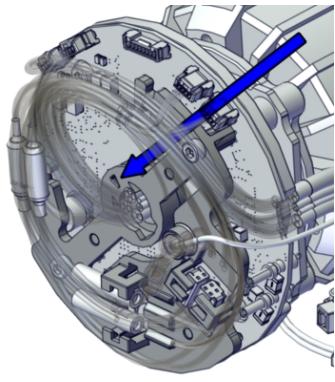
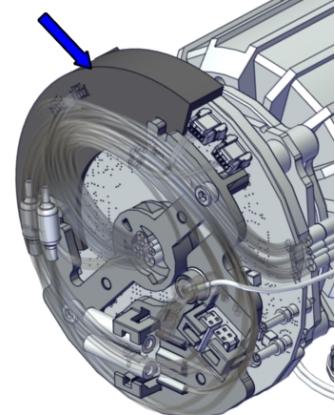
5.3.7 Replacing the axis-6 cabling

Continued

	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	<p>Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002049</p>
5	<p>Connect the two connectors to the torque sensor board.</p> <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 <p>xx2000002053</p>
6	Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 <p>xx2000002056</p> <p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002055</p>

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5.3.7 Replacing the axis-6 cabling
Continued

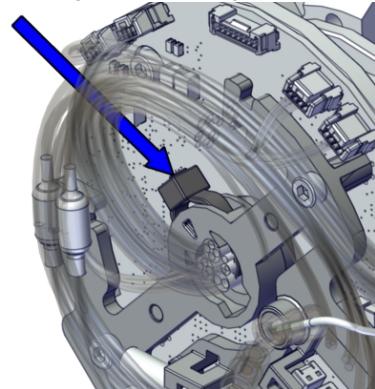
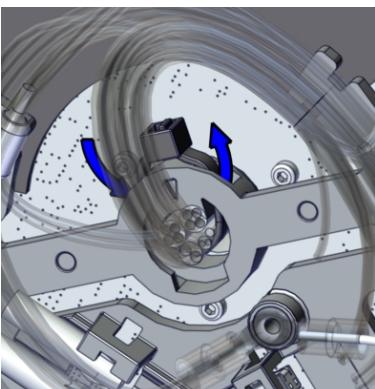
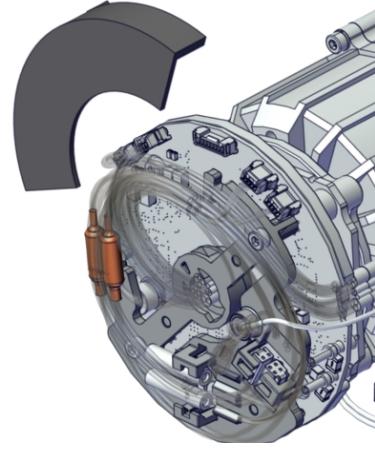
	Action	Note
7	<p>Keep the cabling loose, making sure not to twist or strain it.</p> <p>Use the cable tie to pre-fix the cable by hand.</p>	 xx2100000507
8	Fit the protection plate to the drive board unit.	<p>Protection plate: 3HAC077790-001</p>  xx2000002057

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5 Repair

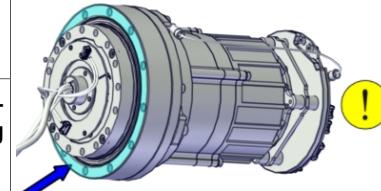
5.3.7 Replacing the axis-6 cabling

Continued

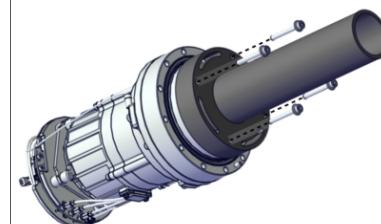
	Action	Note
9	<p>Secure the cables to the cable support with a cable tie, using a cable tie gun.</p> <p>Assembly direction for the cable tie is shown in the figure.</p>	<p>Cable tie: 3HAC075545-001. For securing joint unit cable.</p> <p>Cable tie gun EVO7</p> <p>Setting for cable tie gun: 6.75.</p>  <p>xx2000002058</p>  <p>xx2000002059</p>
10	Remove the protection plate.	 <p>xx2100000301</p>

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Preparations before fitting the joint 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 44 .	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	

Refitting the axis-6 joint unit

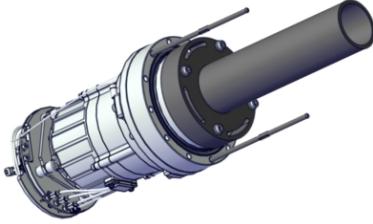
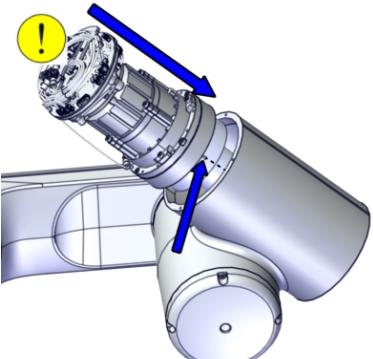
	Action	Note
1	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079143-001 Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957

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5 Repair

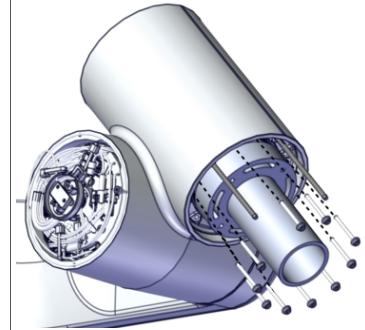
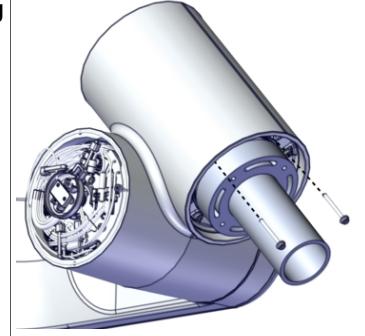
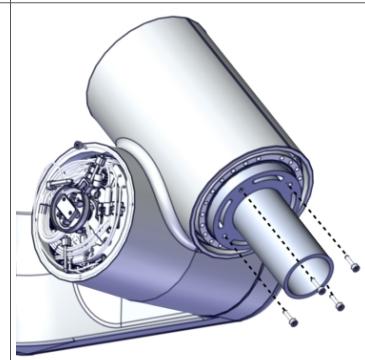
5.3.7 Replacing the axis-6 cabling

Continued

	Action	Note
2	Fit two guide pins to the joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  <p>xx2000002438</p>
3	Place the cabling at the slot before refitting the joint unit.	 <p>xx2100000041</p>
4	<p>Fit the joint unit to the tilt, aligning the pin with the pin hole.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000002195</p>

Continues on next page

5.3.7 Replacing the axis-6 cabling
Continued

Action	Note
5 Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+Pro-COat111, with NYPLAS glue , 12 pcs</p> <p>Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2100000329</p>
6 Remove the guide pins and secure the remaining two attachment screws.	 <p>xx2000002170</p>
7 Pre-tighten the screws crosswise.	
8 Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm.
9 Remove the lifting aid by removing the screws.	 <p>xx2000002168</p>
10 Clean pushed-out flange sealant, if any.	

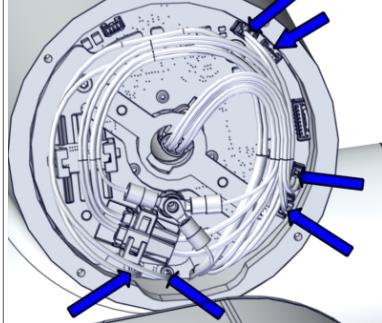
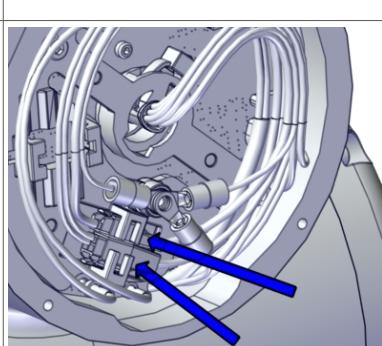
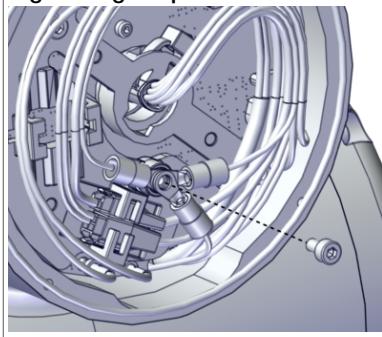
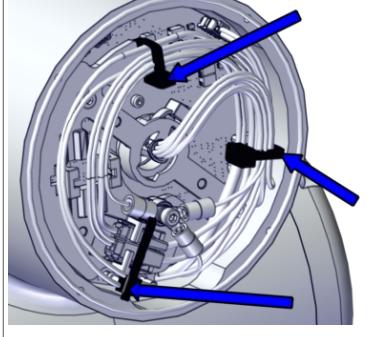
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5 Repair

5.3.7 Replacing the axis-6 cabling

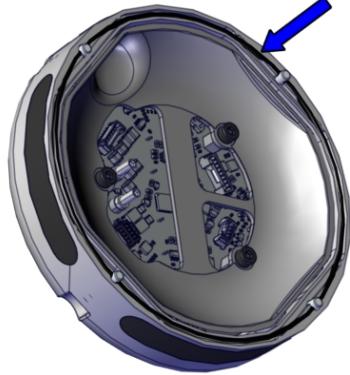
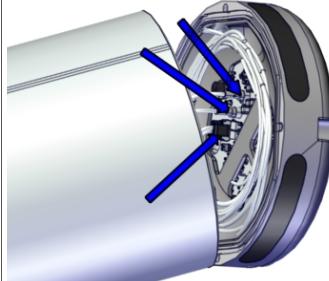
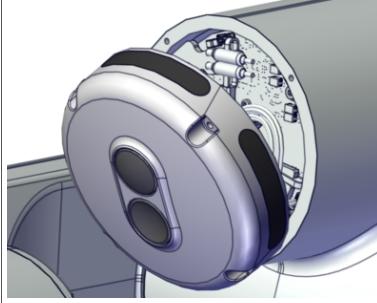
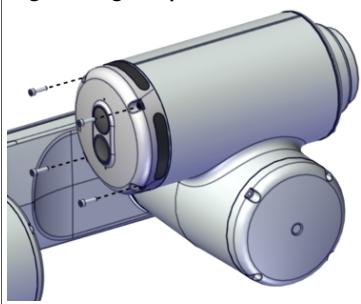
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Connecting the axis-6 joint unit cabling

Action	Note
<p>1 Reconnect the connectors to the drive board.</p> <ul style="list-style-type: none"> • D6.X1 to X1 • D6.DC+ to +DC • D6.DC- to Ground • D6.X4 to X4 • D6.X2 to X2 • D6.X5 to X5 	 xx2000002164
<p>2 Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J7.CS to J7.CS • J7.CP to J7.CP 	 xx2000002163
<p>3 Secure the cables for functional earth and protective earth with a screw.</p>	<p>Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.</p>  xx2000002162
<p>4 Secure the cabling with cable ties.</p>	<p>Cable ties (3 pcs)</p>  xx2000002161

Continues on next page

Refitting the arm-side interface

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002551
2	Place the arm-side interface at mounting position and reconnect the connectors. <ul style="list-style-type: none"> • ASI.DC+ • ASI.DC- • ASI.X1 <p>The correct orientation of the arm-side interface is with the convex button in upper position.</p> <p> Note</p> <p>Do not leave the arm-side interface in location without being secured with the attachment screws.</p>	 xx2100000335  xx2100000336
3	Refit the arm-side interface with four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002550

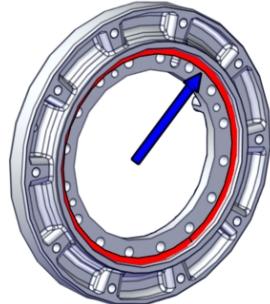
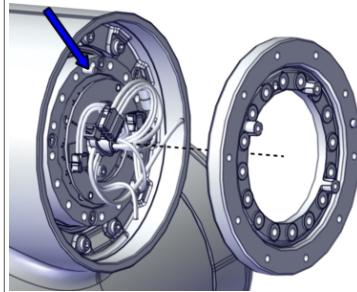
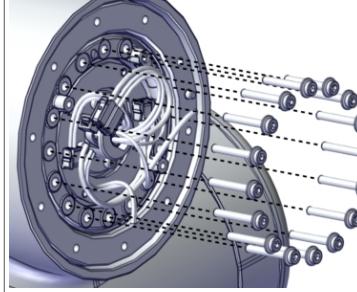
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5 Repair

5.3.7 Replacing the axis-6 cabling

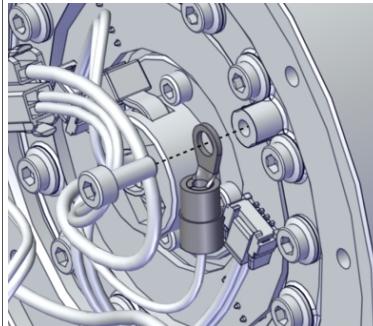
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Refitting the tool flange adapter

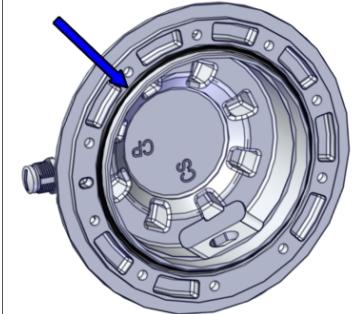
	Action	Note
1	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the adapter mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000002196
2	Refit the tool flange adapter, aligning the pin with the pin hole.	Axis-6 inner flange: 3HAC073952-001  xx2000002167
3	Secure with screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) Tightening torque: 1.8 Nm.  xx2000002165

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Connecting the tool flange functional earth cable

	Action	Note
1	Secure the cable for functional earth to the tool flange adapter with a screw.	 xx2000002159

Refitting the tool flange

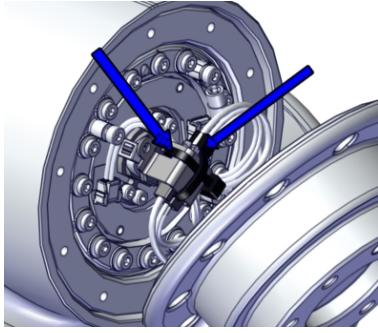
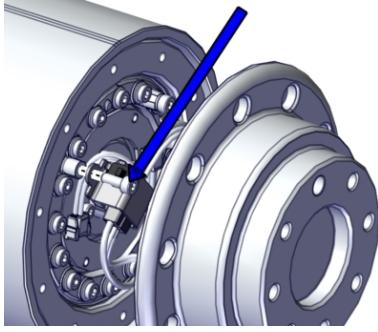
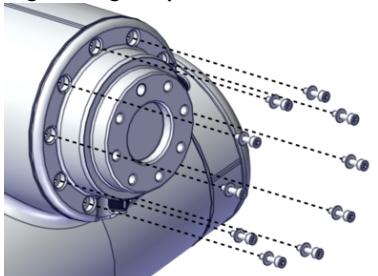
	Action	Note
1	Check the o-ring on the tool flange and lubricate with grease. Replace if damaged.	Axis-6 flange: 3HAC073953-001 O-ring: 3HAB3772-182 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002197
2	Place the tool flange at mounting position and reconnect the CP/CS connectors.	 xx2000002158

Continues on next page

5 Repair

5.3.7 Replacing the axis-6 cabling

Continued

Action	Note
3 Fit the connectors to the cable bracket and secure the connectors with two cable ties.	Cable ties (2 pcs)  xx2000002157
4 Refit the cable bracket with the screw.	Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (1 pcs) Tightening torque: 0.8 Nm.  xx2000002156
5 Refit and secure the tool flange with screws and washers.	Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (10 pcs) Spring washer: 7x3.2x0.6 Steel (10 pcs) Tightening torque: 1.8 Nm.  xx2000002155

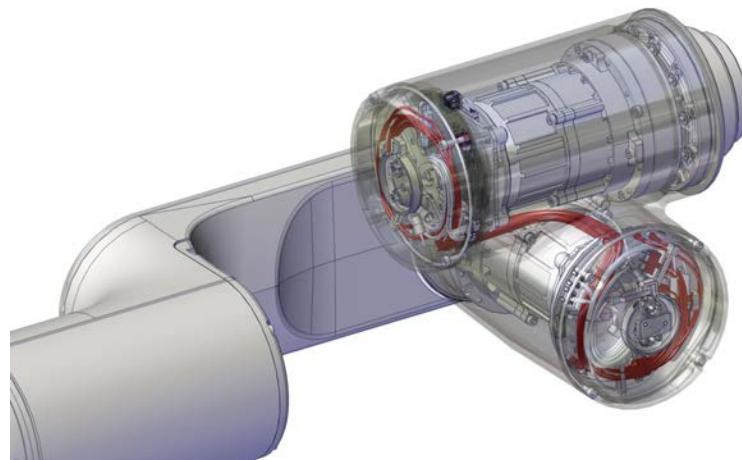
Concluding procedure

Action	Note
1 Calibrate the joint unit torque sensor.	See Calibration on page 719
2  DANGER Make sure all safety requirements are met when performing the first test run.	

5.3.8 Replacing the axis-5 to axis-6 transition cabling

Location of the cable harness

The cable harness is located as shown in the figure.



xx2100000091

Summary of the replacement procedure

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

- 1 Remove the tubular cover.
- 2 Separate the cabling between the tubular and the tilt (at the axis-4 joint unit).
- 3 Remove the tilt and place on a workbench.
- 4 Remove the axis-6 joint unit.
- 5 Remove the axis-5 cover.
- 6 Remove the axis-5 joint unit. Move the cabling from old to new joint unit.
- 7 Replace the axis-5 to axis-6 transition cabling.

Replacing the axis-5 to axis-6 transition cabling

The replacement procedure is identical to replacing the axis-5 joint unit.

Follow procedure [Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling on page 654](#).

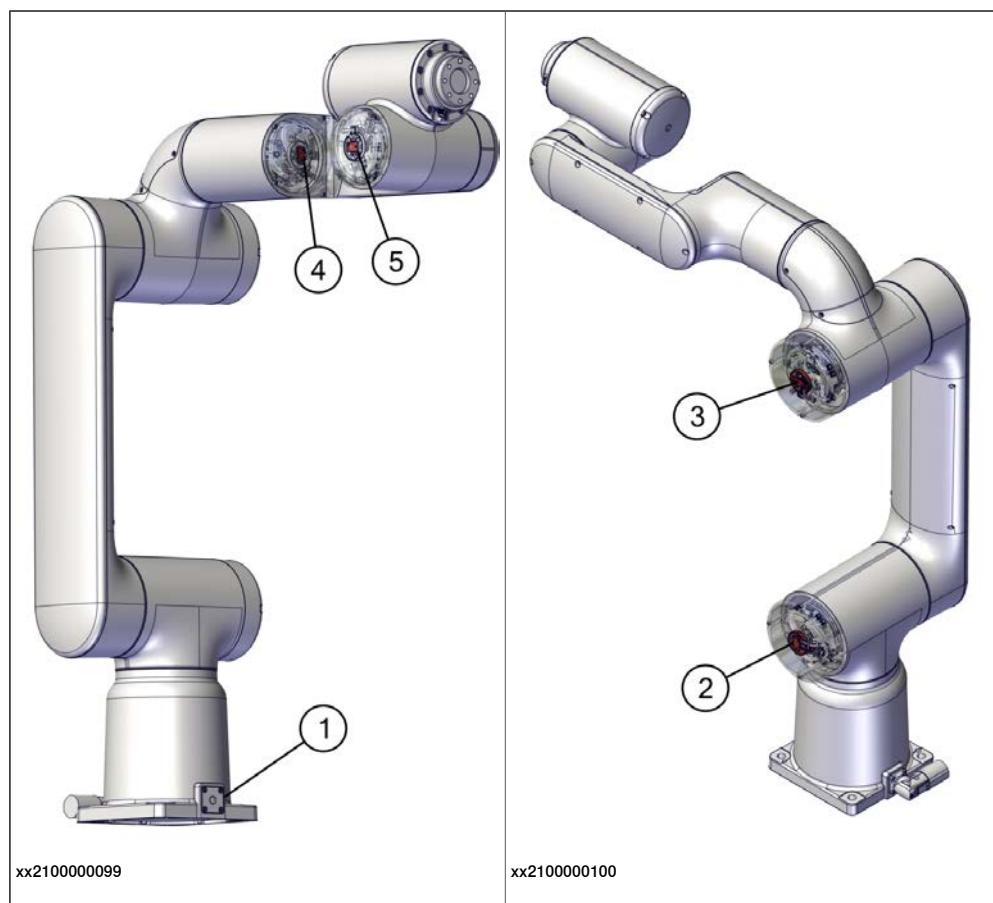
5 Repair

5.3.9 Replacing the brake release unit

5.3.9 Replacing the brake release unit

Location of the brake release unit

The brake release units are located as shown in the figure.



Summary of the replacement procedure

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

Axis-1 brake release unit

- 1 Jog the robot to transportation position.
- 2 Loosen the robot from the foundation and lay it down on its back.
This step requires two persons.
- 3 Remove the base cover.
- 4 Replace the brake release unit.

Axis-2/-3/-4/-5 brake release unit

- 1 Open the joint unit cover.
- 2 Replace the brake release unit.

Continues on next page

Required spare parts**Note**

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Brake release unit	3HAC079144-001	Axis 1
Brake release unit	3HAC079145-001	Axes 2, 3, 4 and 5

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cable ties	-	
O-ring, nitrile rubber	3HAB3772-119	Axis-1 brake release unit Replace if damaged.
O-ring, nitrile rubber	3HAB3772-64	Base cover
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.
O-ring	3HAC061327-051	Axis-4 cover Replace if damaged.
O-ring	3HAC061327-051	Axis-5 cover Replace if damaged.
Grease	3HAC031695-001	Harmonic Grease 4B No.2 Used to lubricate the seals.
Grease	3HAC042536-001	Shell Gadus S2

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5 Repair

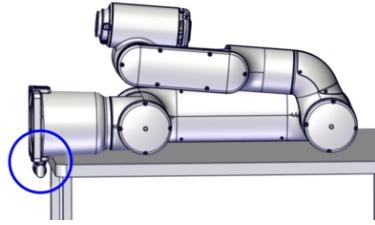
5.3.9 Replacing the brake release unit

Continued

Replacing the brake release unit for axis 1

Use these procedures to replace the brake release unit.

Preparations before removing the brake release unit

	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none">• Axis 1: 0°• Axis 2: 0°• Axis 3: +85°• Axis 4: 0°• Axis 5: 0°• Axis 6: 0°	 xx2100000113
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	
3	<p>Prepare a working bench where the robot can be laid down on its back with the base socket outside the table edge.</p>	 xx2100000414

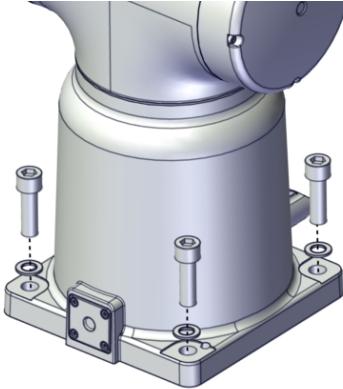
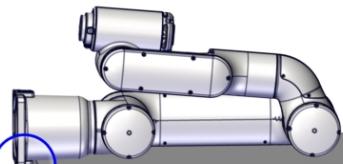
Laying down the robot

	Action	Note
1	<p>! CAUTION</p> <p>The CRB 15000 robot weighs 28 kg. A minimum of two persons are required for lifting as well as securing the robot in order to avoid any damage, instability, and injury.</p>	

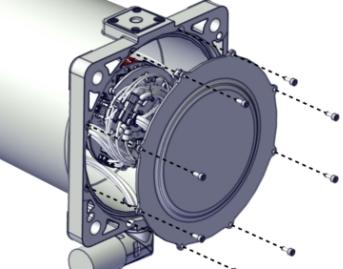
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5.3.9 Replacing the brake release unit

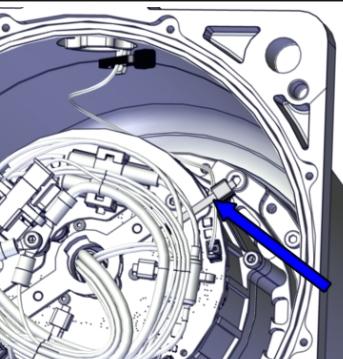
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Action	Note
<p>2 Loosen the robot from the foundation.</p> <ul style="list-style-type: none"> Person 1: keep holding the robot stable. Person 2: loosen the robot base from the foundation by removing the attachment screws and washers. Both persons: grasp the robot at appropriate locations and lay it down on its back on a working bench. Do not damage the base socket. <p>CAUTION</p> <p>Do not leave the robot standing unfastened to the foundation, it is not stable on its own.</p>	 <p>xx2100000415</p>  <p>xx2100000414</p>

Removing the base cover

Action	Note
1 Remove the bottom cover by removing the attachment screws.	 <p>xx2000002007</p>

Removing the brake release unit

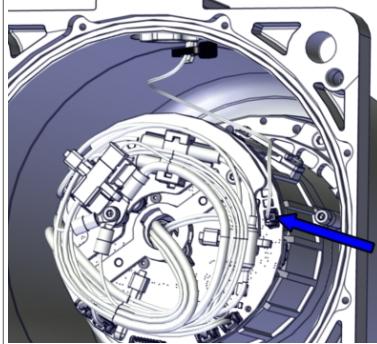
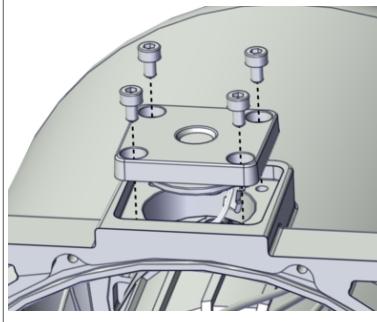
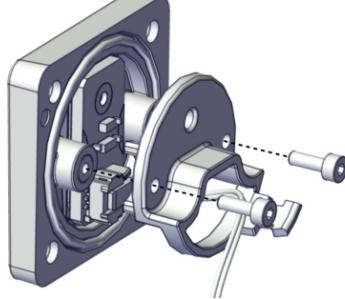
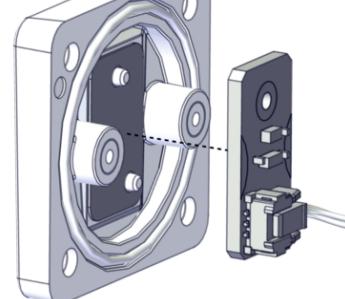
Action	Note
1 Cut the cable tie.	 <p>xx2100000410</p>

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5 Repair

5.3.9 Replacing the brake release unit

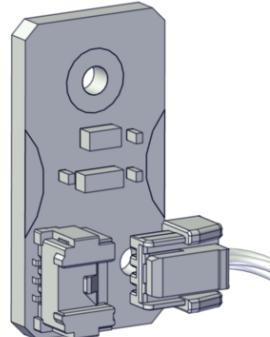
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	Action	Note
2	Disconnect the brake release cable from the board.	 xx2100000411
3	Remove the brake release unit by removing the screws.	 xx2100000413
4	Remove the brake release cover by removing the two screws.	 xx2100000416
5	Remove the brake release board.	 xx2100000418

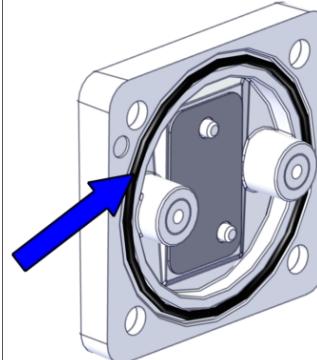
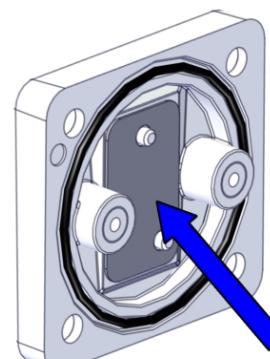
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5.3.9 Replacing the brake release unit

Continued

Action	Note
6 Disconnect the brake release cable from the board.	 xx2100000417

Refitting the brake release unit

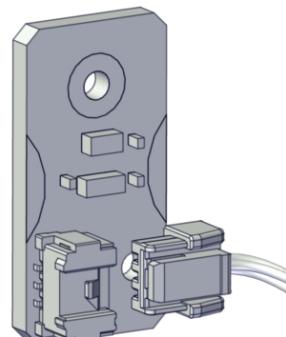
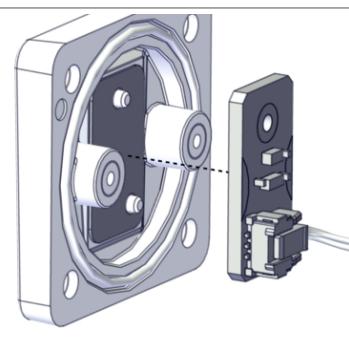
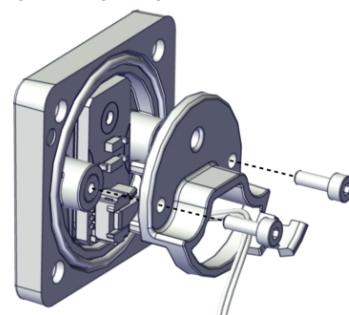
Action	Note
1 Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring, nitrile rubber: 3HAB3772-119 Grease: 3HAC031695-001 Harmonic Grease 4B No.2 Used to lubricate the seals.  xx2100000419
2 If not already fitted, place the sheet metal inside the cover.	 xx2100000420

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5 Repair

5.3.9 Replacing the brake release unit

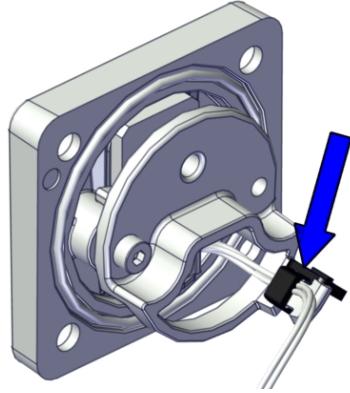
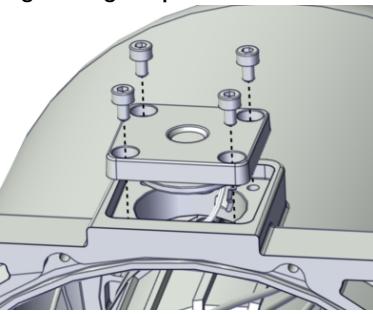
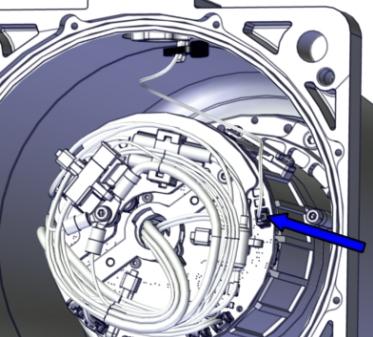
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	Action	Note
3	Connect the brake release cable to the board.	<p>Brake release unit: 3HAC079144-001</p>  <p>xx2100000417</p>
4	Fit the brake release board to the sheet metal.	 <p>xx2100000418</p>
5	Fit the brake release cover and secure with two screws.	<p>Screws: M2x6 12.9 Gleitmo 605 (2 pcs) Tightening torque: 0.2 Nm.</p>  <p>xx2100000416</p>

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5.3.9 Replacing the brake release unit

Continued

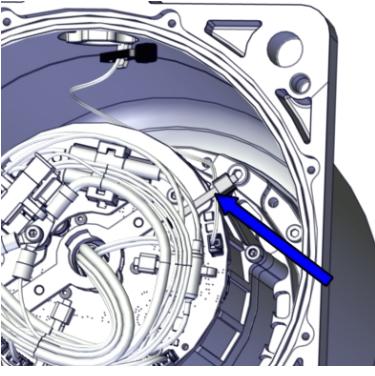
Action	Note
6 Secure the brake release cable with a cable tie.	 xx2100000421
7 Refit the brake release unit with the screws. Screws: M3x5 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.	 xx2100000413
8 Reconnect the brake release connector DR.X8 to the drive board.	 xx2100000411

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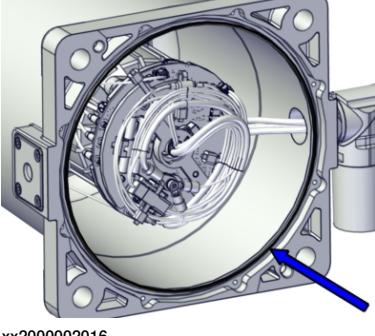
5 Repair

5.3.9 Replacing the brake release unit

Continued

Action	Note
9 Secure the brake release cable with a cable tie.	 xx2100000410

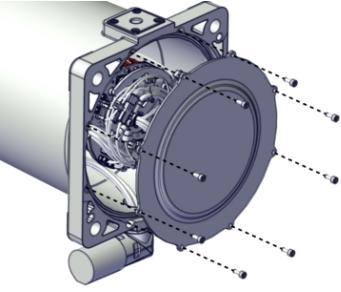
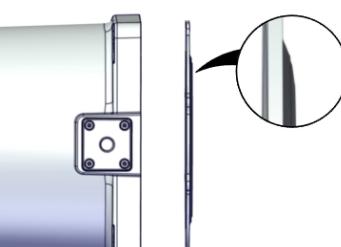
Refitting the base cover

Action	Note
1 Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring, nitrile rubber: 3HAB3772-64 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016

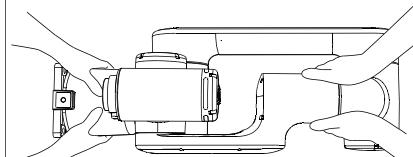
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5.3.9 Replacing the brake release unit

Continued

Action	Note
<p>2 Refit the bottom cover with the attachment screws.</p> <p>Note</p> <p>Fit the cover in correct direction, the protrusion of the cover must face outwards.</p>	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.2 Nm.</p>  <p>xx2000002007</p>  <p>xx2100000268</p>

Lifting and securing the robot

Action	Note
<p>1 CAUTION</p> <p>The CRB 15000 robot weighs 28 kg. A minimum of two persons are required for lifting as well as securing the robot in order to avoid any damage, instability, and injury.</p> <p>Special consideration is necessary when mounting the robot in an elevated, suspended or wall mounted position.</p>	
<p>2 Grasp the robot at the foot and elbow, as shown in the figure, and lift it up from the transportation package.</p>	 <p>xx2100000118</p>
<p>3 CAUTION</p> <p>Do not leave the robot standing unfastened to the foundation, it is not stable on its own.</p>	
<p>4 Fit two pins to the holes in the base.</p>	<p>Centering pins: DIN6325, hardened steel Ø6x24 mm, 2 pcs .</p>

Continues on next page

5 Repair

5.3.9 Replacing the brake release unit

Continued

Action	Note
5 Raise the robot to standing and secure to foundation, paying attention to the centering holes at the bottom of the robot base. <ul style="list-style-type: none">• Person 1: keep holding the robot stable.• Person 2: secure the robot base to the foundation with the securing screws and washers.	Screws: M10x35, 4 pcs, quality 8.8 Washers: 23/10.5/2.5 mm Steel
6 Tighten the bolts in a crosswise pattern to ensure that the base is not distorted.	Tightening torque: 30 Nm ±10%

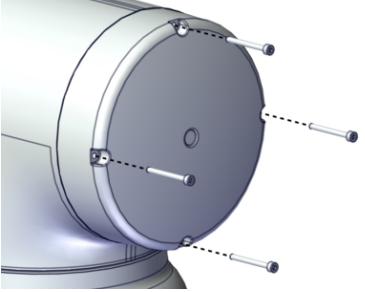
Concluding procedure

Action	Note
1  DANGER Make sure all safety requirements are met when performing the first test run.	

Replacing the brake release unit for axes 2, 3, 4 and 5

Use these procedures to replace the brake release unit.

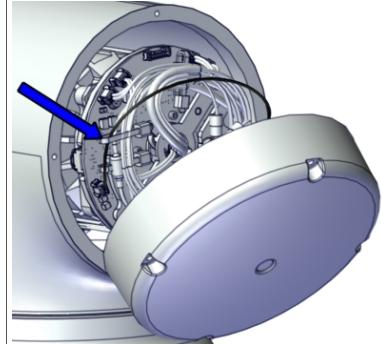
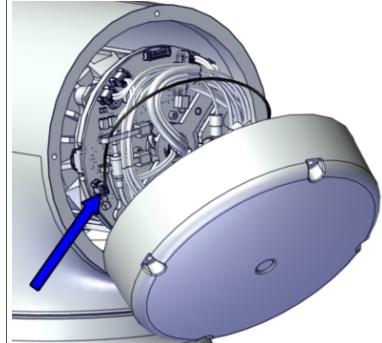
Opening the joint unit cover

Action	Note
1  CAUTION Make sure that all supplies for electrical power are turned off.	
2 Remove the cover screws.	 xx2000001935
3  CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	

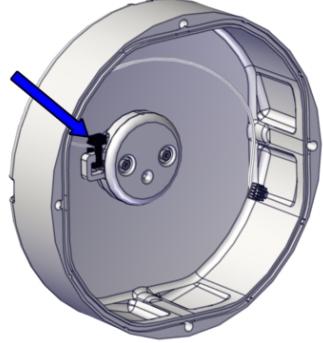
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5.3.9 Replacing the brake release unit

Continued

Action	Note
4 Open the cover and cut the cable tie that holds the brake release cable.	 xx2000001931
5 Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000001932

Removing the brake release unit

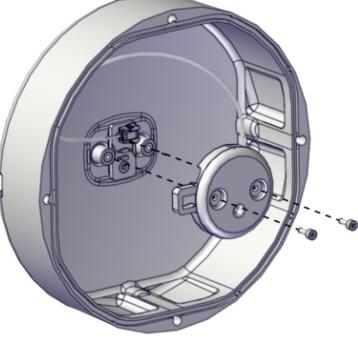
Action	Note
1 Cut the cable tie.	 xx2100000096

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5 Repair

5.3.9 Replacing the brake release unit

Continued

Action	Note
2	<p>Remove the brake release cover by removing the two screws.</p>  <p>xx2100000095</p>
3	<p>Disconnect the brake release cable from the board.</p>  <p>xx2100000094</p>
4	<p>Remove the brake release board.</p>  <p>xx2100000093</p>

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Refitting the brake release unit

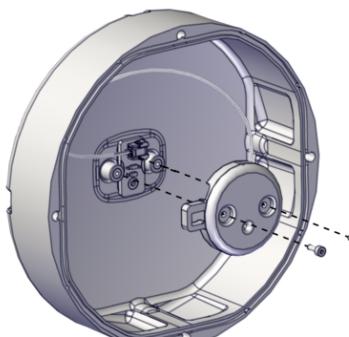
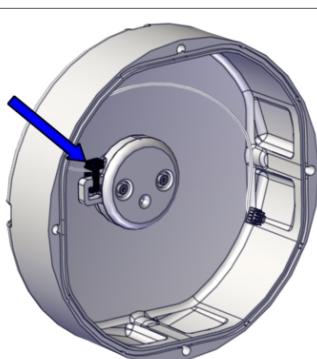
	Action	Note
1	If not already fitted, place the sheet metal inside the cover.	 xx2100000092
2	Fit the brake release board to the sheet metal.	 xx2100000093
3	Connect the brake release cable to the board.	 xx2100000094

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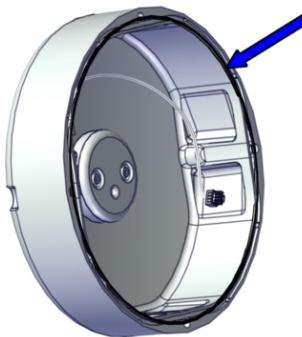
5 Repair

5.3.9 Replacing the brake release unit

Continued

	Action	Note
4	Fit the brake release cover and secure with two screws.	Screws: M2x6 12.9 Gleitmo 605 (2 pcs) Tightening torque: 0.2 Nm.  xx2100000095
5	Secure the cable with a cable tie.	 xx2100000096

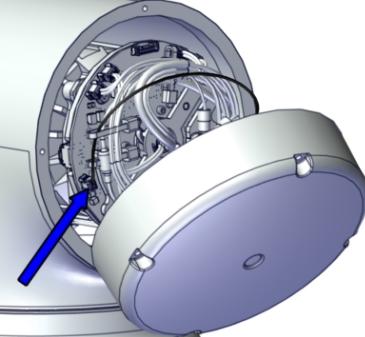
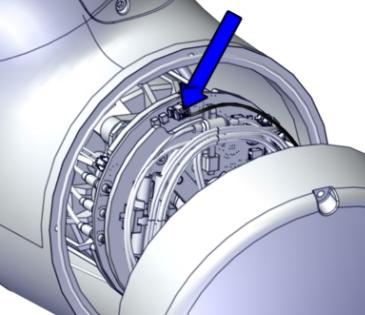
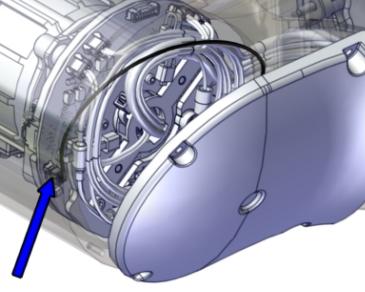
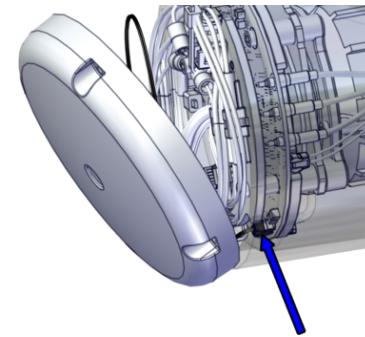
Closing the joint unit cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962

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5.3.9 Replacing the brake release unit

Continued

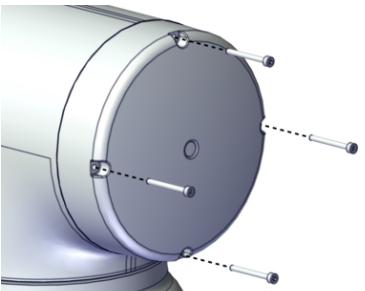
Action	Note
2 Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	<p>Axis 2:  xx2000001932</p> <p>Axis 3:  xx2000002023</p> <p>Axis 4: Tweezers  xx2000002085</p> <p>Axis 5:  xx2000002134</p>

Continues on next page

5 Repair

5.3.9 Replacing the brake release unit

Continued

	Action	Note
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000001931
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: Axis 2: 0.45 Nm Axis 3: 0.45 Nm Axis 4: 0.2 Nm Axis 5: 0.2 Nm  xx2000001935

Concluding procedure

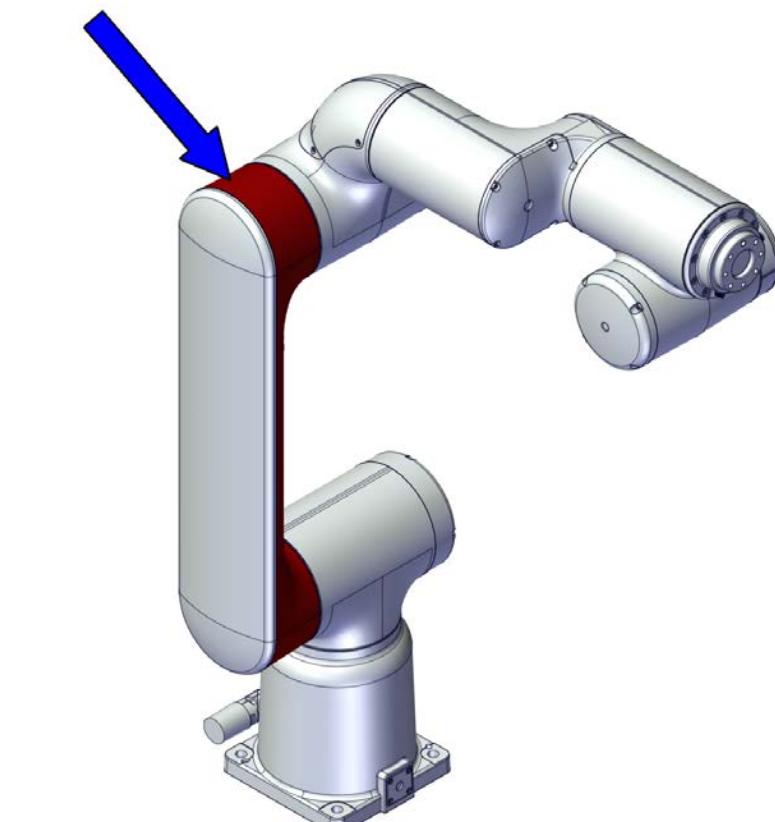
	Action	Note
1	 DANGER Make sure all safety requirements are met when performing the first test run.	

5.4 Upper and lower arms

5.4.1 Replacing the lower arm

Location of the lower arm

The lower arm is located as shown in the figure.



xx2000001928

Summary of the replacement procedure

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

- 1 Separate the cabling between the swing and the lower arm.
- 2 Remove the upper arm.
- 3 Replace the lower arm.

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Continues on next page

5 Repair

5.4.1 Replacing the lower arm

Continued

Spare part	Article number	Note
Lower arm	3HAC073948-001	

Required tools and equipment

Equipment	Article number	Note
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs.
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Cable ties	-	
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.
O-ring	3HAC061327-044	Lower arm, inner cover. 1 pcs / cover. Replace if damaged.

Removing the lower arm

Use these procedures to remove the lower arm.

Preparations before removing the lower arm

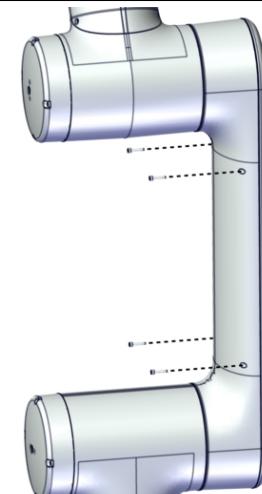
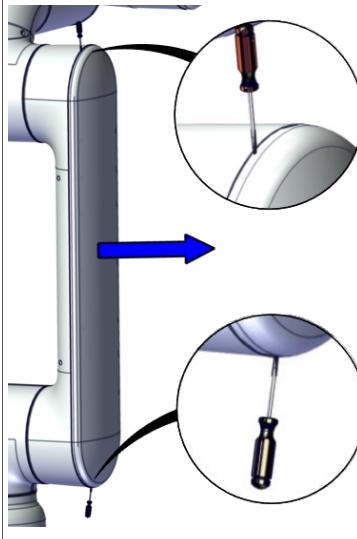
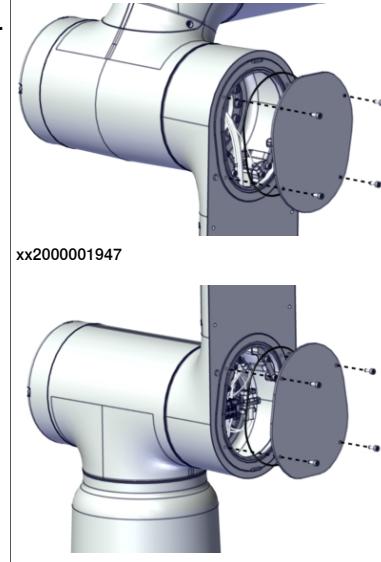
	Action	Note
1	Jog the robot to the synchronization position.	
2	 CAUTION Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the lower arm covers

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

Continues on next page

**5.4.1 Replacing the lower arm
Continued**

Action	Note
2 Remove the four lower arm cover screws.	 xx2000001929
3 Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267
4 Remove the inner covers by removing the screws.	 xx2000001947 xx2000001930

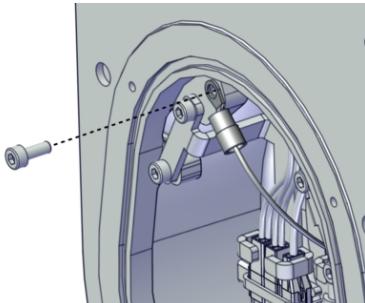
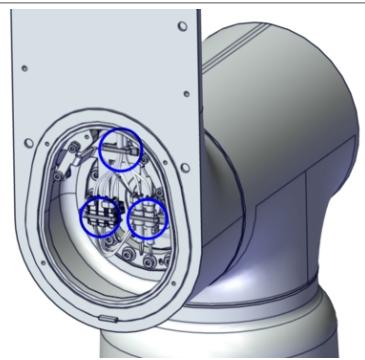
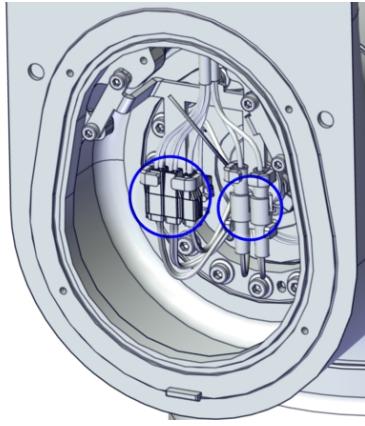
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5 Repair

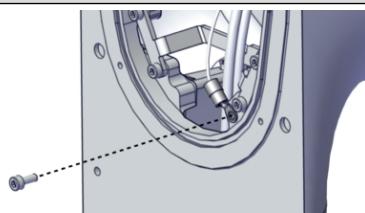
5.4.1 Replacing the lower arm

Continued

Disconnecting the cabling between the lower arm and the swing

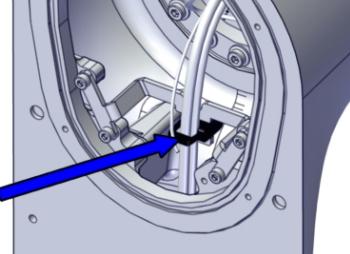
	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936
2	Cut the cable ties.	 xx2000001937
3	Snap loose and disconnect all connectors.	 xx2000001938

Loosening the cabling between the lower and upper arm

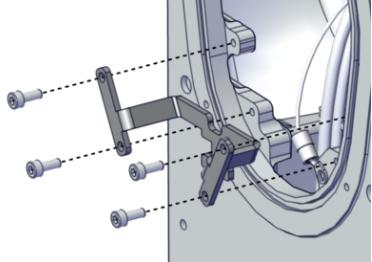
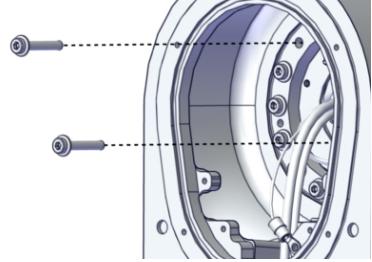
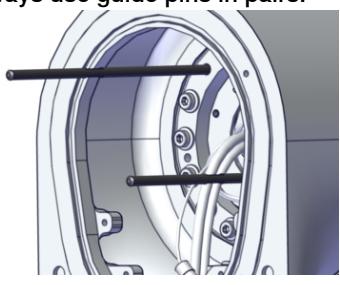
	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001964

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5.4.1 Replacing the lower arm
Continued

Action	Note
2 Cut the cable tie.	 xx2000001965

Removing the upper arm

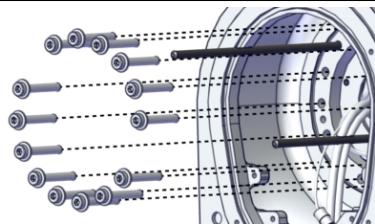
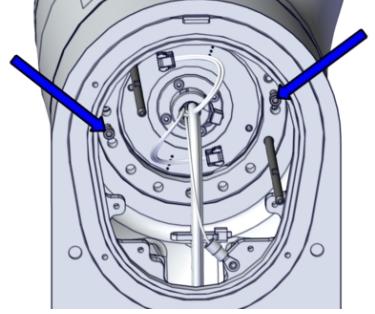
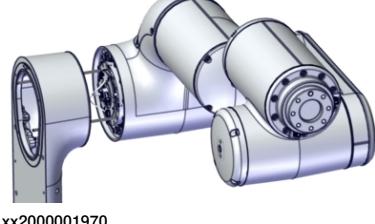
Action	Note
1 Remove the cable bracket by removing the four screws.	 xx2000001966
2 Secure the weight of the upper arm. CAUTION The weight of the complete upper arm is 14 kg.	
3 Remove two attachment screws.	 xx2000001967
4 Fit two guide pins to the axis-3 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001968

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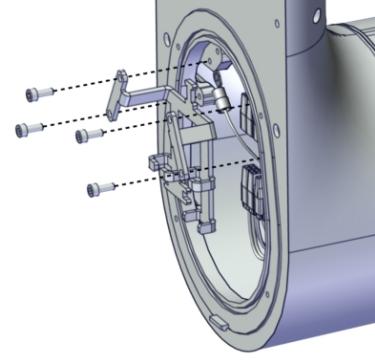
5 Repair

5.4.1 Replacing the lower arm

Continued

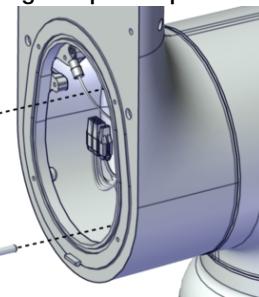
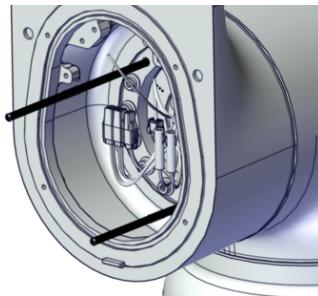
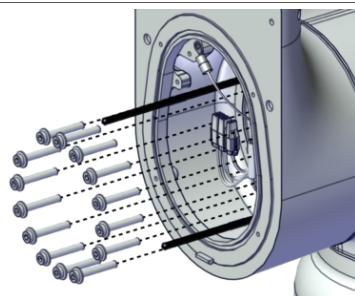
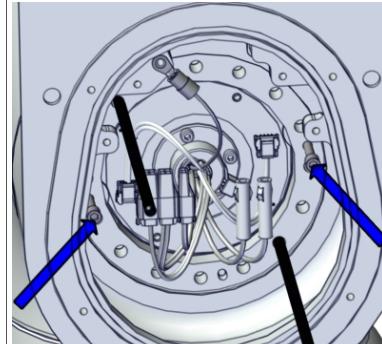
Action	Note
5 Remove the remaining attachment screws.	 xx2000001969
6 Press the upper arm out of position by using two fully threaded attachment screws as removal tools.	 xx2100000001
7 Remove the upper arm from the lower arm. Assist the cabling to be removed from the lower arm while lifting away the complete upper arm. Place the upper arm on a workbench.	 xx2000001970

Removing the lower arm

Action	Note
1 Remove the cable bracket by removing the four screws.	 xx2000001939
2 Secure the weight of the lower arm.	

Continues on next page

5.4.1 Replacing the lower arm
Continued

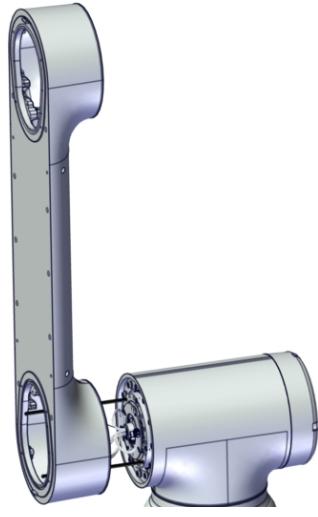
Action	Note
3 Remove two attachment screws and fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.</p>  <p>xx2000001951</p>  <p>xx2000001960</p>
4 Remove the lower arm attachment screws.	 <p>xx2000001940</p>
5 Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 <p>xx2000002151</p>

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5 Repair

5.4.1 Replacing the lower arm

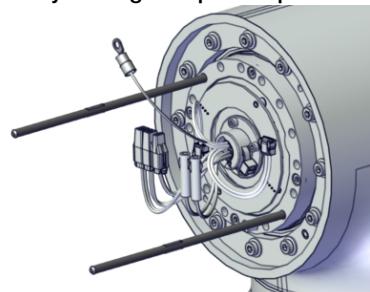
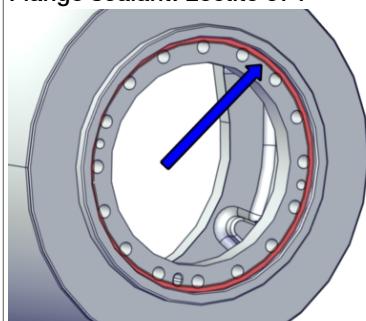
Continued

Action	Note
6 Remove the lower arm from the swing.	 xx2000001952

Refitting the lower arm

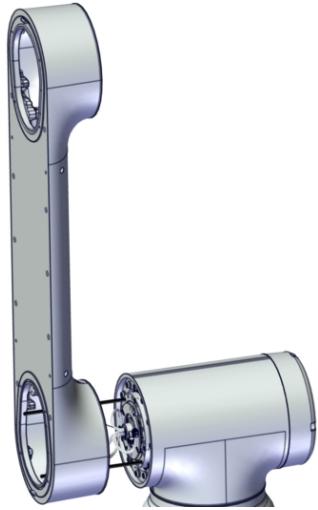
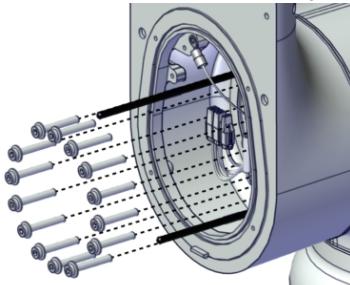
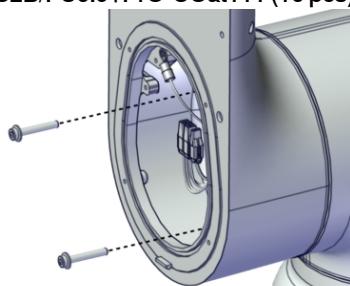
Use these procedures to refit the lower arm.

Refitting the lower arm

Action	Note
1 Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001949
2 Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001963

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5.4.1 Replacing the lower arm
Continued

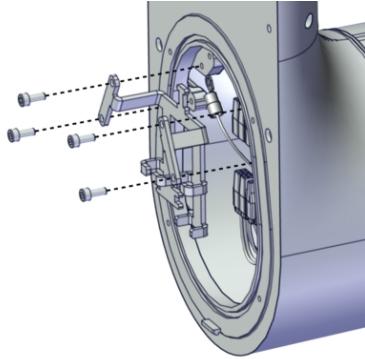
Action	Note
3 Lift the lower arm to mounting position and slide it onto the guide pins.	 xx2000001952
4 Secure the lower arm to the swing with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001940
5 Remove the guide pins and fasten the remaining two screws.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001951
6 Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.

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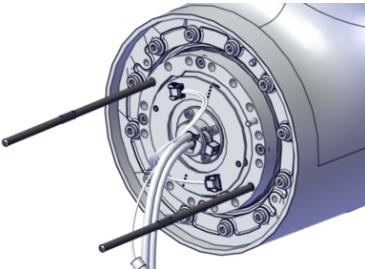
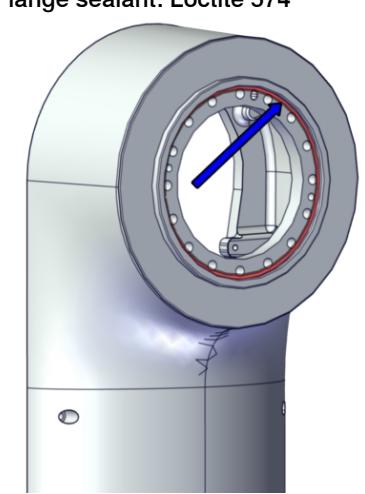
5 Repair

5.4.1 Replacing the lower arm

Continued

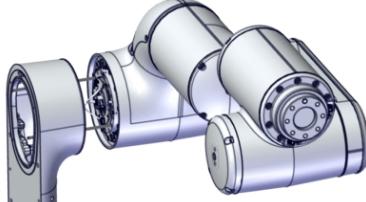
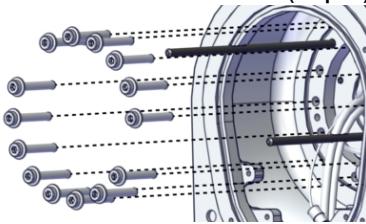
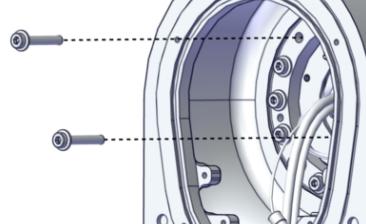
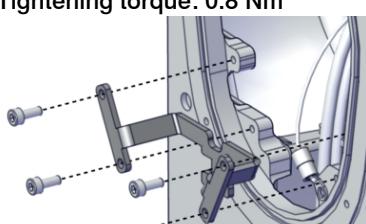
	Action	Note
7	Refit the cable bracket with four screws.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm</p>  <p>xx2000001939</p>

Refitting the upper arm

	Action	Note
1	Fit two guide pins to the axis-3 joint.	 <p>xx2000001971</p>
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000001973</p>

Continues on next page

5.4.1 Replacing the lower arm
Continued

	Action	Note
3	Lift the upper arm into mounting position while inserting the cabling into the lower arm.	 xx2000001970
4	Slide the upper arm into place on the guide pins.	
5	Secure the upper arm to the lower arm with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001969
6	Remove the guide pins and fasten the remaining two screws.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001967
7	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.
8	Refit the cable bracket with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm  xx2000001966

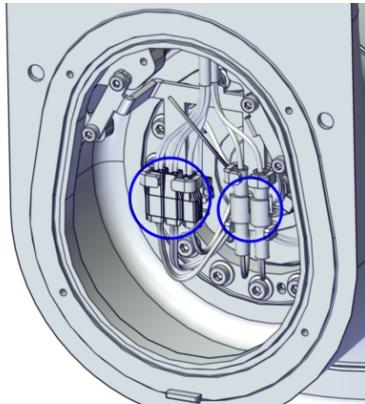
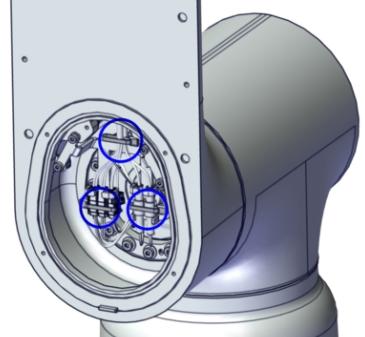
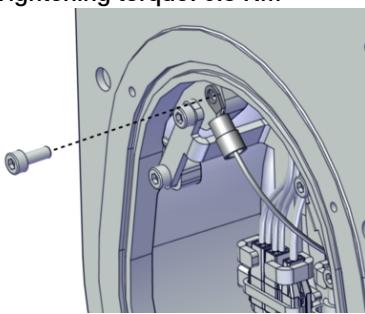
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5 Repair

5.4.1 Replacing the lower arm

Continued

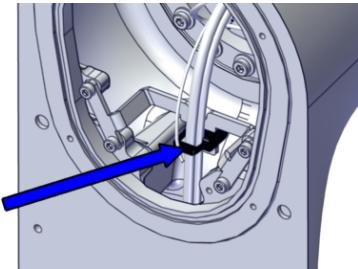
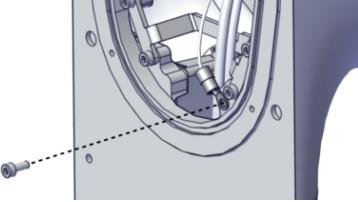
Connecting the cabling between the lower arm and swing

	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938
2	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937
3	Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

Continues on next page

5.4.1 Replacing the lower arm
Continued

Fastening the cabling between the lower and upper arm

	Action	Note
1	Secure the cabling with the cable tie.	<p>Cable ties</p>  <p>xx2000001965</p>
2	Connect the functional earth cable with the screw.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm</p>  <p>xx2000001964</p>

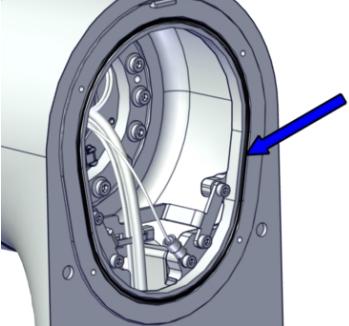
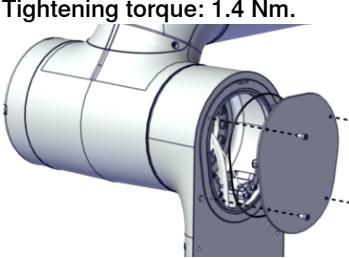
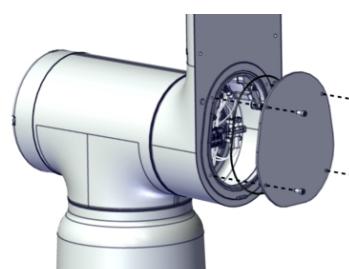
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5 Repair

5.4.1 Replacing the lower arm

Continued

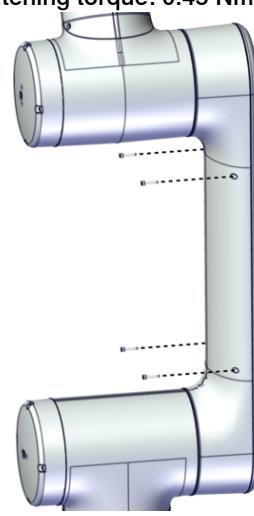
Refitting the lower arm covers

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001955  xx2000001954
2	Refit the inner covers with four screws each.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.4 Nm.  xx2000001947  xx2000001930

Continues on next page

5.4.1 Replacing the lower arm

Continued

Action	Note
3 Snap the lower arm cover into place.	
4 Secure the cover with four screws.	Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000001929

Concluding procedure

Action	Note
1  DANGER Make sure all safety requirements are met when performing the first test run.	

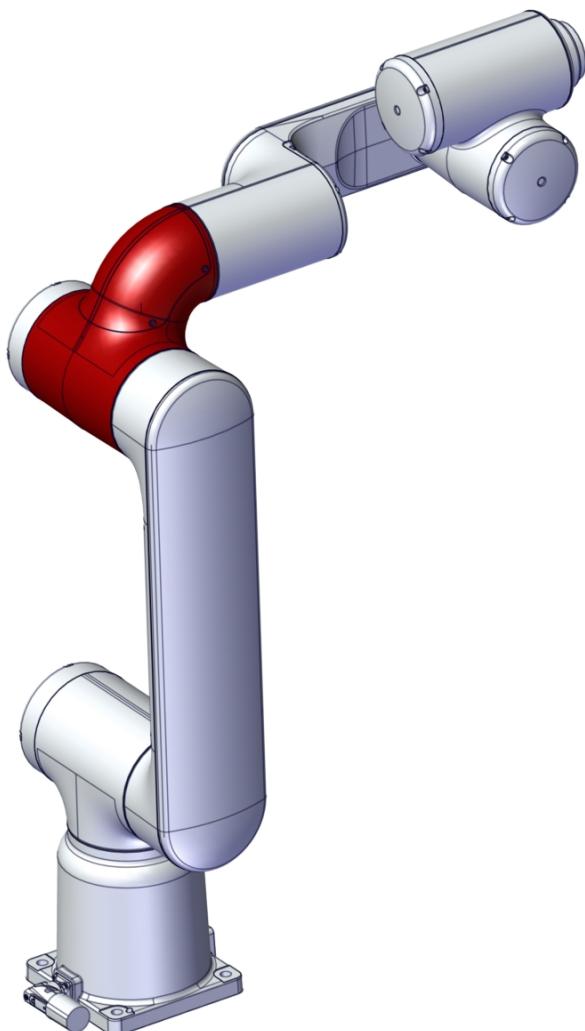
5 Repair

5.4.2 Replacing the housing

5.4.2 Replacing the housing

Location of the housing

The housing is located as shown in the figure.



xx2000002019

Summary of the replacement procedure

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

- 1 Disconnect the cabling between the lower arm and the upper arm.
- 2 Remove the upper arm and place on a workbench.
- 3 Remove the axis-3 joint unit.
- 4 Remove the tubular.
- 5 Replace the housing.

Continues on next page

Required spare parts**Note**

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal,
www.abb.com/myABB.

Spare part	Article number	Note
Housing	3HAC073949-001	Also order new attachment screws for the axis-3 joint unit: 3HAB3413-435 (12 pcs).
Flange socket head screw with glue	3HAB3413-435	M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when re-fitting a joint unit. If ordering a new joint unit spare part, new screws are included.
Cable tie	3HAC075545-001	For securing joint unit cable.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3. Attachment screws M4x35 (4 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3.
Guide pin, M3x110	3HAC077787-001	Always use guide pins in pairs.
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Cable ties	-	
Gasket	3HAC075056-001	Cover inside housing Replace if damaged.
Flange socket head screw with glue	3HAB3413-435	M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when re-fitting a joint unit. If ordering a new joint unit spare part, new screws are included.
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.

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5 Repair

5.4.2 Replacing the housing

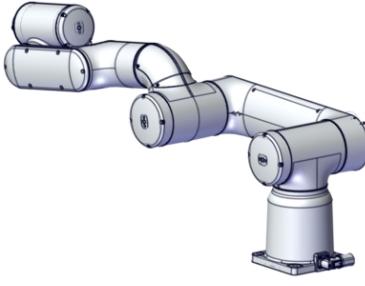
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Consumable	Article number	Note
O-ring	3HAC061327-044	Lower arm, inner cover. 1 pcs / cover. Replace if damaged.
Grease	3HAC042536-001	Shell Gadus S2

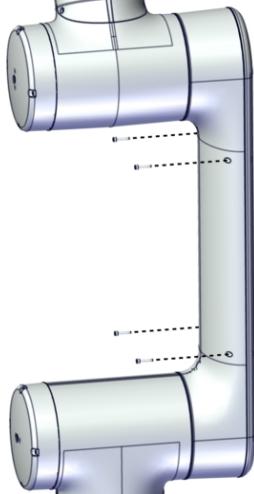
Removing the housing

Use these procedures to remove the housing.

Preparations before removing the housing

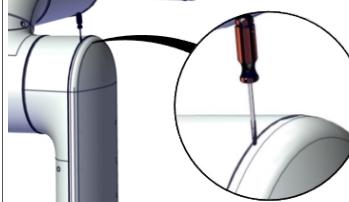
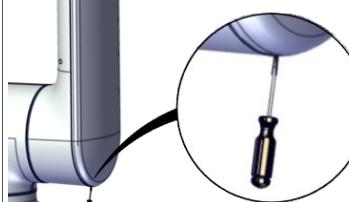
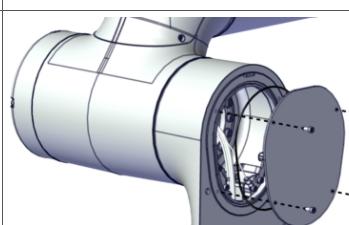
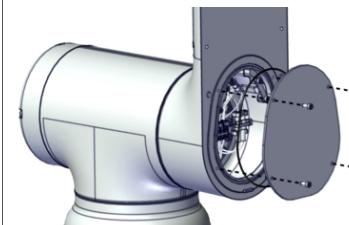
	Action	Note
1	Jog the robot to the specified position: <ul style="list-style-type: none">• Axis 1: 0°• Axis 2: +90° (suggested position for convenient working position)• Axis 3: -80°• Axis 4: 0°• Axis 5: 0°• Axis 6: 0°	 xx2100000002
2	 CAUTION Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the lower arm covers

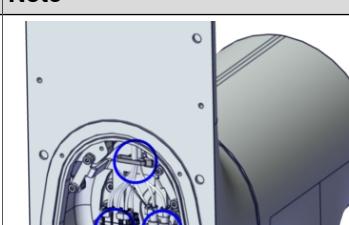
	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	Remove the four lower arm cover screws.	 xx2000001929

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5.4.2 Replacing the housing
Continued

Action	Note
3 Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	  xx2100000267
4 Remove the inner covers by removing the screws.	 xx2000001947  xx2000001930

Disconnecting the upper arm cabling

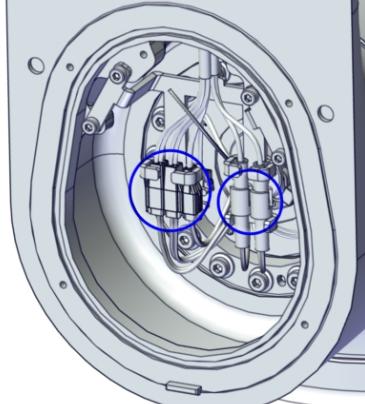
Action	Note
1 Cut the cable ties.	 xx2000001937

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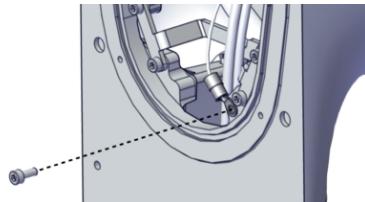
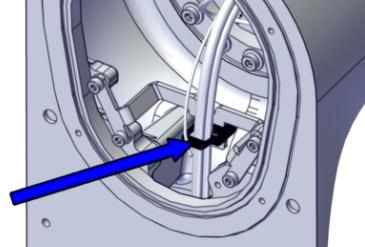
5 Repair

5.4.2 Replacing the housing

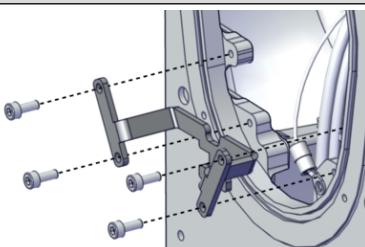
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Action	Note
2 Snap loose and disconnect all connectors.	 xx2000001938

Loosening the cabling between the lower and upper arm

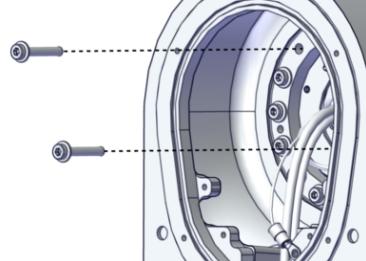
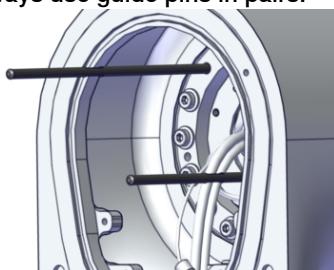
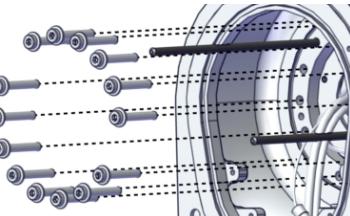
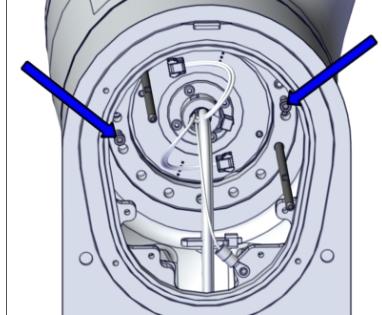
Action	Note
1 Remove the functional earth cable by removing the screw.	 xx2000001964
2 Cut the cable tie.	 xx2000001965

Removing the upper arm

Action	Note
1 Remove the cable bracket by removing the four screws.	 xx2000001966

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5.4.2 Replacing the housing Continued

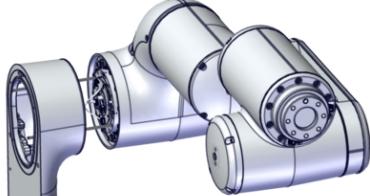
	Action	Note
2	Secure the weight of the upper arm.  CAUTION The weight of the complete upper arm is 14 kg.	
3	Remove two attachment screws.	 xx2000001967
4	Fit two guide pins to the axis-3 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001968
5	Remove the remaining attachment screws.	 xx2000001969
6	Press the upper arm out of position by using two fully threaded attachment screws as removal tools.	 xx2100000001

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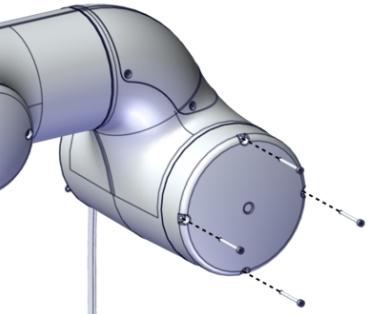
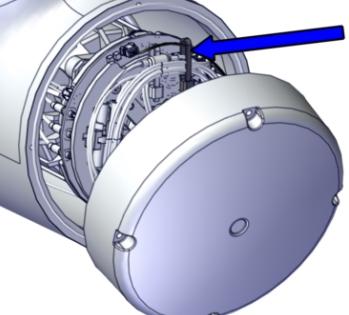
5 Repair

5.4.2 Replacing the housing

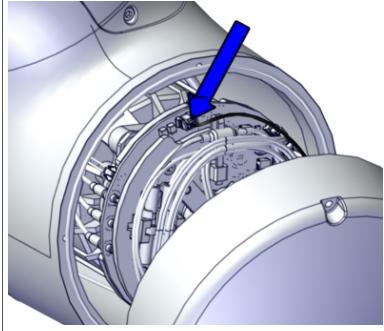
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	Action	Note
7	<p>Remove the upper arm from the lower arm. Assist the cabling to be removed from the lower arm while lifting away the complete upper arm. Place the upper arm on a workbench.</p>	 xx2000001970

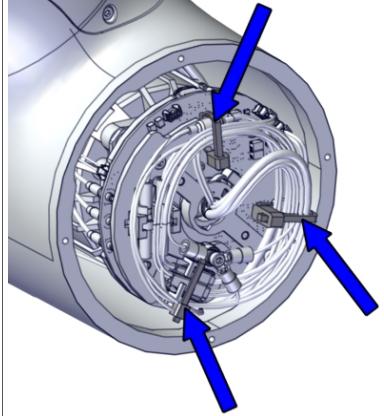
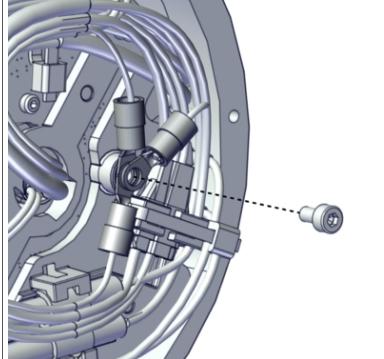
Removing the housing cover

	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	Remove the cover screws.	 xx2000002021
3	 CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002022

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Action	Note
5 Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002023

Disconnecting the axis-3 joint unit cabling

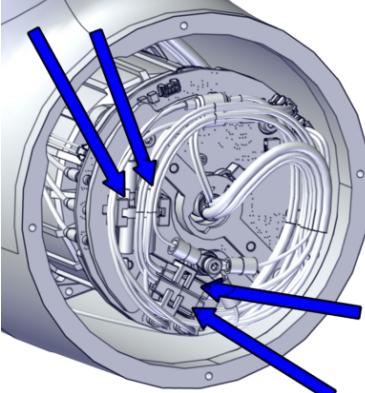
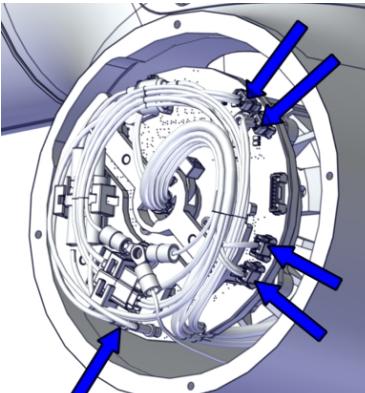
Action	Note
1 Cut the cable ties.	 xx2000002066
2 Remove the functional and protective earth cables by removing the screw.	 xx2000001945

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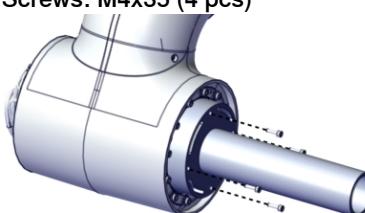
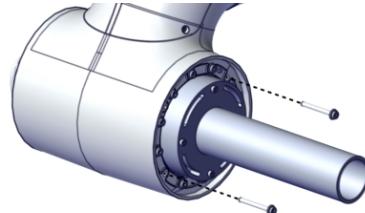
5 Repair

5.4.2 Replacing the housing

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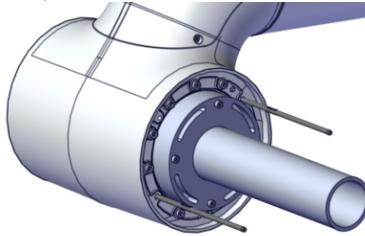
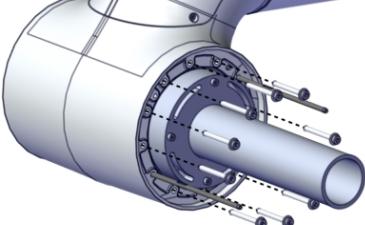
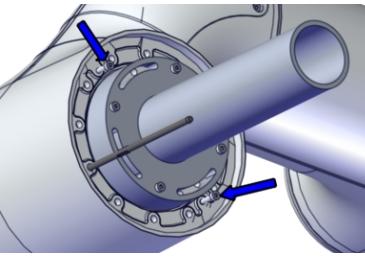
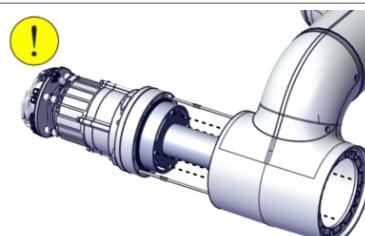
Action	Note
<p>3 Snap loose and disconnect the connectors:</p> <ul style="list-style-type: none"> • J4.DC+ • J4.DC- • J4.CS • J4.CP 	 xx2000002067
<p>4 Disconnect the connectors from the drive board.</p> <ul style="list-style-type: none"> • D3.X1 • D3/4.DC+ • D3/4.DC- • D3.X4 • D3/4.X2 • D3.X5 <p>! CAUTION Use tweezers to unlock connectors and pull them off.</p>	 xx2000002068

Removing the axis-3 joint unit

Action	Note
<p>1 Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>! CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000002069
<p>2 Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002070

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5.4.2 Replacing the housing Continued

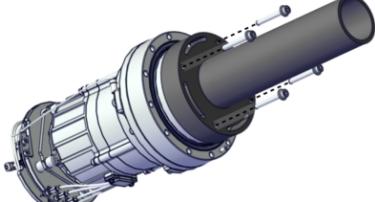
Action	Note
3 Fit two guide pins to the axis-3 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002576</p>
4 Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.	 <p>xx2100000320</p>
5 Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 <p>xx2100000003</p>
6 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 <p>xx2000002577</p>
7 Remove the joint unit from the housing. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 <p>xx2000002071</p>

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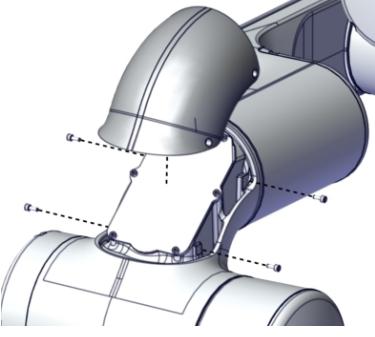
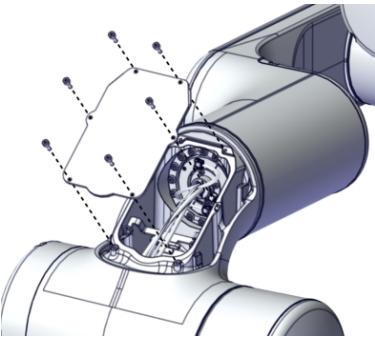
5 Repair

5.4.2 Replacing the housing

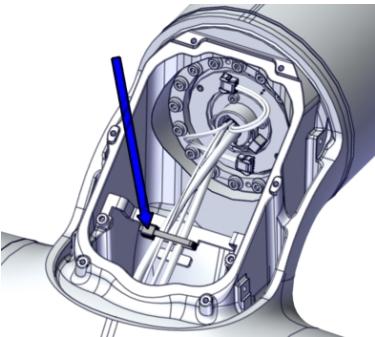
Continued

Action	Note
8 Remove the lifting aid and guide pins.	 xx2000001957

Opening the housing top cover

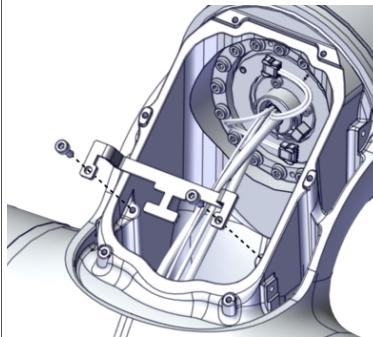
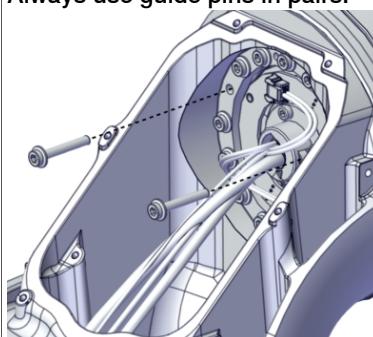
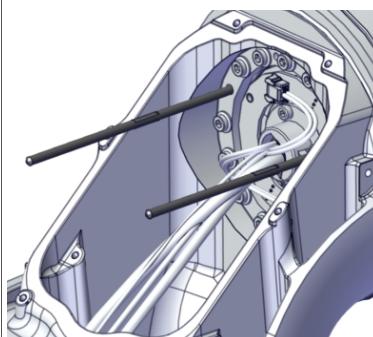
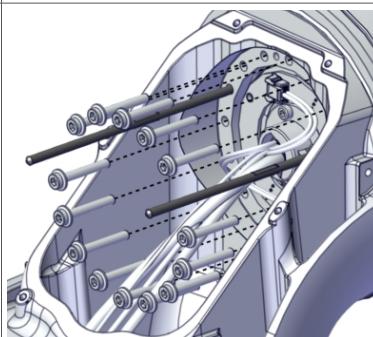
Action	Note
1 Remove the cover by removing the four screws.	 xx2000002075
2 Remove the inner plate by removing the screws.	 xx2000002076

Removing the tubular

Action	Note
1 Cut the cable tie.	 xx2000002077

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**5.4.2 Replacing the housing
Continued**

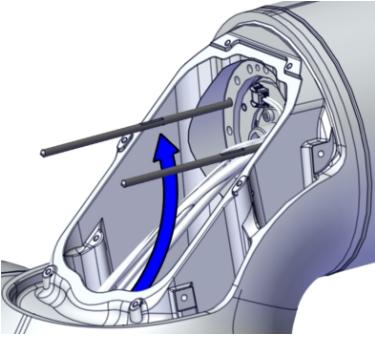
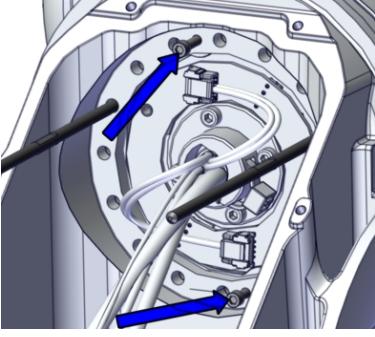
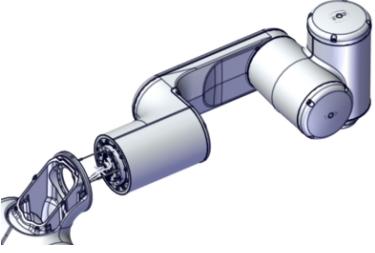
	Action	Note
2	Remove the cable bracket by removing the two screws.	 xx2000002078
3	Remove two attachment screws and fit two guide pins to the axis-4 joint unit. Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.	 xx2000002079  xx2000002080
4	Remove the remaining attachment screws.	 xx2000002081

Continues on next page

5 Repair

5.4.2 Replacing the housing

Continued

	Action	Note
5	Pull out the cabling carefully from the housing.	 xx2000002127
6	Use two fully threaded attachment screws as removal tools to press the housing out of position.	 xx2100000006
7	Remove the tubular from the housing. Assist the cabling to be removed from the housing while lifting away the complete tubular. Place the tubular on a workbench.	 xx2000002082

Replace the housing

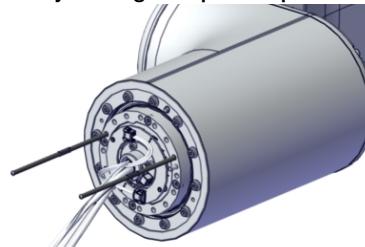
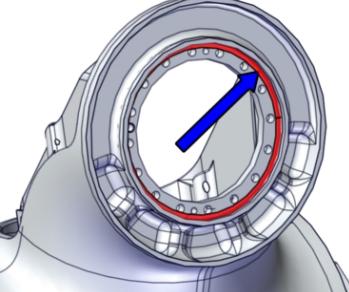
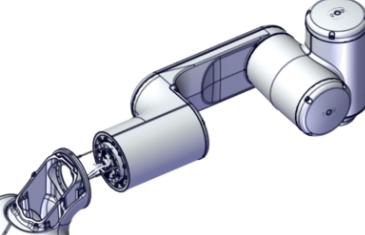
	Action	Note
1	Replace the housing.	Housing: 3HAC073949-001

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Refitting the housing

Use these procedures to refit the housing.

Refitting the tubular

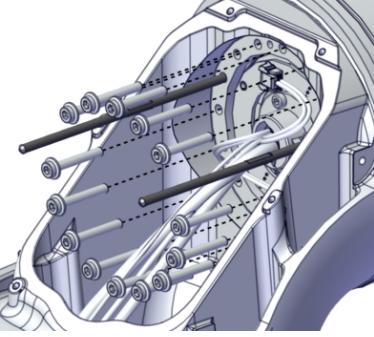
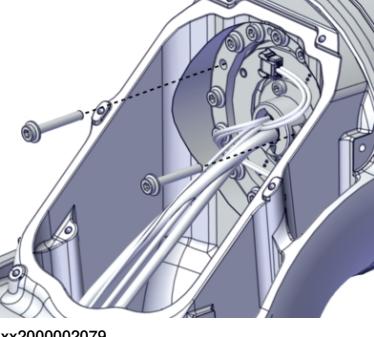
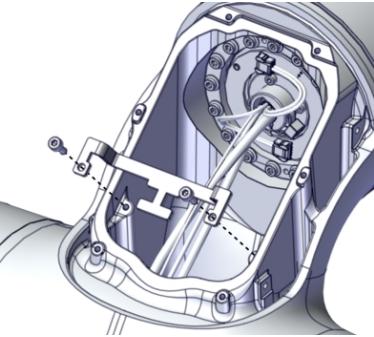
	Action	Note
1	Fit two guide pins to the axis-4 joint.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002093
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the housing mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000002094
3	Lift the tubular into mounting position while inserting the cabling into the housing.	
4	Slide the tubular into place on the guide pins.	 xx2000002082

Continues on next page

5 Repair

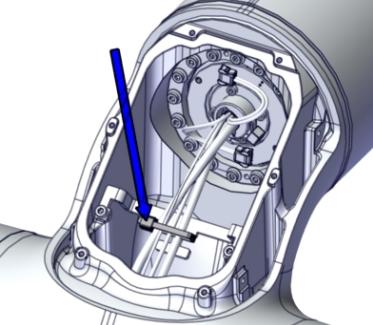
5.4.2 Replacing the housing

Continued

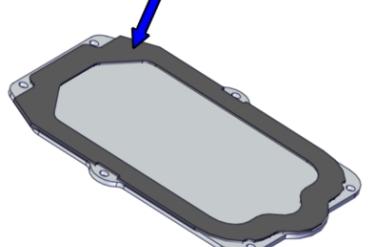
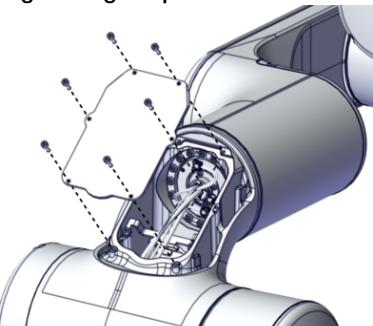
Action	Note
5 Secure the tubular to the housing with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111  xx2000002081
6 Remove the guide pins and fasten the remaining two screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111  xx2000002079
7 Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.
8 Refit the cable bracket with the two screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm  xx2000002078

Continues on next page

5.4.2 Replacing the housing Continued

	Action	Note
9	Secure the cabling with a cable tie.	<p>Cable ties (1 pcs)</p>  <p>xx2000002077</p>

Closing the housing top cover

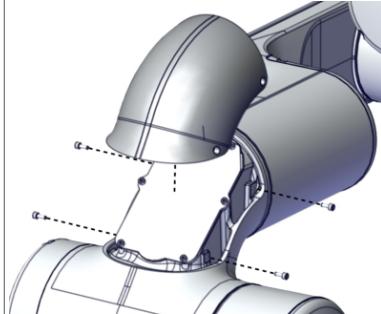
	Action	Note
1	Check the inner plate gasket. Replace if damaged.	<p>Gasket: 3HAC075056-001</p>  <p>xx2000002095</p>
2	Refit the inner plate with the screws.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 1.4 Nm</p>  <p>xx2000002076</p>

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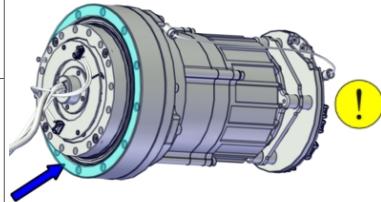
5 Repair

5.4.2 Replacing the housing

Continued

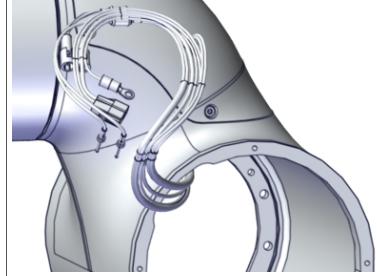
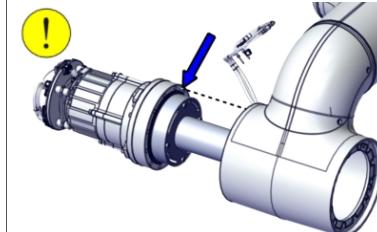
Action	Note
3 Refit the cover with the four screws.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.45 Nm</p>  <p>xx2000002075</p>

Preparations before fitting the joint 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 44 .	
2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574
3 Apply a thin layer of flange sealant to the mounting surface. Do not contaminate the radial sealing with sealant.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	 xx2000001860

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Refitting the axis-3 joint unit

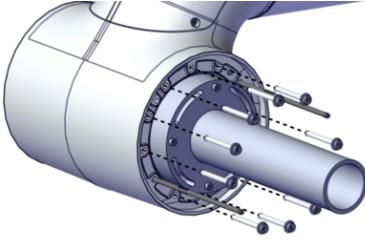
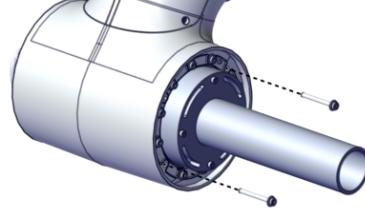
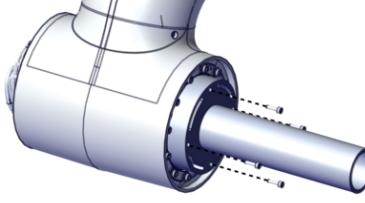
	Action	Note
1	<p>Fit the lifting aid to the joint unit.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)
2	Fit two guide pins to the joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.
3	Place the cabling at the slot before refitting the joint unit.	 xx2100000004
4	<p>Fit the joint unit to the housing, aligning the pin with the pin hole.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002072

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5 Repair

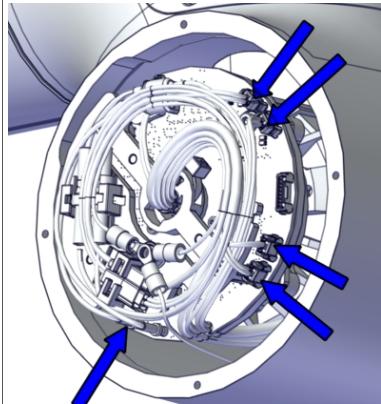
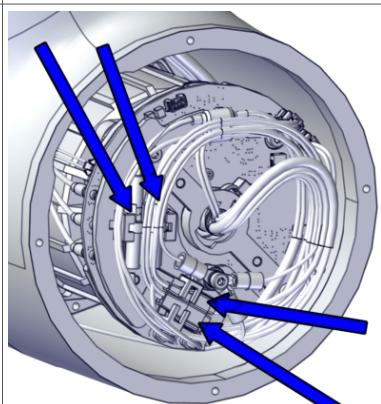
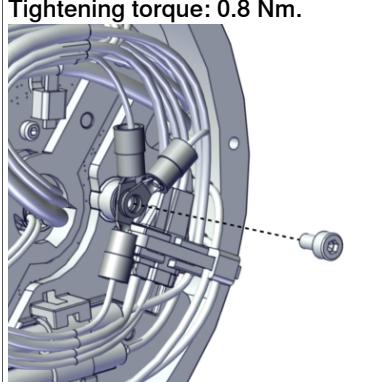
5.4.2 Replacing the housing

Continued

Action	Note
5 Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs</p> <p>Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2100000320</p>
6 Remove the guide pins and secure the remaining two attachment screws.	 <p>xx2000002070</p>
7 Pre-tighten the screws crosswise.	
8 Torque tighten all screws crosswise.	Tightening torque: 4.3 Nm.
9 Remove the lifting aid by removing the screws.	 <p>xx2000002069</p>
10 Clean pushed-out flange sealant, if any.	

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Connecting the axis-3 joint unit cabling

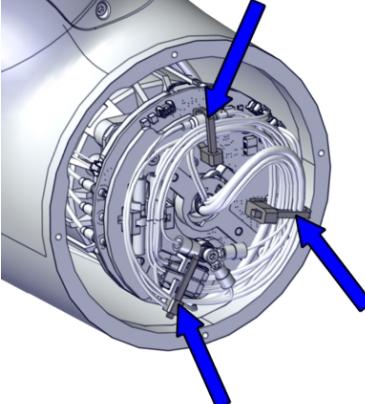
	Action	Note
1	<p>Reconnect the connectors to the drive board.</p> <ul style="list-style-type: none"> • D3.X1 to X1 • D3/4.DC+ to DC+ • D3/4.DC- to Ground • D3.X4 to X4 • D3/4.X2 to X2 • D3.X5 to X5 	 xx2000002068
2	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J4.DC+ to J4/5.DC+ • J4.DC- to J4/5.DC- • J4.CS to J4/5.CS • J4.CP to J4/5.CP 	 xx2000002067
3	<p>Secure the cables for functional earth and protective earth with a screw.</p>	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000001945

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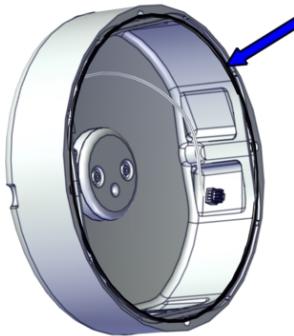
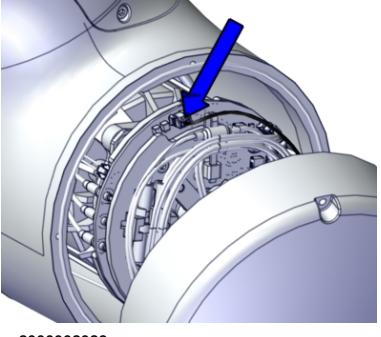
5 Repair

5.4.2 Replacing the housing

Continued

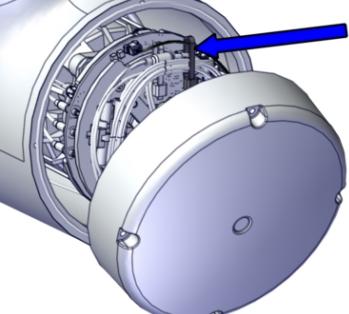
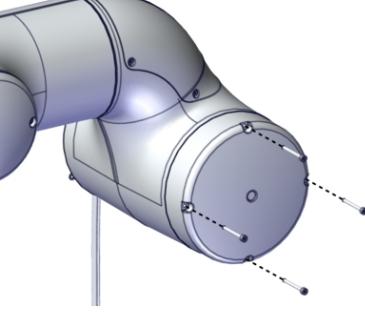
	Action	Note
4	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002066

Refitting the housing cover

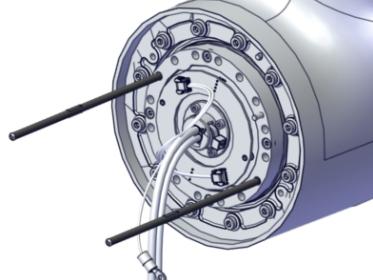
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000002023

Continues on next page

5.4.2 Replacing the housing
Continued

Action	Note
3 Secure the brake release cable with a cable tie.	Cable ties  xx2000002022
4 Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002021

Refitting the upper arm

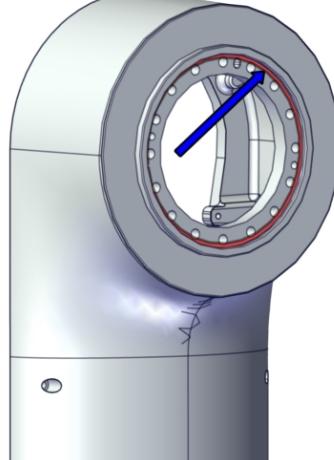
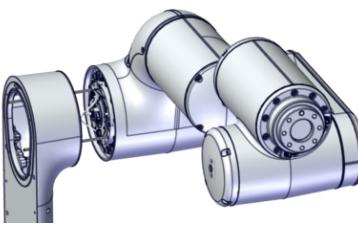
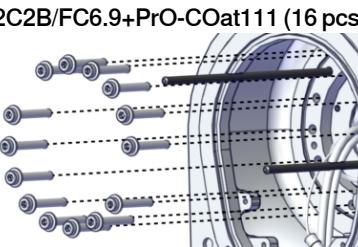
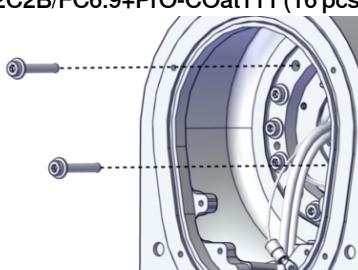
Action	Note
1 Fit two guide pins to the axis-3 joint.	 xx2000001971

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5 Repair

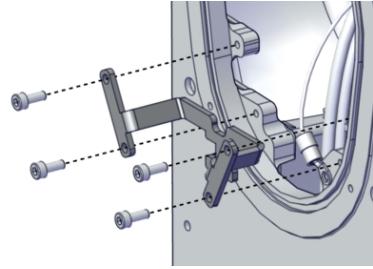
5.4.2 Replacing the housing

Continued

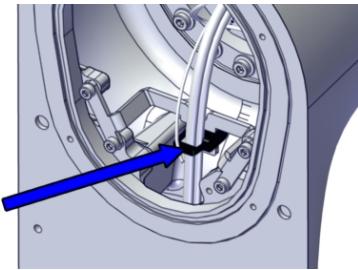
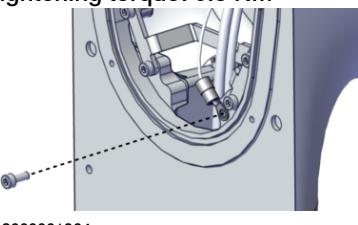
Action	Note
2	<p>Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.</p> 
3	<p>Lift the upper arm into mounting position while inserting the cabling into the lower arm.</p>
4	<p>Slide the upper arm into place on the guide pins.</p> 
5	<p>Secure the upper arm to the lower arm with all attachment screws but two. Pre-tighten the screws crosswise firstly.</p> 
6	<p>Remove the guide pins and fasten the remaining two screws.</p> 
7	<p>Torque tighten all screws crosswise.</p>
	<p>Tightening torque: 4.6 Nm.</p>

Continues on next page

5.4.2 Replacing the housing
Continued

	Action	Note
8	Refit the cable bracket with the four screws.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm</p>  <p>xx2000001966</p>

Fastening the cabling between the lower and upper arm

	Action	Note
1	Secure the cabling with the cable tie.	<p>Cable ties</p>  <p>xx2000001965</p>
2	Connect the functional earth cable with the screw.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm</p>  <p>xx2000001964</p>

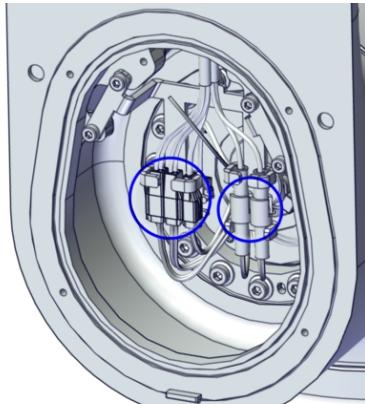
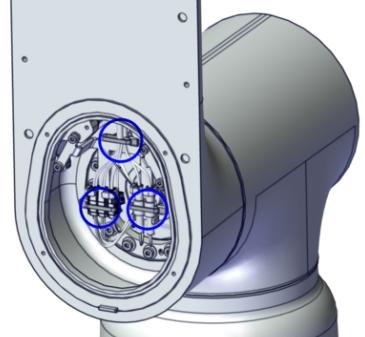
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5 Repair

5.4.2 Replacing the housing

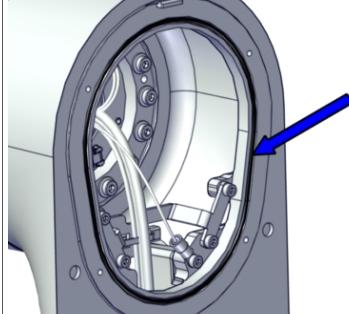
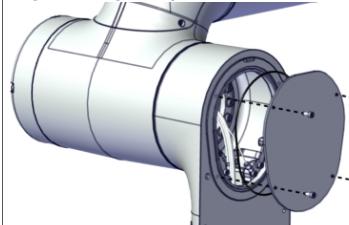
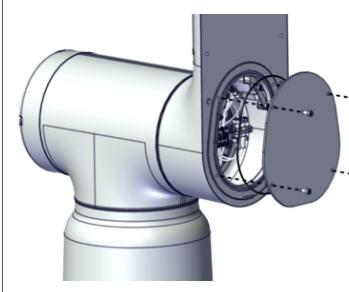
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Connecting the upper arm cabling

	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938
2	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937

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Refitting the lower arm covers

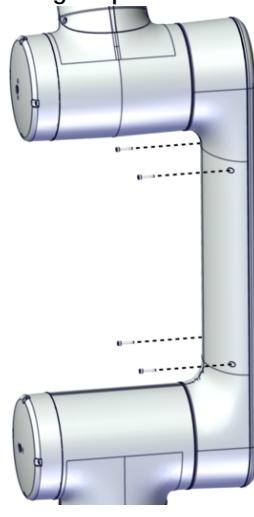
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001955  xx2000001954
2	Refit the inner covers with four screws each.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.4 Nm.  xx2000001947  xx2000001930

Continues on next page

5 Repair

5.4.2 Replacing the housing

Continued

	Action	Note
3	Snap the lower arm cover into place.	
4	Secure the cover with four screws.	Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000001929

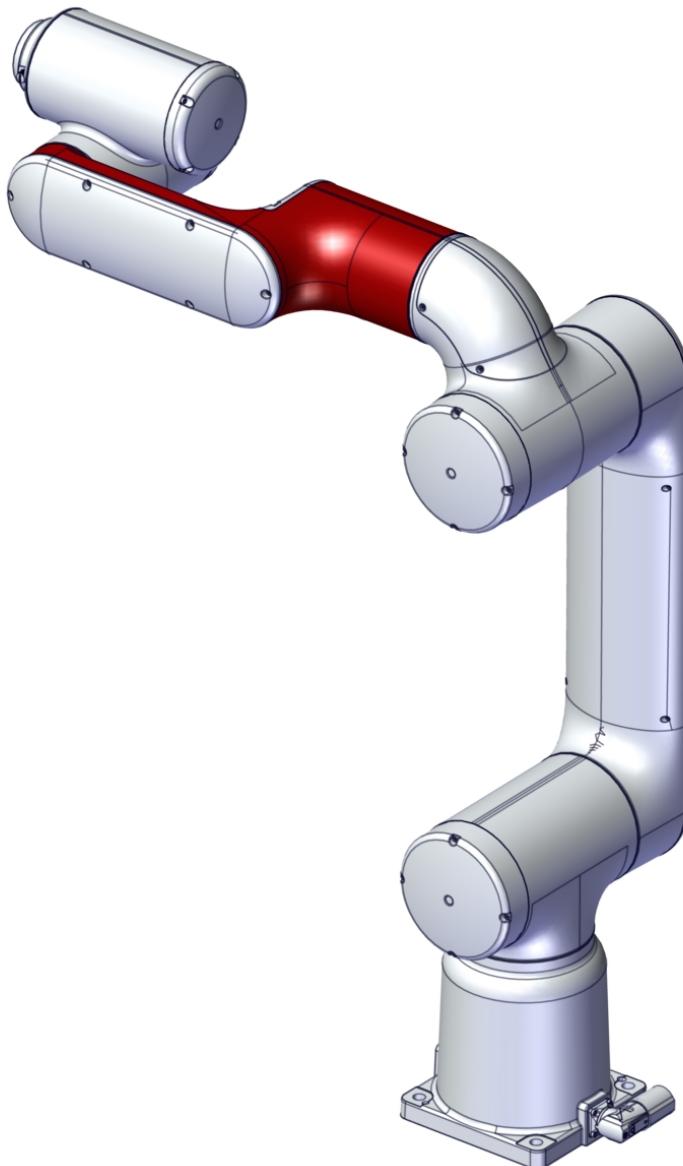
Concluding procedure

	Action	Note
1	Calibrate the axis-3 joint unit torque sensor.	See Calibration on page 719
2	 DANGER Make sure all safety requirements are met when performing the first test run.	

5.4.3 Replacing the tubular

Location of the tubular

The tubular is located as shown in the figure.



xx2100000052

Summary of the replacement procedure

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

- 1 Separate the cabling between the housing and the tubular (at the axis-3 joint unit).
- 2 Remove the complete tubular.
- 3 Remove the axis-4 joint unit.

Continues on next page

5 Repair

5.4.3 Replacing the tubular

Continued

- 4 Remove the tilt.
- 5 Replace the tubular.

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Tubular	3HAC074509-001	Also order new attachment screws for the axis-4 joint unit: 3HAB3413-330 (12 pcs).
Flange socket head screw with glue	3HAB3413-312	M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included.
Flange socket head screw with glue	3HAB3413-330	M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when re-fitting a joint unit. If ordering a new joint unit spare part, new screws are included.
Cable tie	3HAC075545-001	For securing joint unit cable.

Required tools and equipment

Equipment	Article number	Note
Tweezers	-	Used to handle drive board connectors.
Lifting aid	3HAC077789-001	For joint units on axes 4, 5 and 6. Attachment screws M3x12 (4 pcs) are enclosed.
Guide pin, M3x110	3HAC077787-001	Always use guide pins in pairs. For joint units on axes 4, 5 and 6.
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Cable ties	-	

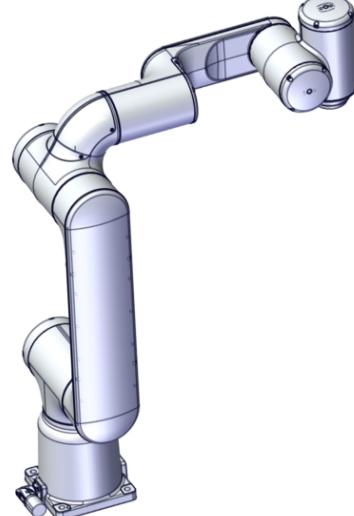
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Consumable	Article number	Note
O-ring	3HAC061327-043	Tubular cover Replace if damaged.
Grease	3HAC042536-001	Shell Gadus S2
O-ring	3HAC061327-051	Axis-4 cover Replace if damaged.
Gasket	3HAC075056-001	Cover inside housing Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.

Removing the tubular

Use these procedures to remove the tubular.

Preparations before removing the tubular

	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none"> • Axis 1: No significance. • Axis 2: 0° • Axis 3: 0° • Axis 4: 0° • Axis 5: +90° • Axis 6: No significance. 	 xx2100000005
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

Removing the housing cover

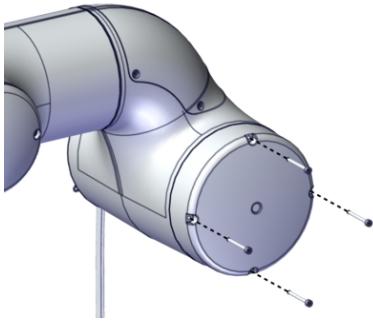
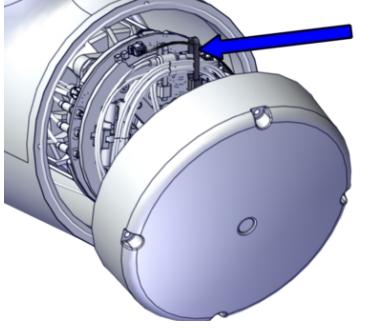
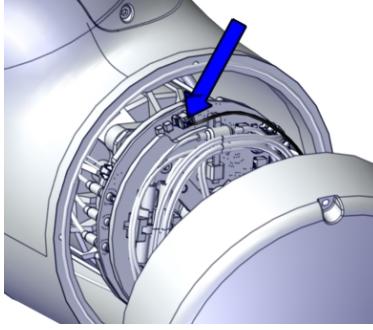
	Action	Note
1	<p>! CAUTION</p> <p>Make sure that all supplies for electrical power are turned off.</p>	

Continues on next page

5 Repair

5.4.3 Replacing the tubular

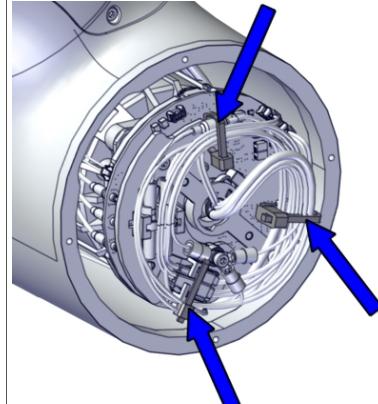
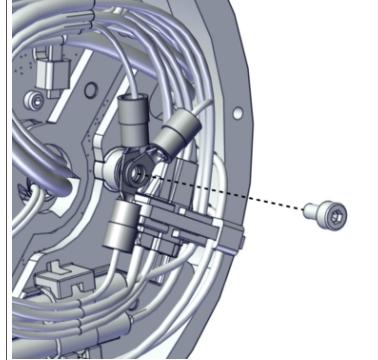
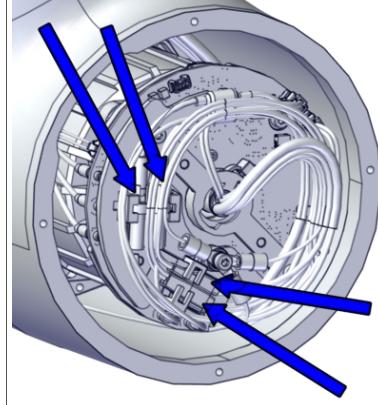
Continued

	Action	Note
2	Remove the cover screws.	
3	<p> CAUTION</p> <p>There is cabling connected between the cover and the joint unit drive board.</p> <p>Open the cover with care to avoid damage to the cabling or the connector(s).</p> <p>Do not leave the cover in location without being secured with the attachment screws.</p>	
4	Open the cover and cut the cable tie that holds the brake release cable.	
5	Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	

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5.4.3 Replacing the tubular
Continued

Separating the cabling between the housing and the tubular

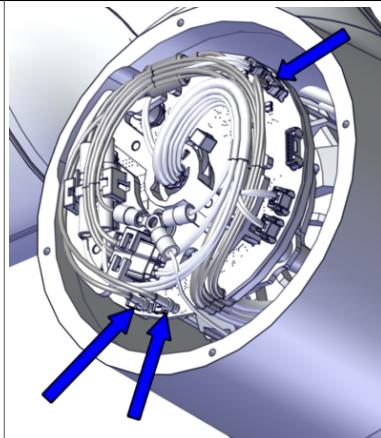
	Action	Note
1	Cut the cable ties.	 xx2000002066
2	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
3	Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP 	 xx2000002067

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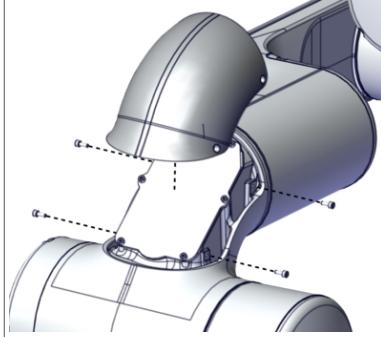
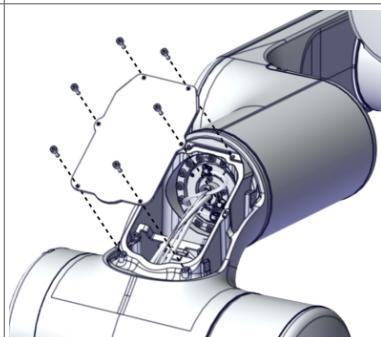
5 Repair

5.4.3 Replacing the tubular

Continued

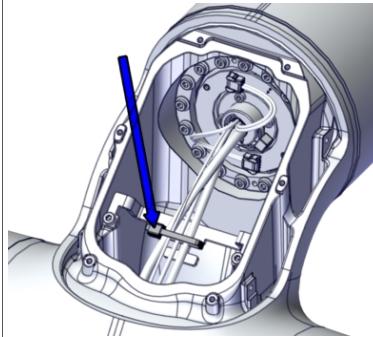
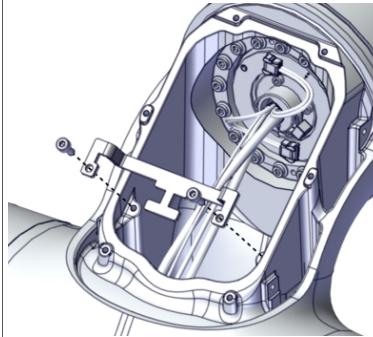
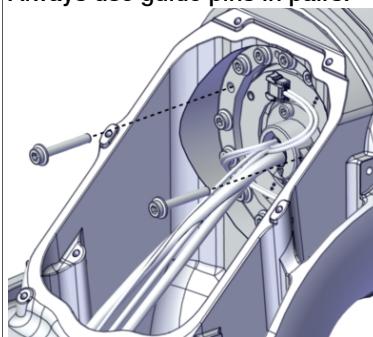
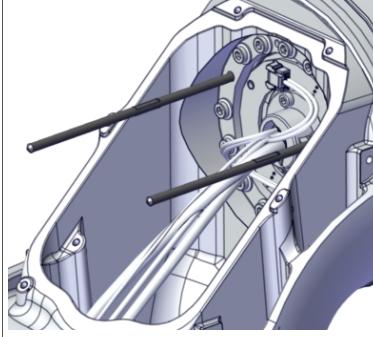
Action	Note
4 Disconnect the connectors from the drive board. <ul style="list-style-type: none">• D3/4.X2• D3/4.DC+• D3/4.DC-	 xx2000002120

Opening the housing top cover

Action	Note
1 Remove the cover by removing the four screws.	 xx2000002075
2 Remove the inner plate by removing the screws.	 xx2000002076

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Removing the tubular

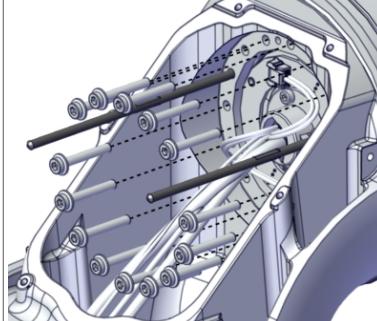
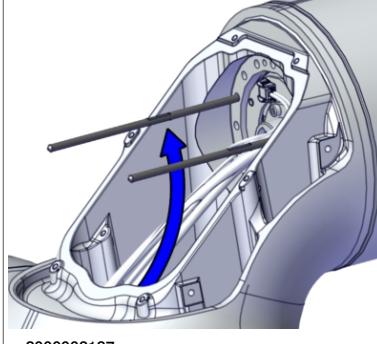
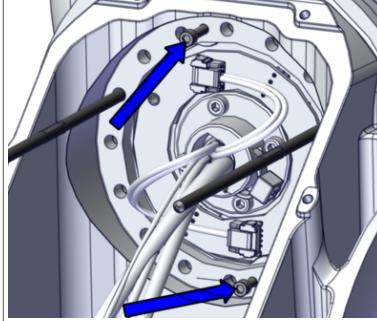
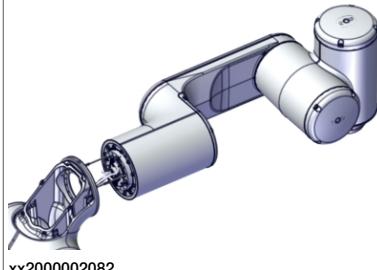
	Action	Note
1	Cut the cable tie.	 xx2000002077
2	Remove the cable bracket by removing the two screws.	 xx2000002078
3	Remove two attachment screws and fit two guide pins to the axis-4 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002079  xx2000002080

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5 Repair

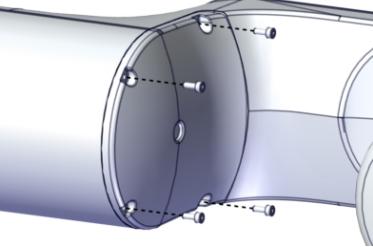
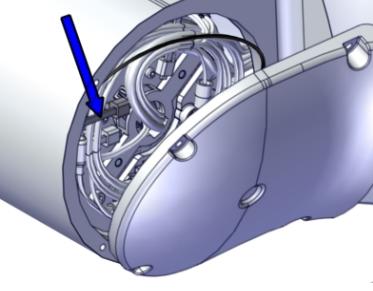
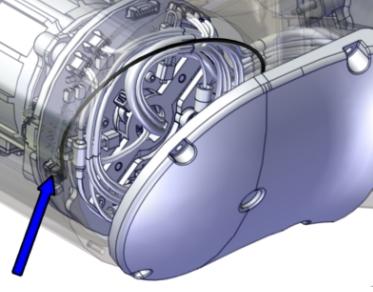
5.4.3 Replacing the tubular

Continued

Action	Note
4 Remove the remaining attachment screws.	 xx2000002081
5 Pull out the cabling carefully from the housing.	 xx2000002127
6 Use two fully threaded attachment screws as removal tools to press the housing out of position.	 xx2100000006
7 Remove the tubular from the housing. Assist the cabling to be removed from the housing while lifting away the complete tubular. Place the tubular on a workbench.	 xx2000002082

Continues on next page

Removing the axis-4 cover

	Action	Note
1	Remove the cover screws.	
2	<p>! CAUTION</p> <p>There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.</p>	
3	Open the cover and cut the cable tie that holds the brake release cable.	
4	<p>Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.</p>	

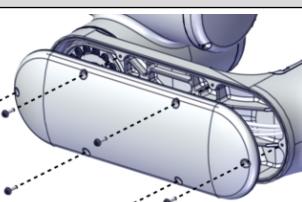
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5 Repair

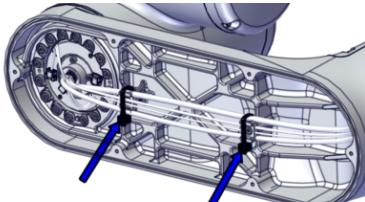
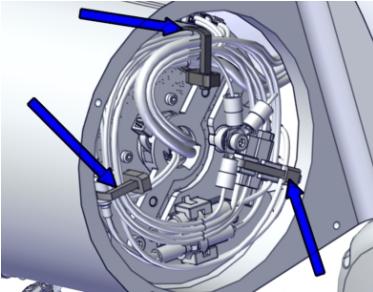
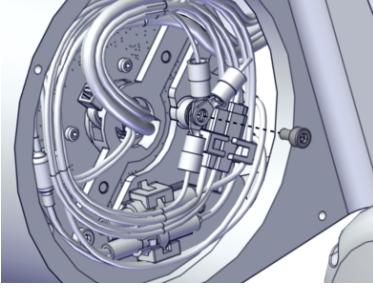
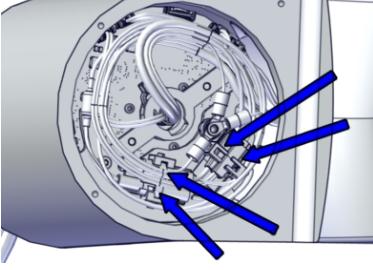
5.4.3 Replacing the tubular

Continued

Removing the tubular cover

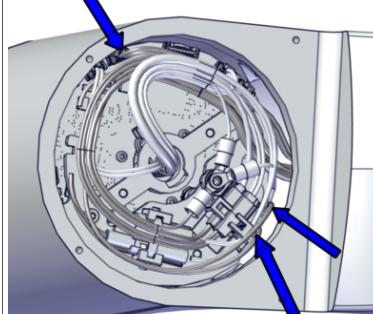
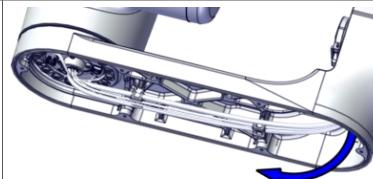
	Action	Note
1	Remove the cover by removing the six screws. Dispose the screws. New screws must be used when refitting the cover. New screws are included in the spare part delivery of the joint unit.	 xx2000002123

Separating the cabling between the tubular and the tilt

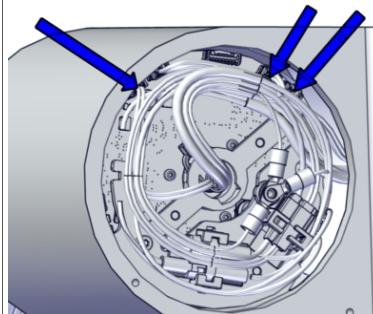
	Action	Note
1	Cut the cable ties, if needed.	 xx2000002124  xx2000002086
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002087
3	Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP 	 xx2000002089

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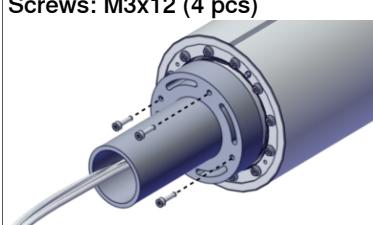
5.4.3 Replacing the tubular Continued

	Action	Note
4	<p>Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board:</p> <ul style="list-style-type: none"> • D3/4.X2 • D3/4.DC- • D3/4.DC+ <p>Use tweezers, if needed.</p>	<p>Tweezers</p>  <p>xx2000002125</p>
5	Pull out the cabling carefully from the tubular.	 <p>xx2000002126</p>

Disconnecting the axis-4 joint unit cabling

	Action	Note
1	<p>Disconnect the connectors from the drive board.</p> <p>CAUTION</p> <p>Use tweezers to unlock connectors and pull them off.</p> <ul style="list-style-type: none"> • D4/5.X1 • D4/5.X4 • D4/5.X5 	<p>Tweezers</p>  <p>xx2000002088</p>

Removing the axis-4 joint unit

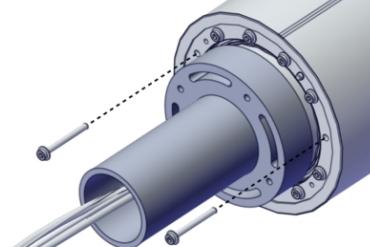
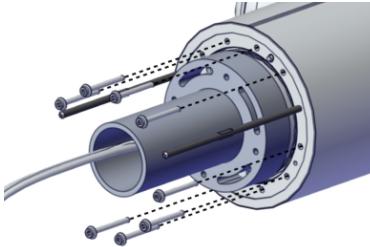
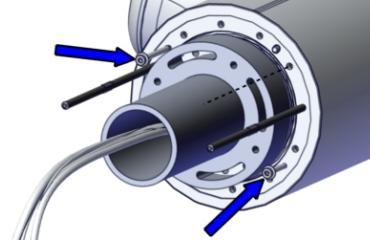
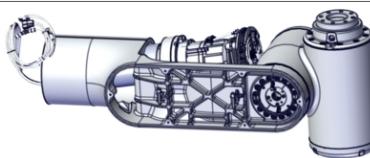
	Action	Note
1	<p>Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)</p>  <p>xx2000002090</p>

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5 Repair

5.4.3 Replacing the tubular

Continued

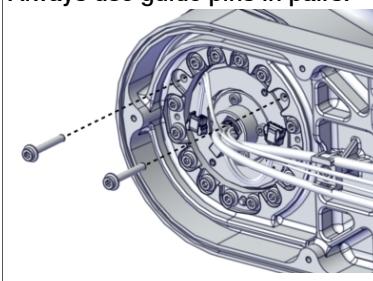
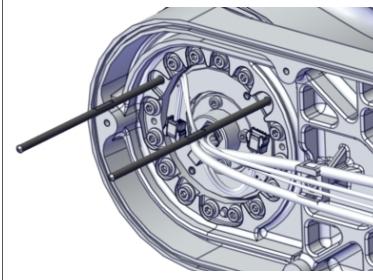
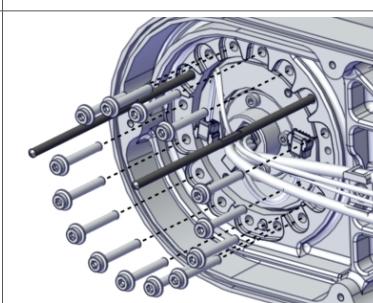
Action	Note
<p>2 Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002091
<p>3 Fit two guide pins to the axis-4 joint unit.</p>	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  xx2000002578
<p>4 Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000326
<p>5 Press the joint unit out of position using two of the previous attachment screws as removal tools.</p>	 xx2100000327
<p>6 Remove the joint unit from the tubular.</p> <p>CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002116

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**5.4.3 Replacing the tubular
Continued**

Action	Note
7 Remove the lifting aid and guide pins.	 xx2000001957

Removing the tilt

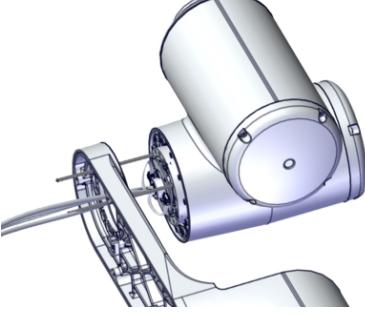
Action	Note
1 Remove two attachment screws and fit two guide pins to the axis-5 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002128
	 xx2000002129
2 Remove the remaining attachment screws.	 xx2000002130
3 Press the tilt out of position using two of the previous attachment screws as removal tools.	

Continues on next page

5 Repair

5.4.3 Replacing the tubular

Continued

Action	Note
4 Remove the tilt from the tubular. Assist the cabling to be removed while lifting away the complete tilt. Place the tilt on a workbench.	 xx2000002131

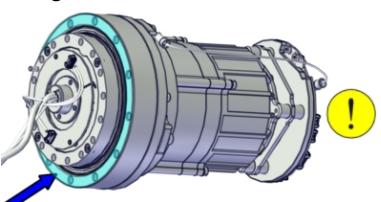
Replacing the tubular

Action	Note
1 Replace the tubular.	Tubular: 3HAC074509-001

Refitting the tubular

Use these procedures to refit the tubular.

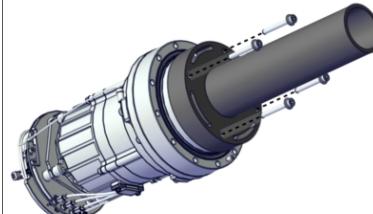
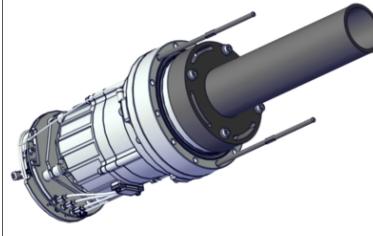
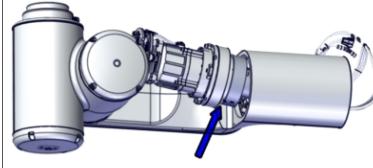
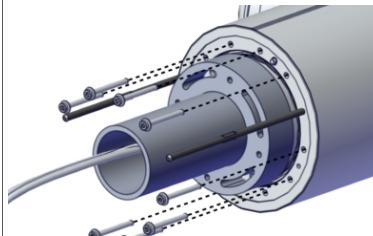
Preparations before fitting the joint unit

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 44 .	
2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574
3 Apply a thin layer of flange sealant to the mounting surface. Do not contaminate the radial sealing with sealant.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	 xx2000001860

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5.4.3 Replacing the tubular
Continued

Refitting the axis-4 joint unit

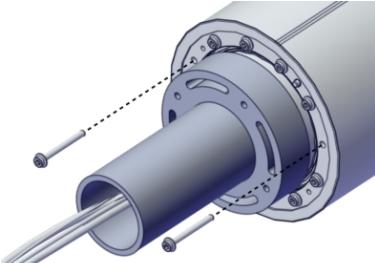
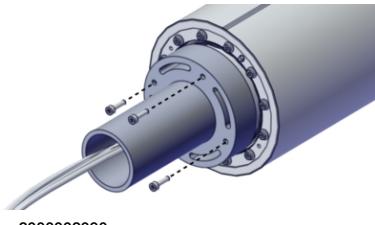
	Action	Note
1	<p>Fit the lifting aid to the joint unit.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Joint unit: 3HAC079143-001 Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)</p>  <p>xx2000001957</p>
2	Fit two guide pins to the joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  <p>xx2000002438</p>
3	<p>Fit the joint unit to the tubular, aligning the pin with the pin hole.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000002117</p>
4	Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+Pro-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2100000326</p>

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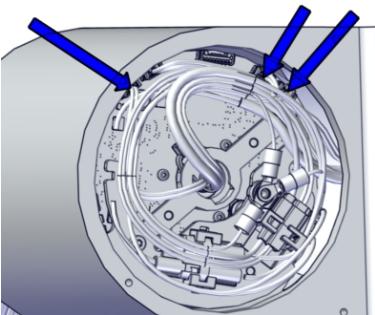
5 Repair

5.4.3 Replacing the tubular

Continued

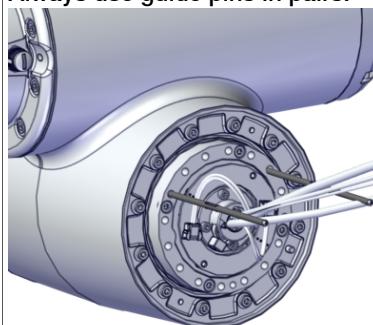
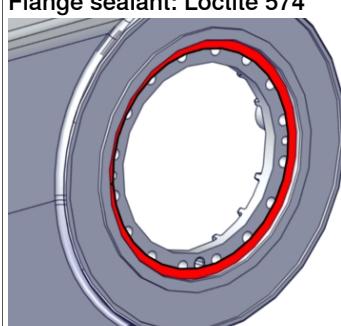
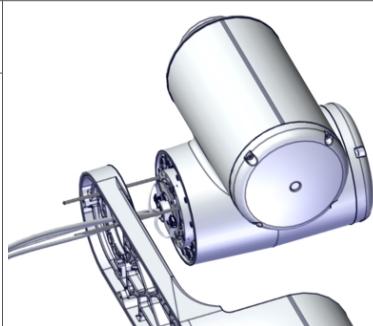
Action	Note
5 Remove the guide pins and secure the remaining two attachment screws.	 xx2000002091
6 Pre-tighten the screws crosswise.	
7 Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm.
8 Remove the lifting aid by removing the screws.	 xx2000002090
9 Clean pushed-out flange sealant, if any.	

Connecting the axis-4 joint unit cabling

Action	Note
1 Reconnect the connectors to the drive board. <ul style="list-style-type: none">• D4/5.X1 to X1• D4/5.X4 to X4• D4/5.X5 to X5	 xx2000002088

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Refitting the tilt

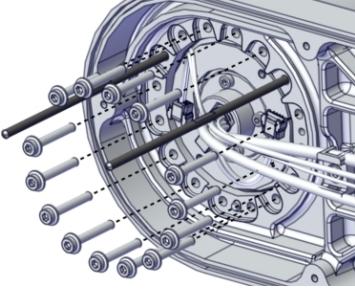
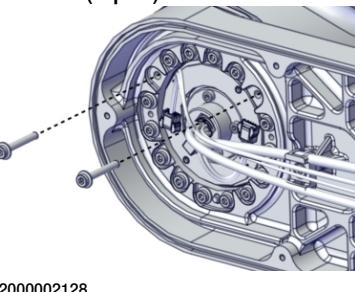
	Action	Note
1	Fit two guide pins to the axis-5 joint.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002146
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the tubular mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000002147
3	Lift the tilt into mounting position while inserting the cabling into the tubular.	
4	Slide the tilt into place on the guide pins.	 xx2000002131

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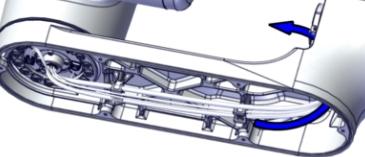
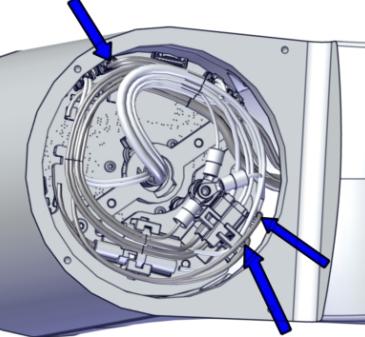
5 Repair

5.4.3 Replacing the tubular

Continued

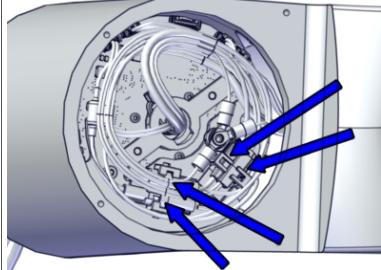
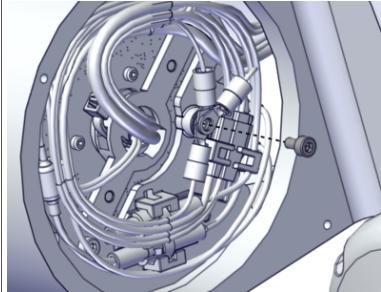
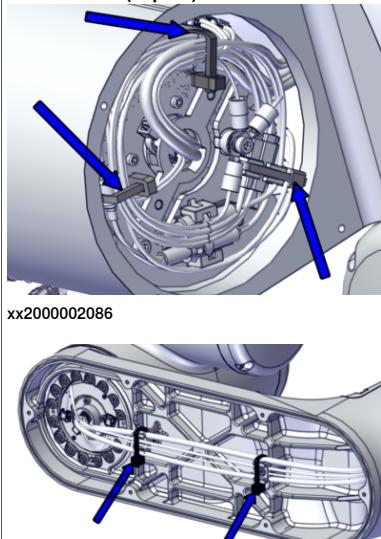
Action	Note
5 Secure the tilt to the tubular with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (14 pcs)  xx2000002130
6 Remove the guide pins and fasten the remaining two screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (2 pcs)  xx2000002128
7 Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.

Connecting the tilt cabling

Action	Note
1 Insert the cabling into the tubular.	 xx2000002148
2 Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D3/4.X2 to X2 • D3/4.DC- to Ground • D3/4.DC+ to +DC 	 xx2000002125

Continues on next page

5.4.3 Replacing the tubular
Continued

	Action	Note
3	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J4/5.DC+ to J5/6.DC+ • J4/5.DC- to J5/6.DC- • J4/5.CS to J5/6.CS • J4/5.CP to J5/6.CP 	 xx2000002089
4	Secure the cables for functional earth and protective earth with a screw.	<p>Hex socket head cap screw: M3x6 (1 pcs).</p> <p>Tightening torque: 0.8 Nm.</p>  xx2000002087
5	Secure the cabling with cable ties.	<p>Cable ties (3 pcs)</p>  xx2000002086 xx2000002124

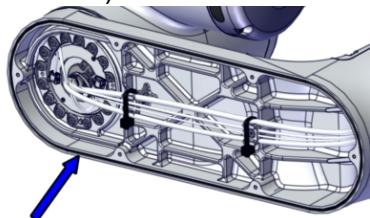
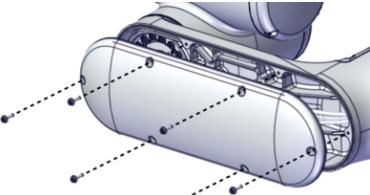
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5 Repair

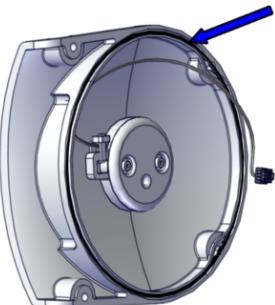
5.4.3 Replacing the tubular

Continued

Refitting the tubular cover

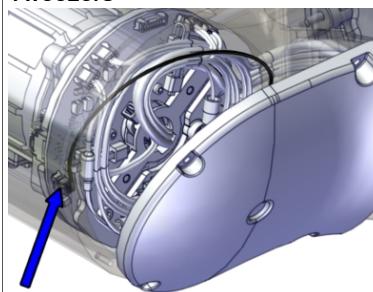
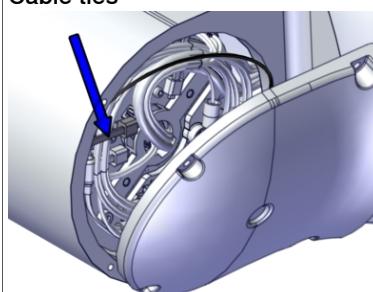
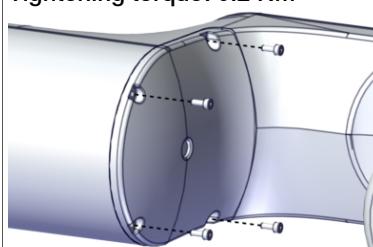
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-043 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002149
2	Refit the cover with new attachment screws.	Flange socket head screw with glue: 3HAB3413-312 M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included. Tightening torque: 1.6 Nm.  xx2000002123

Refitting the axis-4 cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002092

Continues on next page

5.4.3 Replacing the tubular
Continued

	Action	Note
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	Tweezers  xx2000002085
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000002084
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.2 Nm  xx2000002083

Refitting the tubular

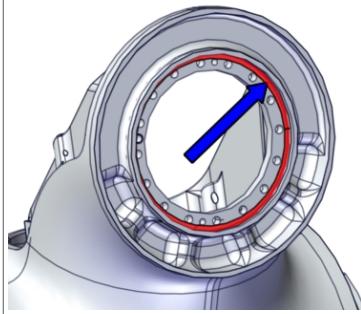
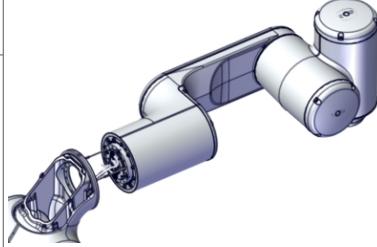
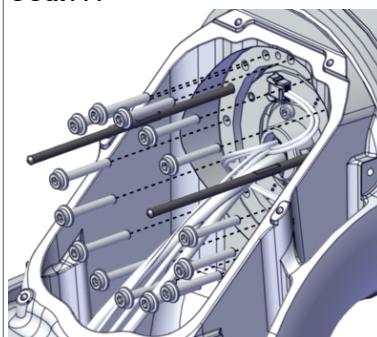
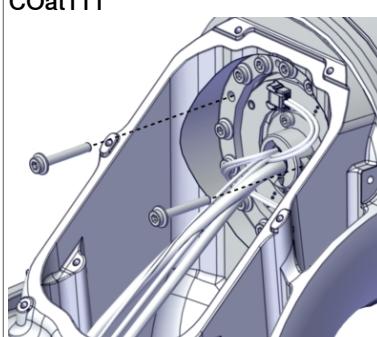
	Action	Note
1	Fit two guide pins to the axis-4 joint.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002093

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5 Repair

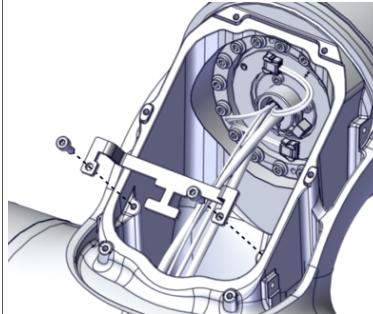
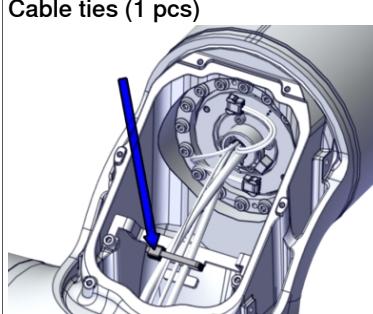
5.4.3 Replacing the tubular

Continued

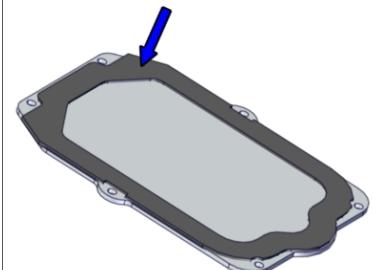
	Action	Note
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the housing mounting surface, as pointed out in the figure.	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000002094</p>
3	Lift the tubular into mounting position while inserting the cabling into the housing.	 <p>xx2000002082</p>
4	Slide the tubular into place on the guide pins.	
5	Secure the tubular to the housing with all attachment screws but two. Pre-tighten the screws crosswise firstly.	<p>Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111</p>  <p>xx2000002081</p>
6	Remove the guide pins and fasten the remaining two screws.	<p>Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111</p>  <p>xx2000002079</p>

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5.4.3 Replacing the tubular
Continued

	Action	Note
7	Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.
8	Refit the cable bracket with the two screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm
		 xx2000002078
9	Secure the cabling with a cable tie.	Cable ties (1 pcs)
		 xx2000002077

Closing the housing top cover

	Action	Note
1	Check the inner plate gasket. Replace if damaged.	Gasket: 3HAC075056-001  xx2000002095

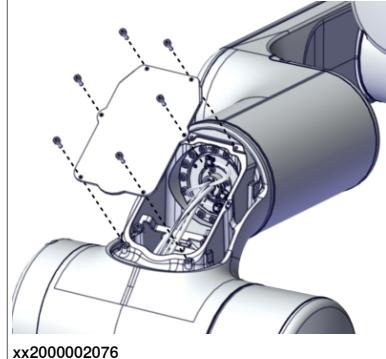
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5 Repair

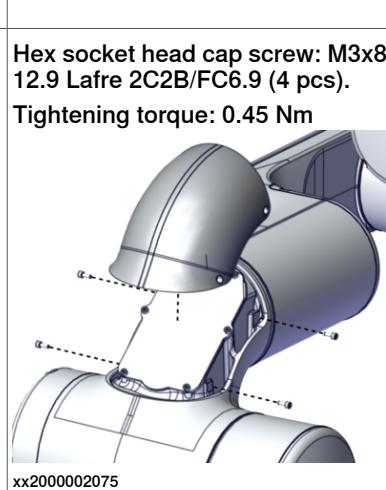
5.4.3 Replacing the tubular

Continued

Action	Note
2	Refit the inner plate with the screws.
3	Refit the cover with the four screws.



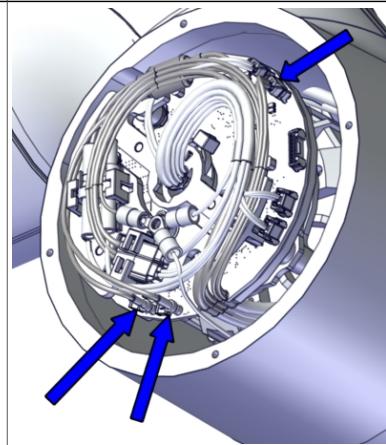
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xx2000002075

Connecting the tubular cabling

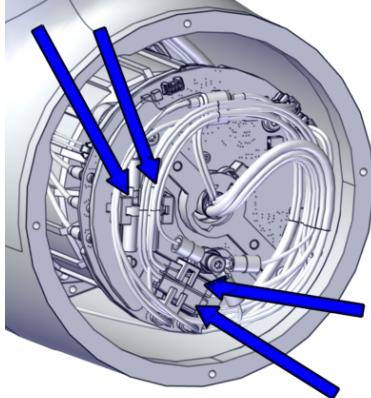
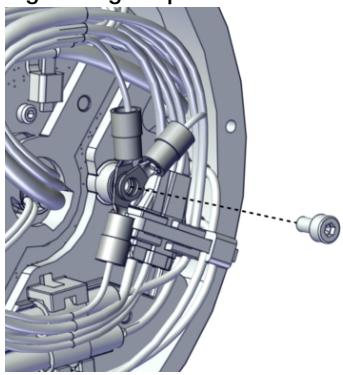
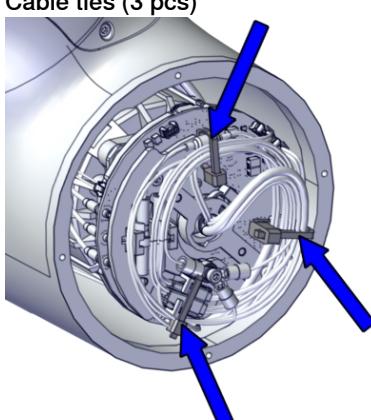
Action	Note
1	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D3/4.DC+ to DC+ • D3/4.DC- to Ground • D3/4.X2 to X2



xx2000002120

Continues on next page

5.4.3 Replacing the tubular
Continued

	Action	Note
2	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J3.DC+ to J3.DC+ • J3.DC- to J3.DC- • J3.CS to J3.CS • J3.CP to J3.CP 	 xx2000002067
3	<p>Secure the cables for functional earth and protective earth with a screw.</p>	<p>Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.</p>  xx2000001945
4	<p>Secure the cabling with cable ties.</p>	<p>Cable ties (3 pcs)</p>  xx2000002066

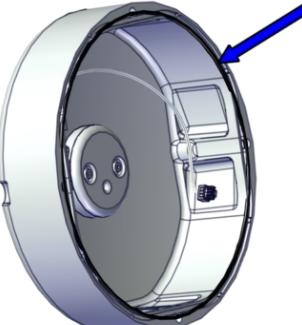
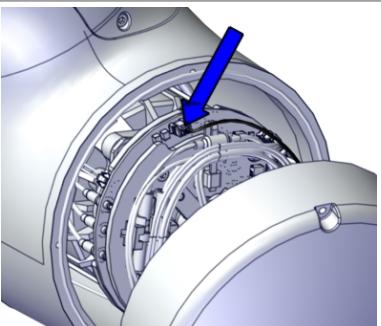
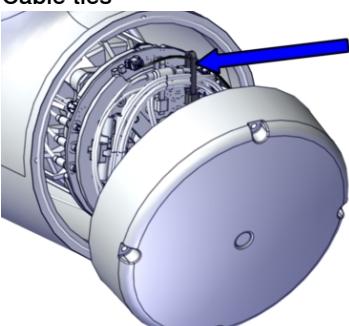
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5 Repair

5.4.3 Replacing the tubular

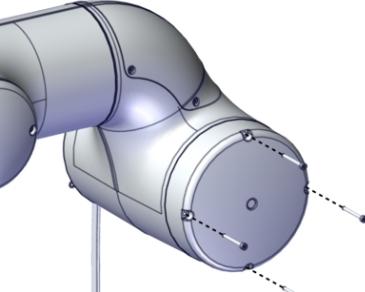
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Refitting the housing cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000002023
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000002022

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5.4.3 Replacing the tubular
Continued

Action	Note
4 Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002021

Concluding procedure

Action	Note
1 Calibrate the axis-4 joint unit torque sensor.	See Calibration on page 719
2  DANGER Make sure all safety requirements are met when performing the first test run.	

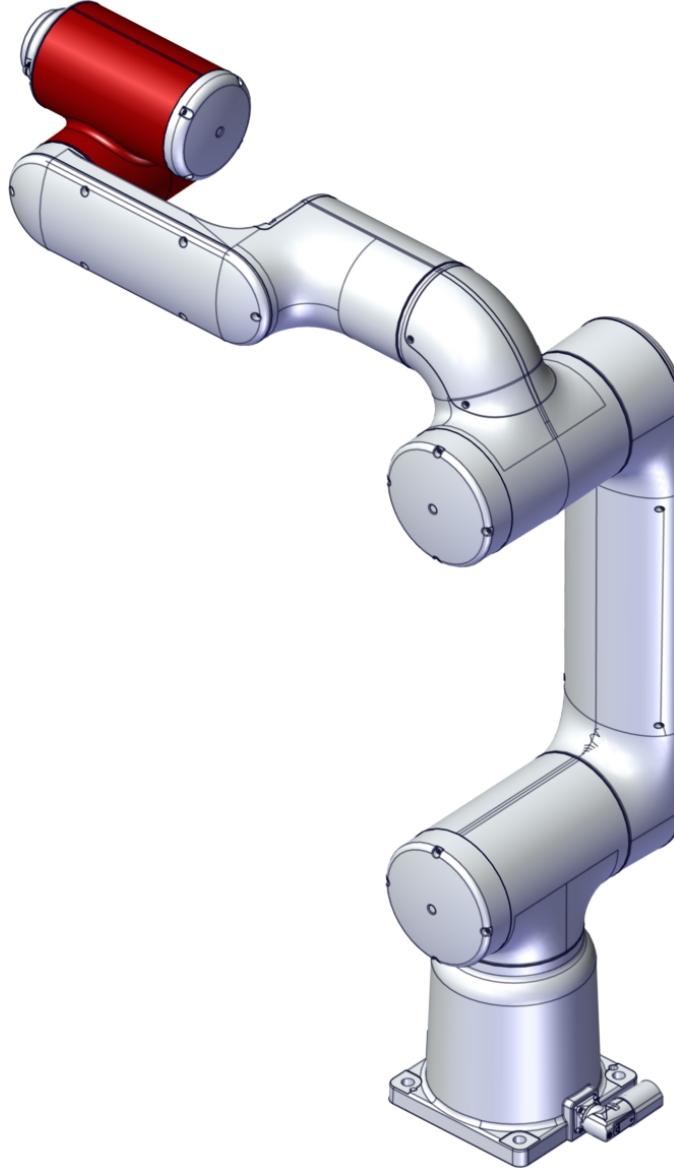
5 Repair

5.4.4 Replacing the wrist housing

5.4.4 Replacing the wrist housing

Location of the wrist

The wrist is located as shown in the figure.



xx2100000053

Summary of the replacement procedure

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

- 1 Remove the tubular cover.
- 2 Separate the cabling between the tubular and the tilt (at the axis-4 joint unit).
- 3 Remove the tilt and place on a workbench.
- 4 Remove the axis-6 joint unit.

Continues on next page

- 5 Remove the axis-5 joint unit.
- 6 Replace the wrist housing.

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Wrist housing	3HAC073951-001	Also order new attachment screws for the axis-5 and axis-6 joint unit: 3HAB3413-330 (24 pcs).
Flange socket head screw with glue	3HAB3413-330	M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when re-fitting a joint unit. If ordering a new joint unit spare part, new screws are included.
Flange socket head screw with glue	3HAB3413-330	M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when re-fitting a joint unit. If ordering a new joint unit spare part, new screws are included.
Flange socket head screw with glue	3HAB3413-312	M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included.
Cable tie	3HAC075545-001	For securing joint unit cable.
Cable tie	3HAC075545-001	For securing joint unit cable.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077789-001	For joint units on axes 4, 5 and 6. Attachment screws M3x12 (4 pcs) are enclosed.
Guide pin, M3x110	3HAC077787-001	Always use guide pins in pairs. For joint units on axes 4, 5 and 6.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.

Continues on next page

5 Repair

5.4.4 Replacing the wrist housing

Continued

Equipment	Article number	Note
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Tweezers	-	Used to handle drive board connectors.
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Grease	3HAC042536-001	Shell Gadus S2
Cable ties	-	
O-ring	3HAC061327-051	Axis-5 cover Replace if damaged.
O-ring	3HAC061327-051	Arm-side interface Replace if damaged.
O-ring	3HAC061327-043	Tubular cover Replace if damaged.

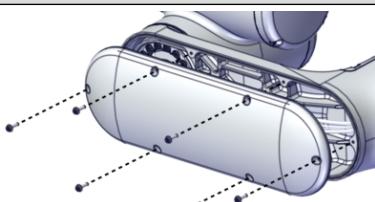
Removing the wrist housing

Use these procedures to remove the wrist.

Preparations before removing the wrist

	Action	Note
1	Jog the robot to the synchronization position.	
2	 CAUTION Turn off all supplies for electrical power to the robot, before starting the repair work.	

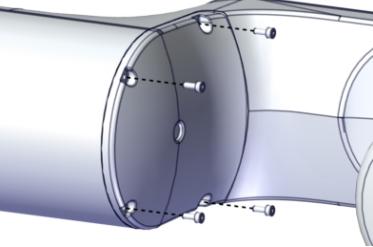
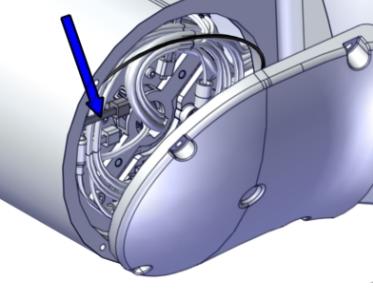
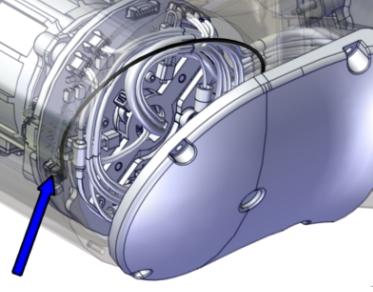
Removing the tubular cover

	Action	Note
1	Remove the cover by removing the six screws. Dispose the screws. New screws must be used when refitting the cover. New screws are included in the spare part delivery of the joint unit.	 xx2000002123

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5.4.4 Replacing the wrist housing
Continued

Removing the axis-4 cover

	Action	Note
1	Remove the cover screws.	 xx2000002083
2	<p>! CAUTION</p> <p>There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.</p>	
3	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002084
4	<p>Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.</p>	 Tweezers xx2000002085

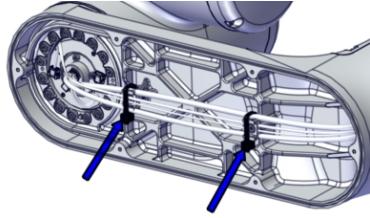
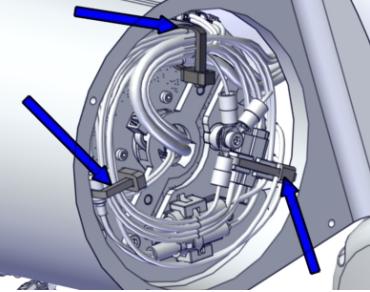
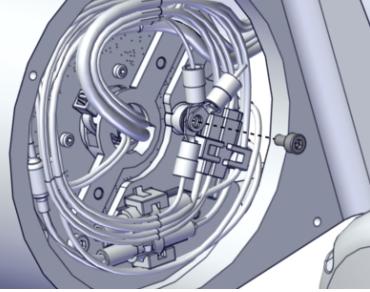
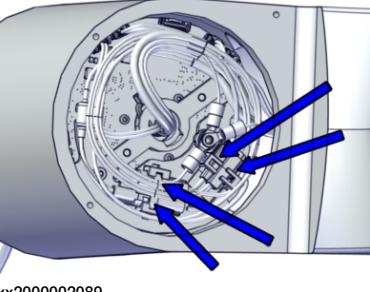
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5 Repair

5.4.4 Replacing the wrist housing

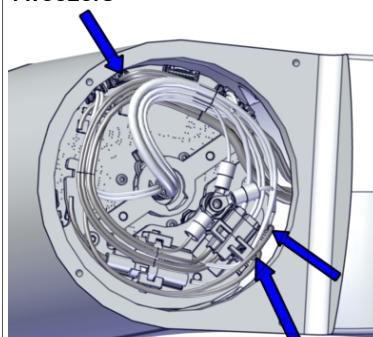
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Separating the cabling between the tubular and the tilt

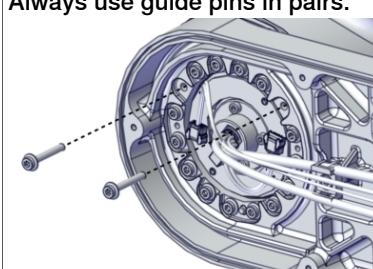
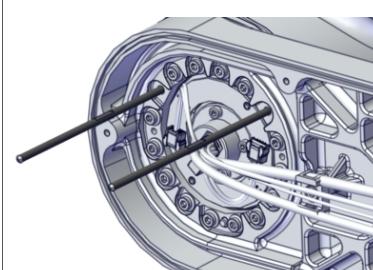
	Action	Note
1	Cut the cable ties, if needed.	 xx2000002124  xx2000002086
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002087
3	Snap loose and disconnect the connectors: <ul style="list-style-type: none">• J4/5.DC+• J4/5.DC-• J4/5.CS• J4/5.CP	 xx2000002089

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5.4.4 Replacing the wrist housing
Continued

Action	Note
<p>4 Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board:</p> <ul style="list-style-type: none"> • D3/4.X2 • D3/4.DC- • D3/4.DC+ <p>Use tweezers, if needed.</p>	<p>Tweezers</p>  <p>xx2000002125</p>
5 Pull out the cabling carefully from the tubular.	 <p>xx2000002126</p>

Removing the tilt

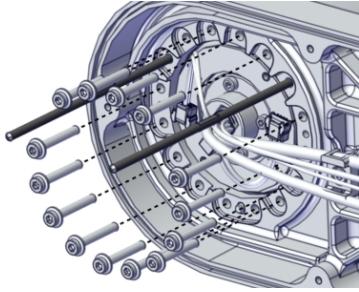
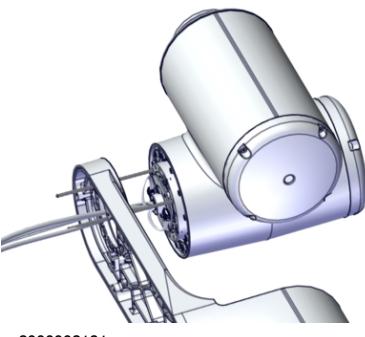
Action	Note
1 Remove two attachment screws and fit two guide pins to the axis-5 joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.</p>  <p>xx2000002128</p>  <p>xx2000002129</p>

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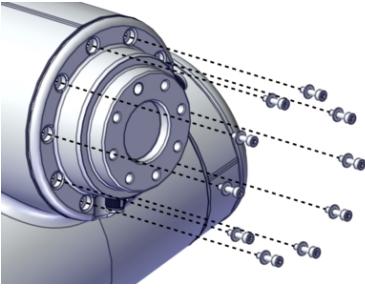
5 Repair

5.4.4 Replacing the wrist housing

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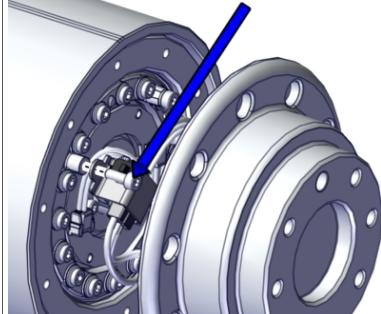
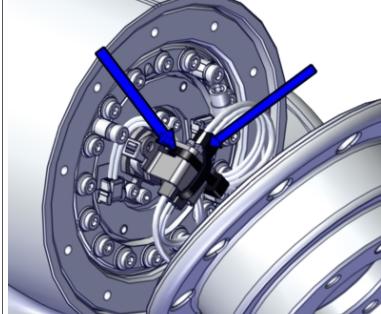
Action	Note
2 Remove the remaining attachment screws.	 xx2000002130
3 Press the tilt out of position using two of the previous attachment screws as removal tools.	
4 Remove the tilt from the tubular. Assist the cabling to be removed while lifting away the complete tilt. Place the tilt on a workbench.	 xx2000002131

Removing the tool flange

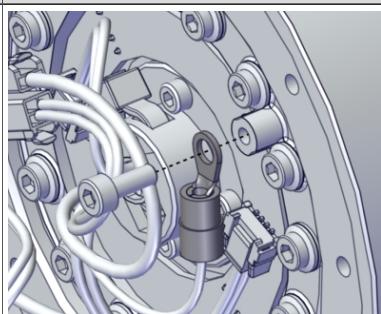
Action	Note
1 Remove the tool flange screws and washers.	 xx2000002155
2  CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	

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5.4.4 Replacing the wrist housing
Continued

Action	Note
3 Loosen the tool flange and remove the cable bracket by removing the screw.	 xx2000002156
4 Cut the cable ties.	 xx2000002157
5 Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

Disconnecting the tool flange functional earth cable

Action	Note
1 Remove the functional earth cable by removing the screw.	 xx2000002159

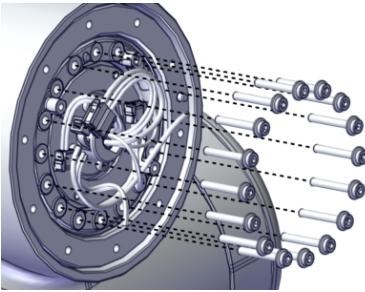
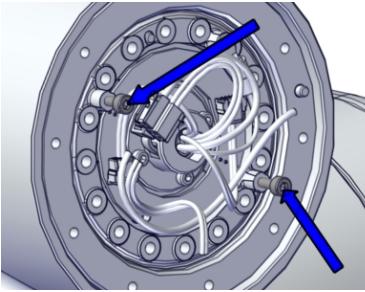
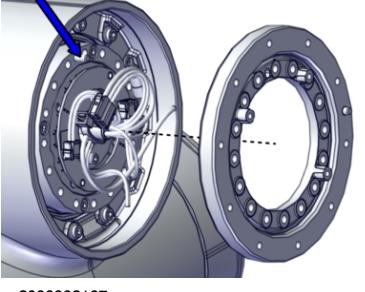
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5 Repair

5.4.4 Replacing the wrist housing

Continued

Removing the tool flange adapter

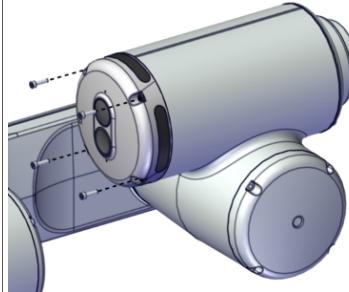
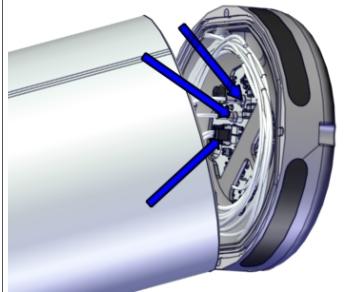
	Action	Note
1	Remove the tool flange adapter screws.	 xx2000002165
2	Press the adapter out of position by using two of the attachment screws as removal tools.	 xx2000002166
3	Remove the tool flange adapter.	 xx2000002167

Removing the arm-side interface

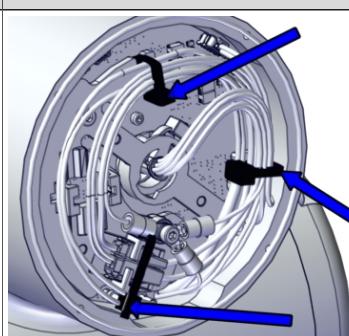
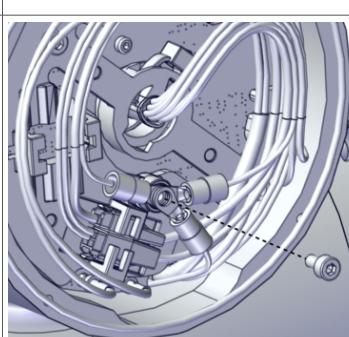
	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	 CAUTION There is cabling connected between the arm-side interface and the joint unit drive board. Open the arm-side interface with care to avoid damage to the cabling or the connector(s). Do not leave the arm-side interface in location without being secured with the attachment screws.	

Continues on next page

5.4.4 Replacing the wrist housing
Continued

Action	Note
3 Remove the attachment screws.	 xx2000002550
4 Loosen the arm-side interface carefully and disconnect the connectors from it. <ul style="list-style-type: none"> • ASI.DC+ • ASI.DC- • ASI.X1 	 xx2100000335

Disconnecting the axis-6 joint unit cabling

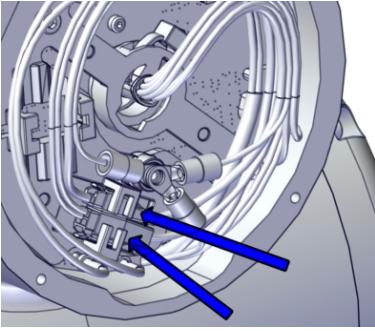
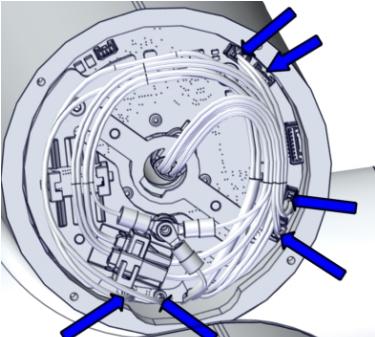
Action	Note
1 Cut the cable ties.	 xx2000002161
2 Remove the functional and protective earth cables by removing the screw.	 xx2000002162

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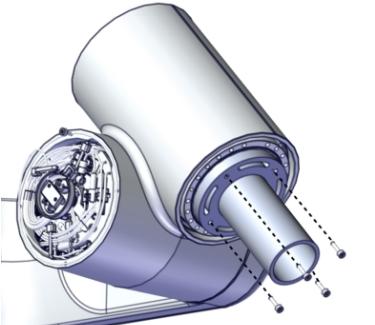
5 Repair

5.4.4 Replacing the wrist housing

Continued

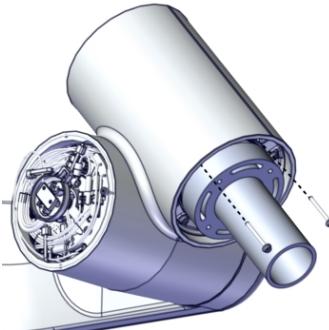
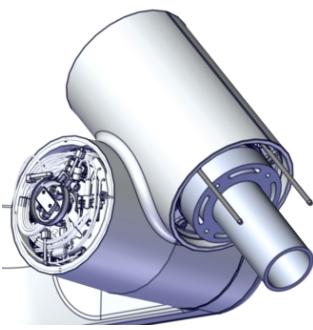
Action	Note
3 Snap loose and disconnect the connectors: • J7.CS • J7.CP	 xx2000002163
4 Disconnect the connectors from the drive board. • D6.X1 • D6.DC+ • D6.DC- • D6.X4 • D6.X2 • D6.X5	Tweezers  xx2000002164

Removing the axis-6 joint unit

Action	Note
1 Fit the lifting aid to the joint unit, on the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002168 Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.

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5.4.4 Replacing the wrist housing
Continued

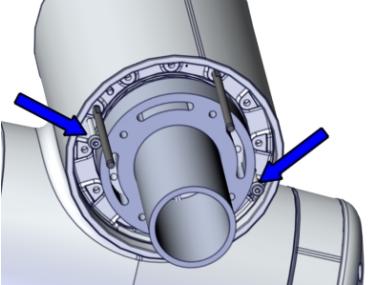
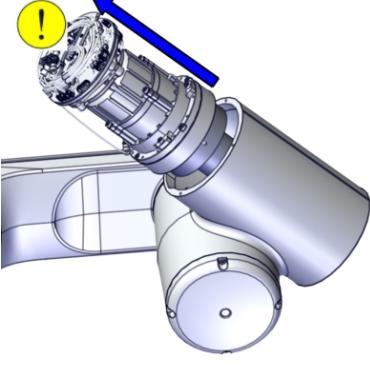
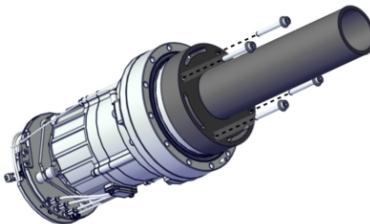
	Action	Note
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002170 <p>Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.</p>
3	<p>Fit two guide pins to the axis-6 joint unit.</p>	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  xx2100000328
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000329

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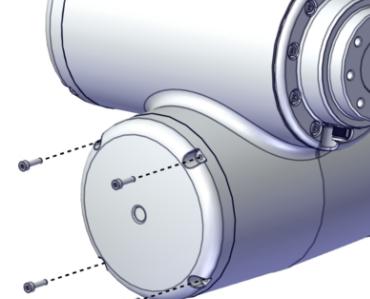
5 Repair

5.4.4 Replacing the wrist housing

Continued

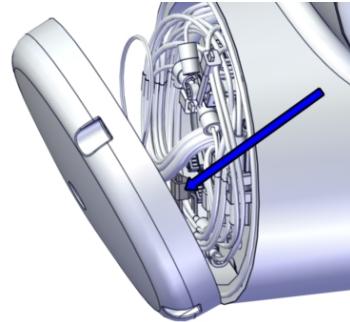
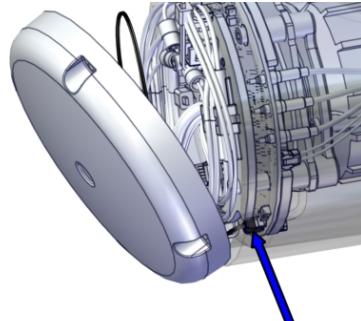
Action	Note
5 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2100000330
6 Remove the joint unit from the tubular. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002169 <p>Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.</p>
7 Remove the lifting aid and guide pins.	 xx2000001957

Removing the axis-5 cover

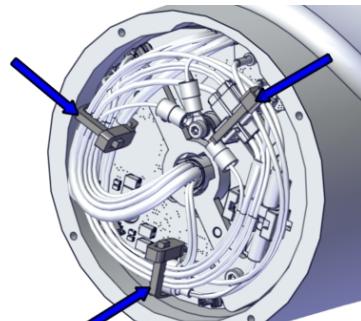
Action	Note
1 Remove the cover by removing the four screws.	 xx2000002132

Continues on next page

5.4.4 Replacing the wrist housing
Continued

Action	Note
<p>2</p> <p>CAUTION</p> <p>There is cabling connected between the cover and the joint unit drive board.</p> <p>Open the cover with care to avoid damage to the cabling or the connector(s).</p> <p>Do not leave the cover in location without being secured with the attachment screws.</p>	
<p>3</p> <p>Open the cover and cut the cable tie that holds the brake release cable.</p>	 <p>xx2000002133</p>
<p>4</p> <p>Disconnect the brake release connector DR.X8 from the drive board.</p> <p>Remove the cover.</p>	 <p>xx2000002134</p>

Disconnecting the axis-5 joint unit cabling

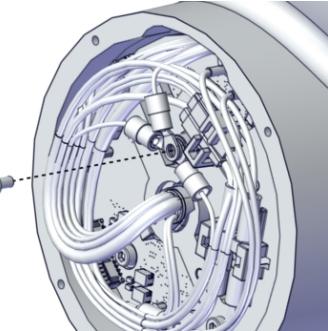
Action	Note
<p>1</p> <p>Cut the cable ties.</p>	 <p>xx2000002135</p>

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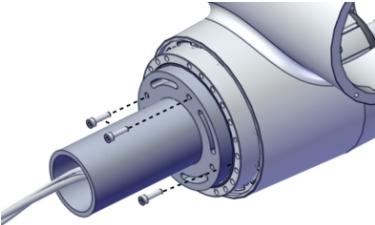
5 Repair

5.4.4 Replacing the wrist housing

Continued

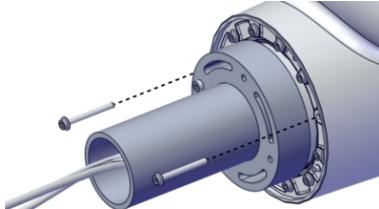
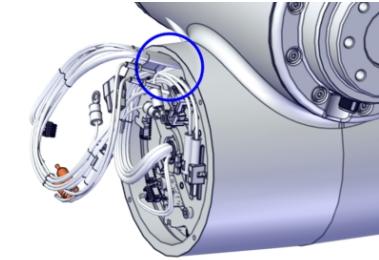
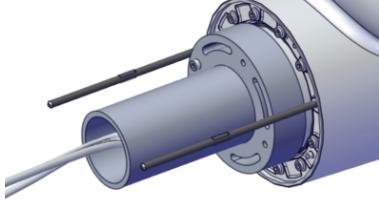
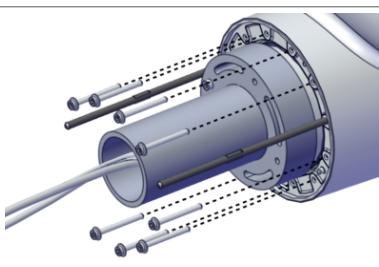
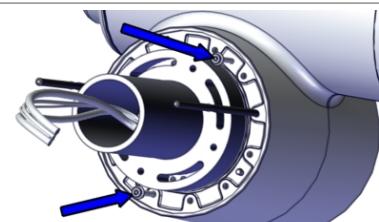
Action	Note
2 Remove the functional and protective earth cables by removing the screw.	 xx2000002136
3 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J5/6.DC+ • J5/6.DC- • J5/6.CS • J5/6.CP 	 xx2000002137
4 Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D4/5.X1 • D5.DC+ • D5.DC- • D4/5.X4 • D5.X2 • D4/5.X5 <p> CAUTION Use tweezers to unlock connectors and pull them off.</p>	Tweezers  xx2000002138

Removing the axis-5 joint unit

Action	Note
1 Fit the lifting aid to the joint unit, on the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002139

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5.4.4 Replacing the wrist housing
Continued

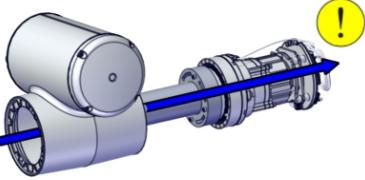
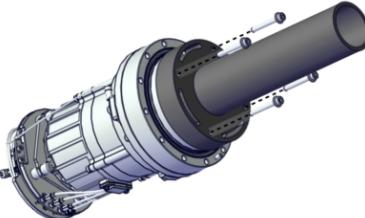
	Action	Note
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002140
3	<p>Put the cabling at the slot in order not to squeeze it during removal of joint unit.</p>	 xx2100000284
4	<p>Fit two guide pins to the axis-5 joint unit.</p>	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  xx2100000332
5	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000333
6	<p>Press the joint unit out of position using two of the previous attachment screws as removal tools.</p>	 xx2100000334

Continues on next page

5 Repair

5.4.4 Replacing the wrist housing

Continued

	Action	Note
7	<p>Remove the joint unit from the tubular.</p> <p> CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002141
8	Remove the lifting aid and guide pins.	 xx2000001957

Replacing the wrist

	Action	Note
1	Replace the wrist unit.	Wrist housing: 3HAC073951-001

Refitting the wrist housing

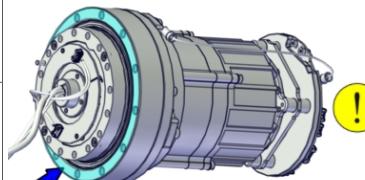
Use these procedures to refit the wrist.

Preparations before fitting the joint unit

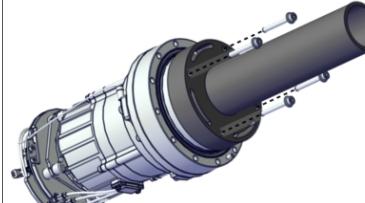
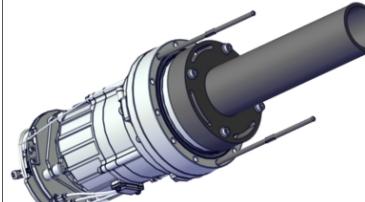
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	

Continues on next page

5.4.4 Replacing the wrist housing
Continued

Action	Note
<p>2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol.</p> <p>Joint unit mounting surface is pointed out in the figure.</p>	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000001860</p>
<p>3 Apply a thin layer of flange sealant to the mounting surface. Do not contaminate the radial sealing with sealant.</p> <p> CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p> <p> ELECTROSTATIC DISCHARGE (ESD)</p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i>.</p>	

Refitting the axis-5 joint unit and transition cabling

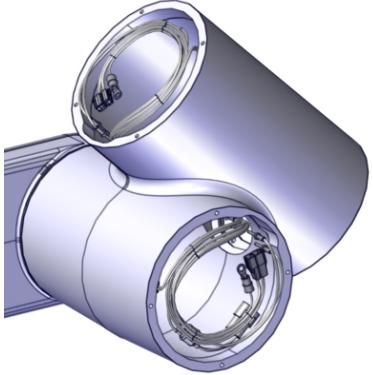
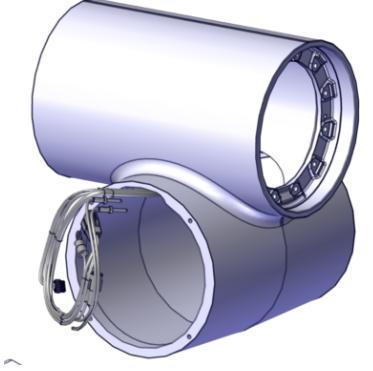
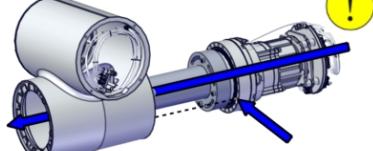
Action	Note
<p>1 Fit the lifting aid to the joint unit.</p> <p> CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Joint unit: 3HAC079143-001 Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)</p>  <p>xx2000001957</p>
<p>2 Fit two guide pins to the joint unit.</p>	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  <p>xx2000002438</p>

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5 Repair

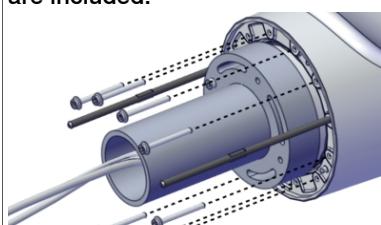
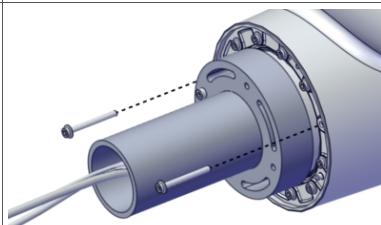
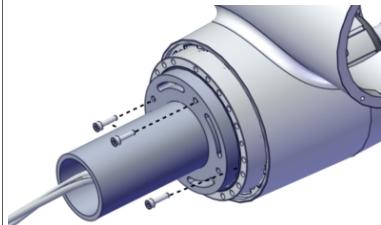
5.4.4 Replacing the wrist housing

Continued

	Action	Note
3	Fit the transition cable between axis-5 and axis-6 joint units into the tilt.	<p>Cable harness, transition joint-5 and joint-6: 3HAC073209-001</p>  <p>xx2100000040</p>
4	Place the cabling at the slot before refitting the joint unit.	 <p>xx2100000041</p>  <p>xx2100000285</p>
5	<p>Fit the joint unit to the tilt, aligning the pin with the pin hole.</p> <p> CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000002142</p>

Continues on next page

5.4.4 Replacing the wrist housing
Continued

Action	Note
6 Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+Pro-COat111, with NYPLAS glue , 12 pcs</p> <p>Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2100000333</p>
7 Remove the guide pins and secure the remaining two attachment screws.	 <p>xx2000002140</p>
8 Pre-tighten the screws crosswise.	
9 Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm.
10 Remove the lifting aid by removing the screws.	 <p>xx2000002139</p>
11 Clean pushed-out flange sealant, if any.	

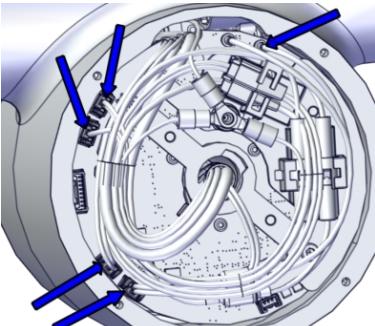
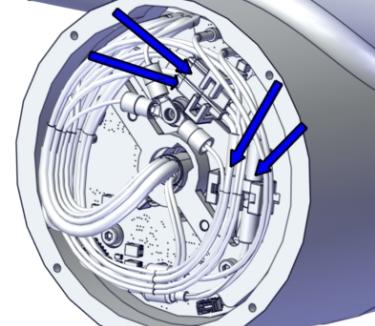
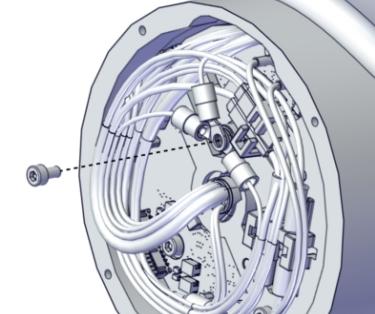
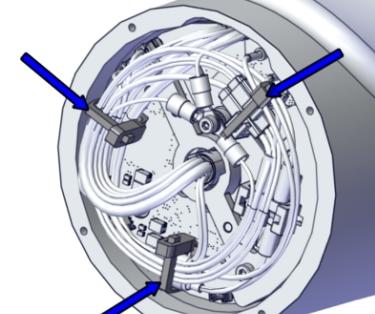
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5 Repair

5.4.4 Replacing the wrist housing

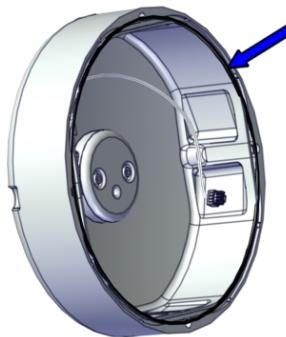
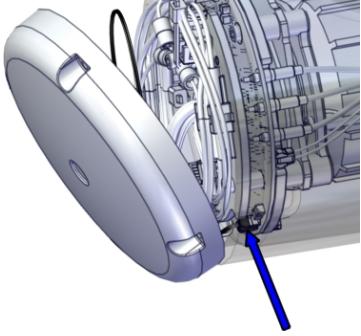
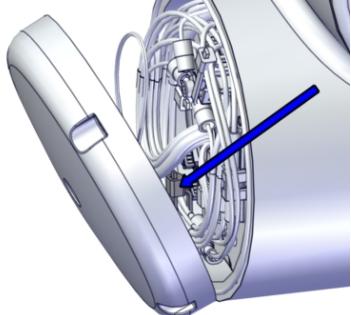
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Connecting the axis-5 joint unit cabling

	Action	Note
1	<p>Reconnect the connectors to the drive board.</p> <ul style="list-style-type: none"> • D4/5.X1 to X1 • D5.DC+ to +DC • D5.DC- to Ground • D4/5.X4 to X4 • D5/4.X2 to X2 • D4/5.X5 to X5 	 xx2000002138
2	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J5/6.DC+ to J6.DC+ • J5/6.DC- to J6.DC- • J5/6.CS to J6.CS • J5/6.CP to J6.CP 	 xx2000002137
3	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002136
4	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002135

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Refitting the axis-5 cover

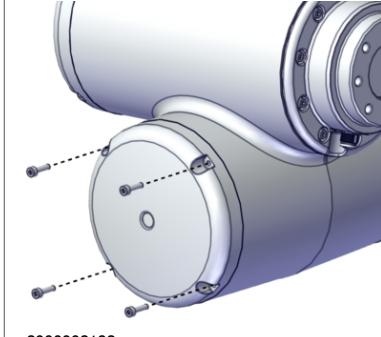
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000001962
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	 xx2000002134
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000002133

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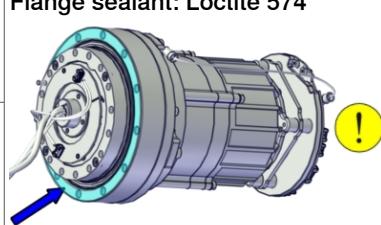
5 Repair

5.4.4 Replacing the wrist housing

Continued

Action	Note
4 Refit the cover with the four screws.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.2 Nm</p>  <p>xx2000002132</p>

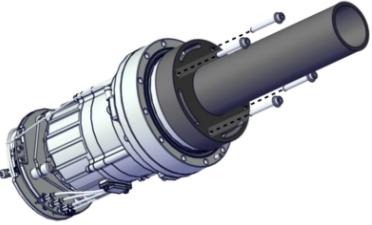
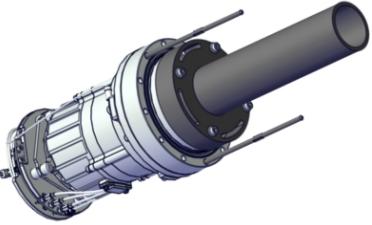
Preparations before fitting the joint unit

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 44 .	
2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574
3 Apply a thin layer of flange sealant to the mounting surface. Do not contaminate the radial sealing with sealant.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	 xx2000001860

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5.4.4 Replacing the wrist housing
Continued

Refitting the axis-6 joint unit

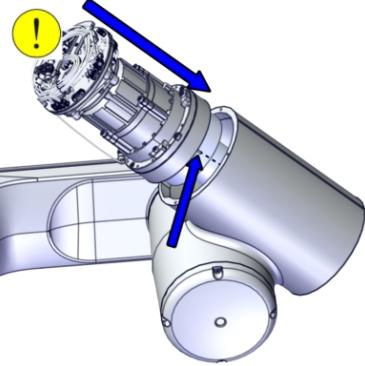
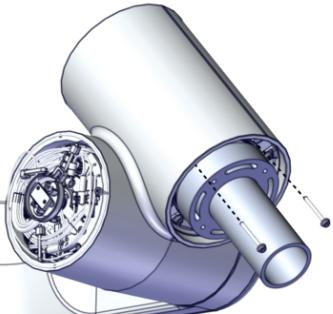
	Action	Note
1	<p>Fit the lifting aid to the joint unit.</p> <p> CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Joint unit: 3HAC079143-001 Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)</p>  <p>xx2000001957</p>
2	Fit two guide pins to the joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  <p>xx2000002438</p>
3	Place the cabling at the slot before refitting the joint unit.	 <p>xx2100000041</p>

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5 Repair

5.4.4 Replacing the wrist housing

Continued

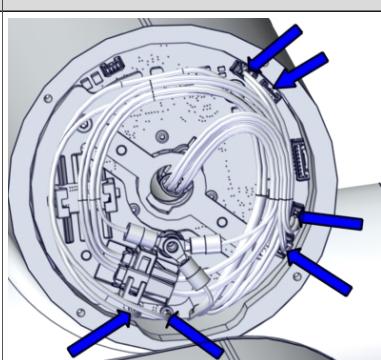
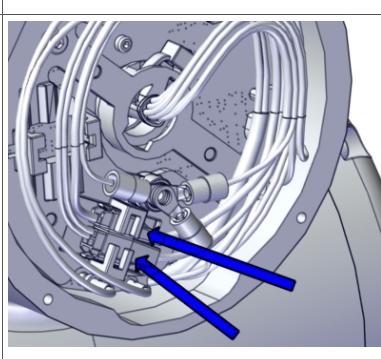
	Action	Note
4	<p>Fit the joint unit to the tilt, aligning the pin with the pin hole.</p> <p> CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002195
5	Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs</p> <p>Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  xx2100000329
6	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002170
7	Pre-tighten the screws crosswise.	
8	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm.

Continues on next page

5.4.4 Replacing the wrist housing
Continued

Action	Note
9 Remove the lifting aid by removing the screws.	 xx2000002168
10 Clean pushed-out flange sealant, if any.	

Connecting the axis-6 joint unit cabling

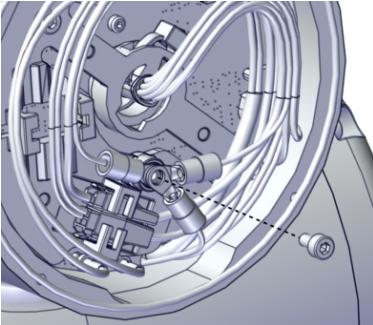
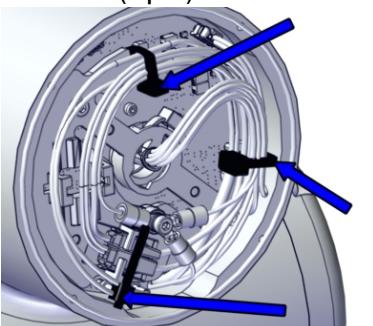
Action	Note
1 Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D6.X1 to X1 • D6.DC+ to +DC • D6.DC- to Ground • D6.X4 to X4 • D6.X2 to X2 • D6.X5 to X5 	 xx2000002164
2 Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J7.CS to J7.CS • J7.CP to J7.CP 	 xx2000002163

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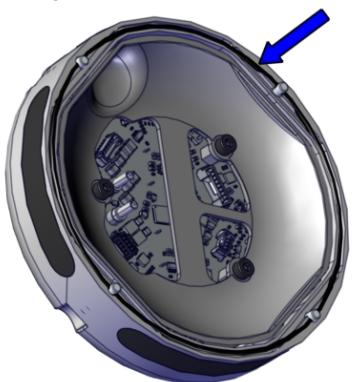
5 Repair

5.4.4 Replacing the wrist housing

Continued

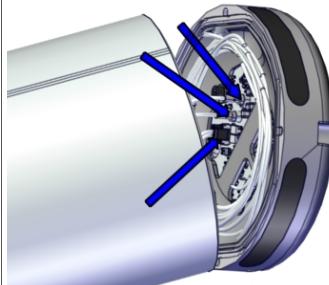
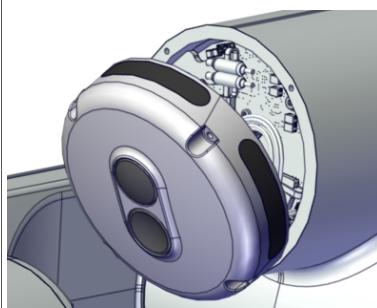
Action	Note
3 Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002162
4 Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002161

Refitting the arm-side interface

Action	Note
1 Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002551

Continues on next page

5.4.4 Replacing the wrist housing Continued

	Action	Note
2	<p>Place the arm-side interface at mounting position and reconnect the connectors.</p> <ul style="list-style-type: none"> • ASI.DC+ • ASI.DC- • ASI.X1 <p>The correct orientation of the arm-side interface is with the convex button in upper position.</p> <p> Note</p> <p>Do not leave the arm-side interface in location without being secured with the attachment screws.</p>	 xx2100000335  xx2100000336
3	Refit the arm-side interface with four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm

Refitting the tool flange adapter

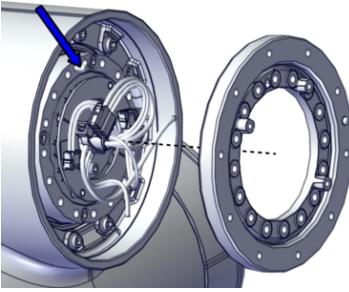
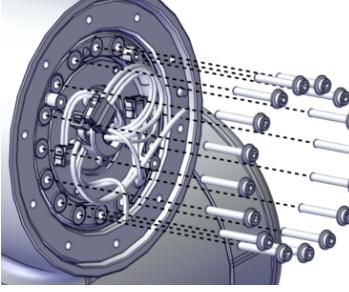
	Action	Note
1	<p>Clean the mounting surface with isopropanol.</p> <p>Apply flange sealant to the corner of the adapter mounting surface, as pointed out in the figure.</p>	Cleaning agent: Isopropanol Flange sealant: Loctite 574

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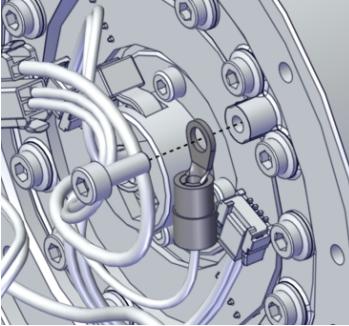
5 Repair

5.4.4 Replacing the wrist housing

Continued

Action	Note
2 Refit the tool flange adapter, aligning the pin with the pin hole.	Axis-6 inner flange: 3HAC073952-001  xx2000002167
3 Secure with screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) Tightening torque: 1.8 Nm.  xx2000002165

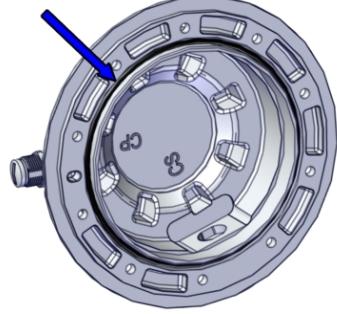
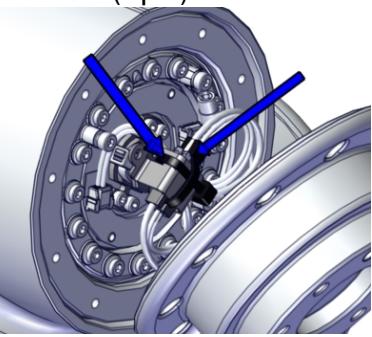
Connecting the tool flange functional earth cable

Action	Note
1 Secure the cable for functional earth to the tool flange adapter with a screw.	 xx2000002159

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5.4.4 Replacing the wrist housing
Continued

Refitting the tool flange

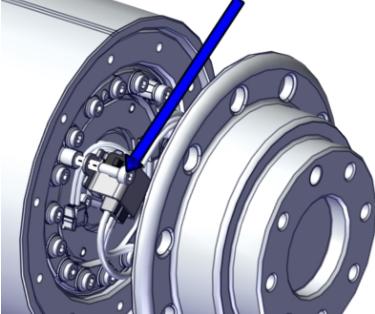
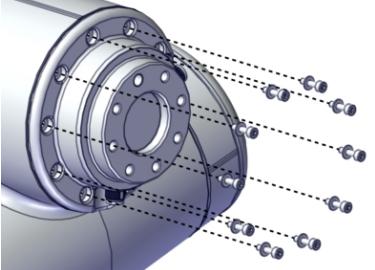
	Action	Note
1	<p>Check the o-ring on the tool flange and lubricate with grease. Replace if damaged.</p>	<p>Axis-6 flange: 3HAC073953-001 O-ring: 3HAB3772-182 Grease: 3HAC042536-001 (Shell Gadus S2)</p>  <p>xx2000002197</p>
2	<p>Place the tool flange at mounting position and reconnect the CP/CS connectors.</p>	 <p>xx2000002158</p>
3	<p>Fit the connectors to the cable bracket and secure the connectors with two cable ties.</p>	<p>Cable ties (2 pcs)</p>  <p>xx2000002157</p>

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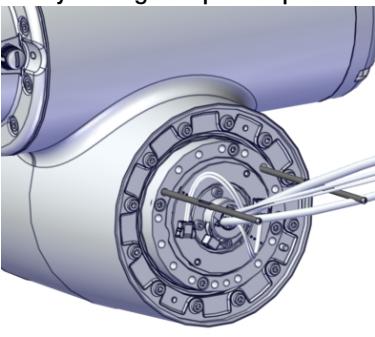
5 Repair

5.4.4 Replacing the wrist housing

Continued

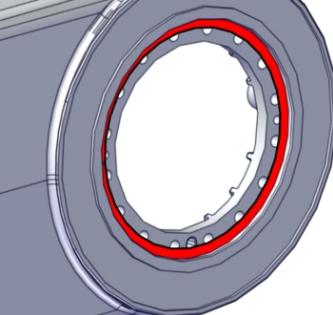
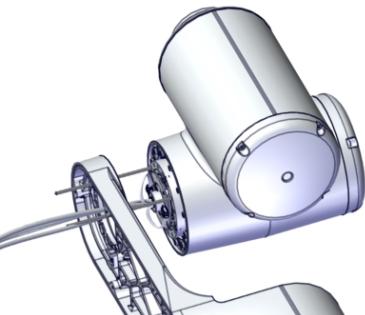
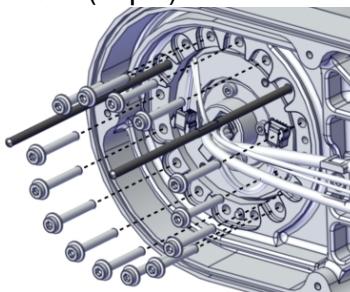
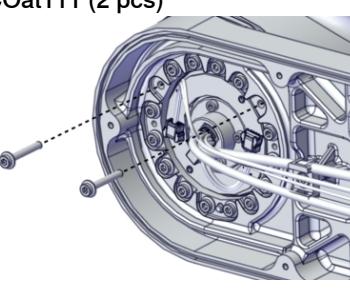
Action	Note
4 Refit the cable bracket with the screw.	<p>Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (1 pcs) Tightening torque: 0.8 Nm.</p>  <p>xx2000002156</p>
5 Refit and secure the tool flange with screws and washers.	<p>Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (10 pcs) Spring washer: 7x3.2x0.6 Steel (10 pcs) Tightening torque: 1.8 Nm.</p>  <p>xx2000002155</p>

Refitting the tilt

Action	Note
1 Fit two guide pins to the axis-5 joint.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.</p>  <p>xx2000002146</p>

Continues on next page

5.4.4 Replacing the wrist housing
Continued

Action	Note
2 Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the tubular mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000002147
3 Lift the tilt into mounting position while inserting the cabling into the tubular.	
4 Slide the tilt into place on the guide pins.	 xx2000002131
5 Secure the tilt to the tubular with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (14 pcs)  xx2000002130
6 Remove the guide pins and fasten the remaining two screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (2 pcs)  xx2000002128
7 Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.

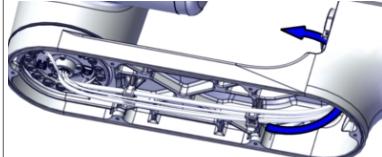
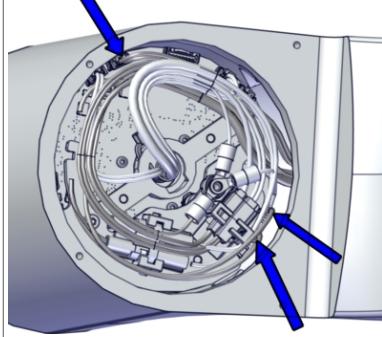
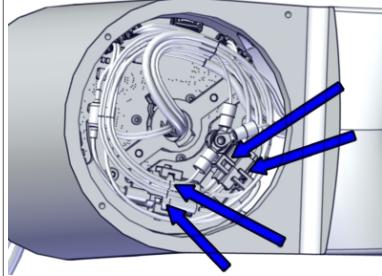
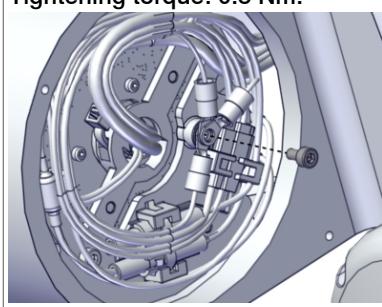
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5 Repair

5.4.4 Replacing the wrist housing

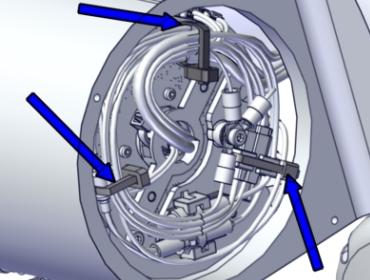
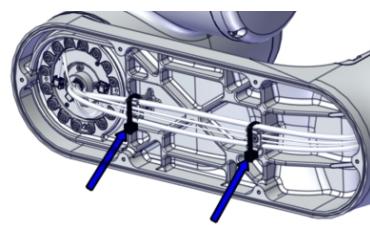
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Connecting the tilt cabling

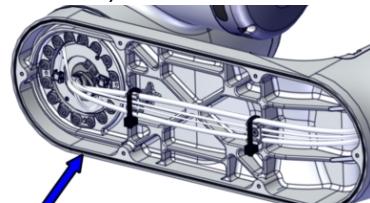
Action	Note
1 Insert the cabling into the tubular.	 xx2000002148
2 Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D3/4.X2 to X2 • D3/4.DC- to Ground • D3/4.DC+ to +DC 	 xx2000002125
3 Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J4/5.DC+ to J5/6.DC+ • J4/5.DC- to J5/6.DC- • J4/5.CS to J5/6.CS • J4/5.CP to J5/6.CP 	 xx2000002089
4 Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002087

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5.4.4 Replacing the wrist housing
Continued

Action	Note
5 Secure the cabling with cable ties.	<p>Cable ties (3 pcs)</p>  <p>xx2000002086</p>  <p>xx2000002124</p>

Refitting the tubular cover

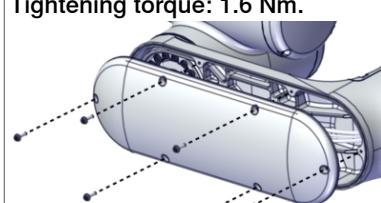
Action	Note
1 Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	<p>O-ring: 3HAC061327-043 Grease: 3HAC042536-001 (Shell Gadus S2)</p>  <p>xx2000002149</p>

Continues on next page

5 Repair

5.4.4 Replacing the wrist housing

Continued

Action	Note
2 Refit the cover with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-312 M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included. Tightening torque: 1.6 Nm.</p>  <p>xx2000002123</p>

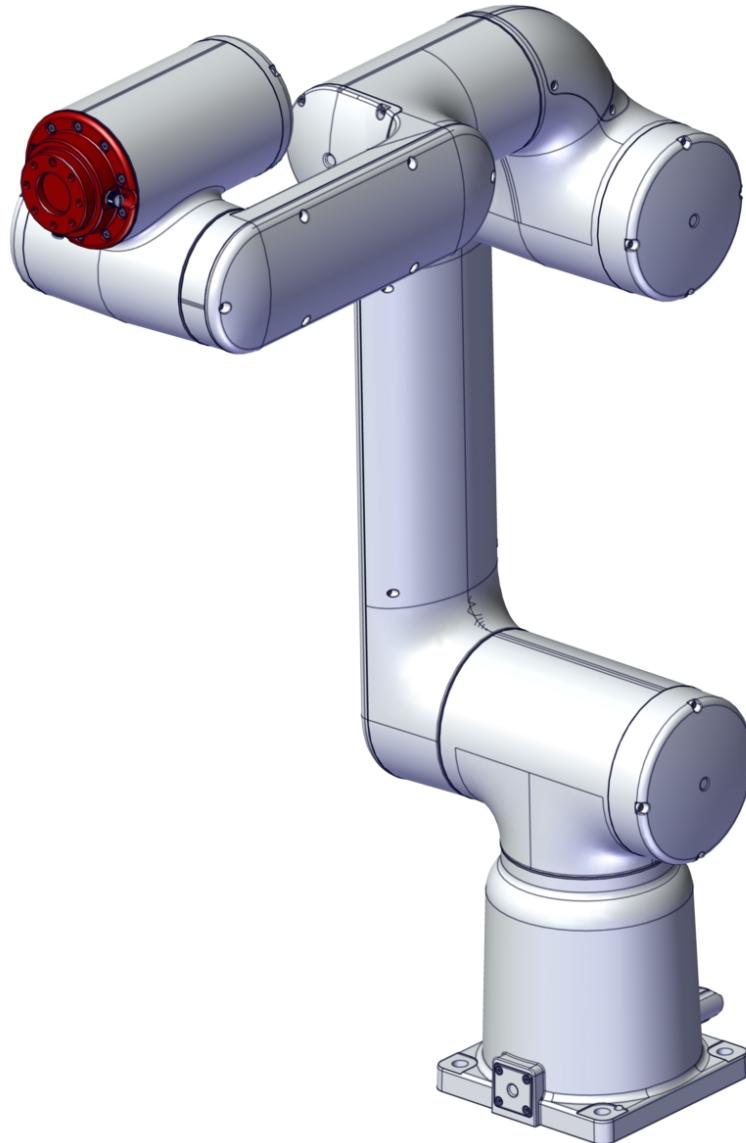
Concluding procedure

Action	Note
1 Calibrate the axis-5 and axis-6 joint unit torque sensor.	See Calibration on page 719
2  DANGER Make sure all safety requirements are met when performing the first test run.	

5.4.5 Replacing the tool flange and axis-6 inner flange

Location of the tool flange and axis-6 inner flange

The tool flange is located as shown in the figure. The axis-6 inner flange is located beneath the tool flange.



xx2100000054

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Continues on next page

5 Repair

5.4.5 Replacing the tool flange and axis-6 inner flange

Continued

Spare part	Article number	Note
Axis-6 flange	3HAC073953-001	
Axis-6 inner flange	3HAC073952-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Grease	3HAC042536-001	Shell Gadus S2
O-ring	3HAB3772-182	Tool flange
Cable ties	-	

Removing the tool flange and axis-6 inner flange

Use these procedures to remove the tool flange and axis-6 inner flange.

Preparations before removing the flanges

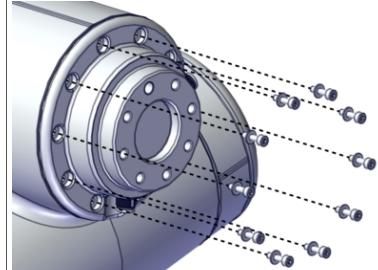
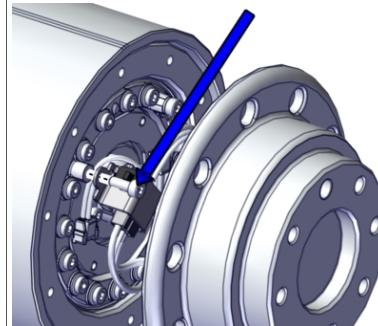
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog the robot to the specified position: <ul style="list-style-type: none">• Axis 1: No significance.• Axis 2: No significance.• Axis 3: No significance.• Axis 4: No significance.• Axis 5: No significance.• Axis 6: 0°	
3	 CAUTION Turn off all supplies for electrical power to the robot, before starting the repair work.	

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5.4.5 Replacing the tool flange and axis-6 inner flange

Continued

Removing the tool flange

	Action	Note
1	Remove the tool flange screws and washers.	 xx2000002155
2	CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
3	Loosen the tool flange and remove the cable bracket by removing the screw.	 xx2000002156
4	Cut the cable ties.	 xx2000002157

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5 Repair

5.4.5 Replacing the tool flange and axis-6 inner flange

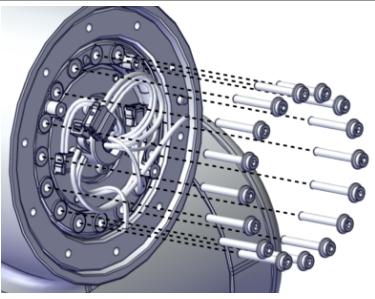
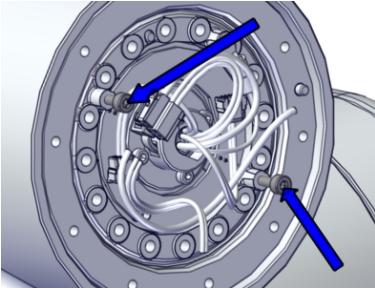
Continued

Action	Note
5 Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

Disconnecting the tool flange functional earth cable

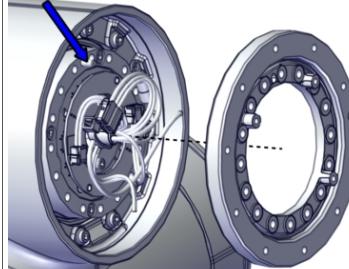
Action	Note
1 Remove the functional earth cable by removing the screw.	 xx2000002159

Removing the tool flange adapter

Action	Note
1 Remove the tool flange adapter screws.	 xx2000002165
2 Press the adapter out of position by using two of the attachment screws as removal tools.	 xx2000002166

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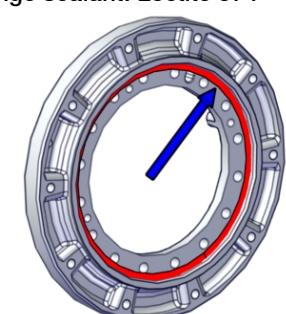
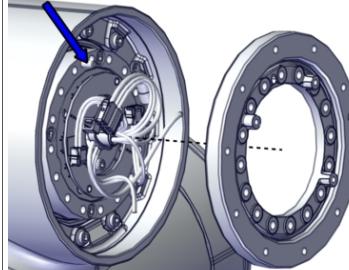
5.4.5 Replacing the tool flange and axis-6 inner flange
Continued

Action	Note
3 Remove the tool flange adapter.	 xx2000002167

Refitting the flanges

Use these procedures to refit the tool flange and axis-6 inner flange.

Refitting the tool flange adapter

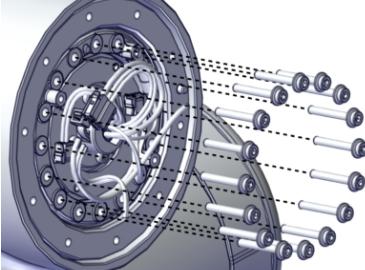
Action	Note
1 Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the adapter mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000002196
2 Refit the tool flange adapter, aligning the pin with the pin hole.	Axis-6 inner flange: 3HAC073952-001  xx2000002167

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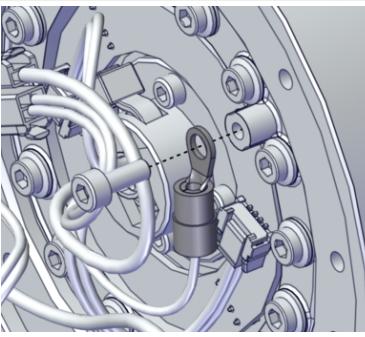
5 Repair

5.4.5 Replacing the tool flange and axis-6 inner flange

Continued

Action	Note
3 Secure with screws.	<p>Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) Tightening torque: 1.8 Nm.</p>  <p>xx2000002165</p>

Connecting the tool flange functional earth cable

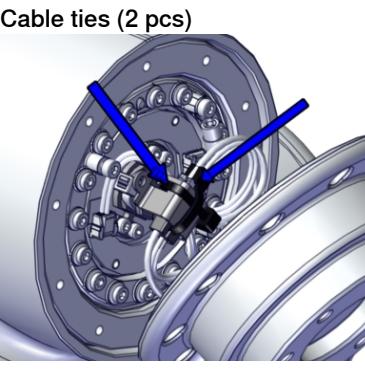
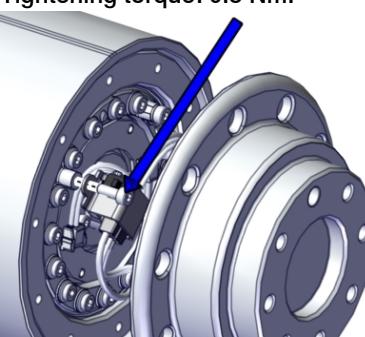
Action	Note
1 Secure the cable for functional earth to the tool flange adapter with a screw.	 <p>xx2000002159</p>

Refitting the tool flange

Action	Note
1 Check the o-ring on the tool flange and lubricate with grease. Replace if damaged.	<p>Axis-6 flange: 3HAC073953-001 O-ring: 3HAB3772-182 Grease: 3HAC042536-001 (Shell Gadus S2)</p>  <p>xx2000002197</p>

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5.4.5 Replacing the tool flange and axis-6 inner flange
Continued

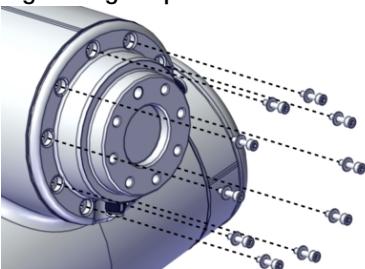
	Action	Note
2	Place the tool flange at mounting position and reconnect the CP/CS connectors.	 xx2000002158
3	Fit the connectors to the cable bracket and secure the connectors with two cable ties.	Cable ties (2 pcs)  xx2000002157
4	Refit the cable bracket with the screw.	Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (1 pcs) Tightening torque: 0.8 Nm.  xx2000002156

Continues on next page

5 Repair

5.4.5 Replacing the tool flange and axis-6 inner flange

Continued

	Action	Note
5	Refit and secure the tool flange with screws and washers.	<p>Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (10 pcs) Spring washer: 7x3.2x0.6 Steel (10 pcs) Tightening torque: 1.8 Nm.</p>  <p>xx2000002155</p>

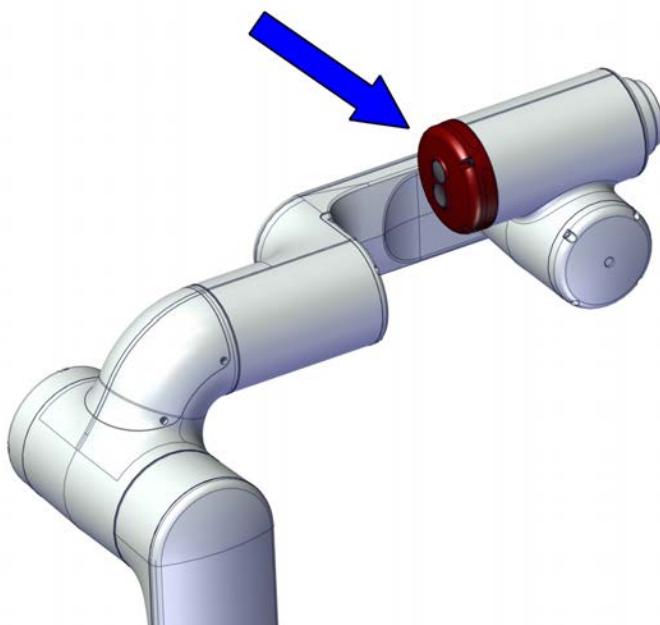
Concluding procedure

	Action	Note
1	 DANGER Make sure all safety requirements are met when performing the first test run.	

5.4.6 Replacing the arm-side interface

Location of the arm-side interface

The arm-side interface is located as shown in the figure.



xx2000002549

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Arm side interface	3HAC076855-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
O-ring	3HAC061327-051	Arm-side interface Replace if damaged.
Cable ties	-	

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5 Repair

5.4.6 Replacing the arm-side interface

Continued

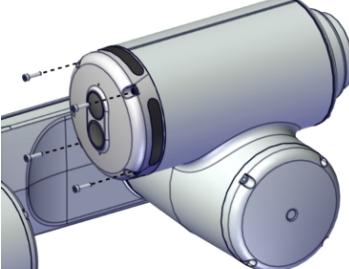
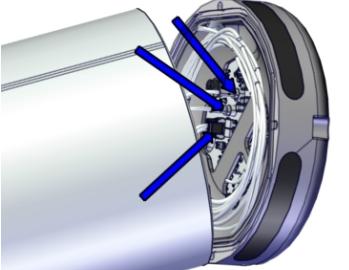
Removing the arm-side interface

Use these procedures to remove the arm side interface.

Preparations before removing the arm-side interface

	Action	Note
1	Jog the robot to a position where the arm side interface is easily accessed.	
2	 CAUTION Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the arm-side interface

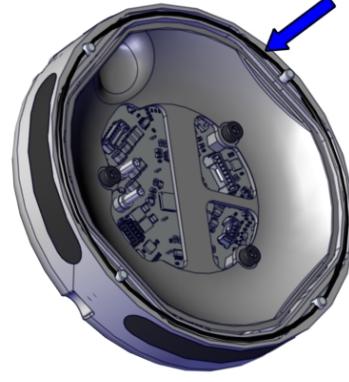
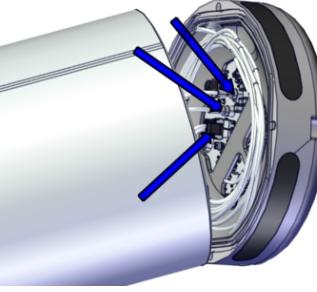
	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	 CAUTION There is cabling connected between the arm-side interface and the joint unit drive board. Open the arm-side interface with care to avoid damage to the cabling or the connector(s). Do not leave the arm-side interface in location without being secured with the attachment screws.	
3	Remove the attachment screws.	 xx2000002550
4	Loosen the arm-side interface carefully and disconnect the connectors from it. <ul style="list-style-type: none">• ASI.DC+• ASI.DC-• ASI.X1	 xx2100000335

Continues on next page

Refitting the arm-side interface

Use these procedures to refit the arm-side interface.

Refitting the arm-side interface

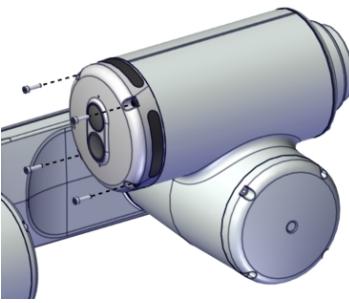
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	 O-ring: 3HAC061327-051 xx2000002551
2	Place the arm-side interface at mounting position and reconnect the connectors. <ul style="list-style-type: none"> • ASI.DC+ • ASI.DC- • ASI.X1 The correct orientation of the arm-side interface is with the convex button in upper position.  Note Do not leave the arm-side interface in location without being secured with the attachment screws.	 xx2100000335

Continues on next page

5 Repair

5.4.6 Replacing the arm-side interface

Continued

	Action	Note
3	Refit the arm-side interface with four screws.	<p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm</p>  <p>xx2000002550</p>

Concluding procedure

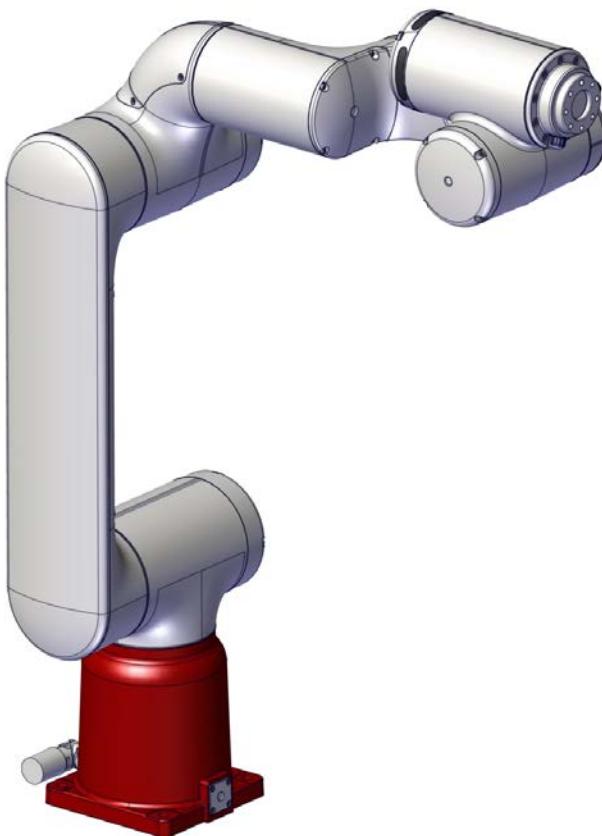
	Action	Note
1	 DANGER Make sure all safety requirements are met when performing the first test run.	

5.5 Swing and base

5.5.1 Replacing the base

Location of the base

The base is located as shown in the figure.



xx2100000422

Figure 5.1:

Summary of the replacement procedure

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

- 1 Separate the cabling between the swing and the lower arm.
- 2 Remove the lower and upper arm undivided.
- 3 Remove the axis-2 joint unit.
- 4 Remove the swing.
- 5 Loosen the base from the foundation and lay it down on its side.
- 6 Remove the axis-1 joint unit.
- 7 Replace the base. Move the base cabling and axis-1 brake release unit from old to new base.

Continues on next page

5 Repair

5.5.1 Replacing the base

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Base	3HAC073922-001	Also order new attachment screws for the axis-1 and axis-2 joint unit: 3HAB3413-435 (24 pcs).
Flange socket head screw with glue	3HAB3413-435	M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when re-fitting a joint unit. If ordering a new joint unit spare part, new screws are included.
Flange socket head screw with glue	3HAB3413-435	M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when re-fitting a joint unit. If ordering a new joint unit spare part, new screws are included.
Cable tie	3HAC075545-001	For securing joint unit cable.
Cable tie	3HAC075545-001	For securing joint unit cable.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3. Attachment screws M4x35 (4 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cable tie	3HAC075545-001	For securing joint unit cable.
O-ring, nitrile rubber	3HAB3772-119	Axis-1 brake release unit Replace if damaged.

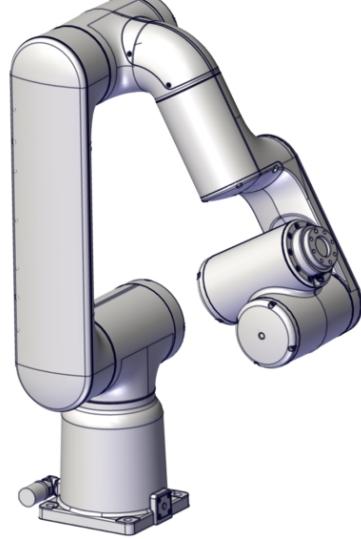
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Consumable	Article number	Note
O-ring, nitrile rubber	3HAB3772-64	Base cover
O-ring	3HAC061327-044	Lower arm, inner cover. 1 pcs / cover. Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.
Grease	3HAC031695-001	Harmonic Grease 4B No.2 Used to lubricate the seals.
Grease	3HAC042536-001	Shell Gadus S2
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Cable ties	-	

Removing the base

Use these procedures to remove the base.

Preparations before removing the base

	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none"> • Axis 1: 0° • Axis 2: 0° • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	 xx2100000044
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

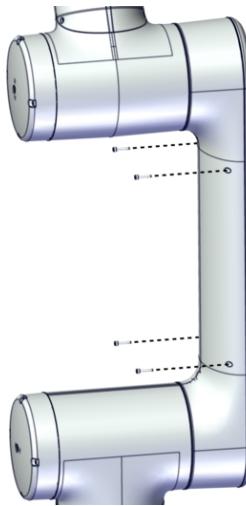
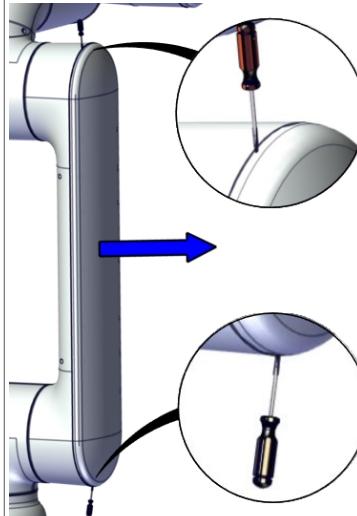
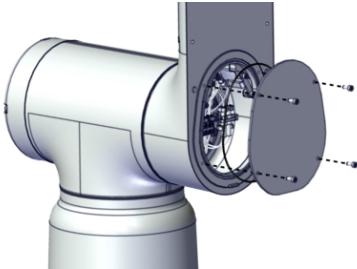
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5 Repair

5.5.1 Replacing the base

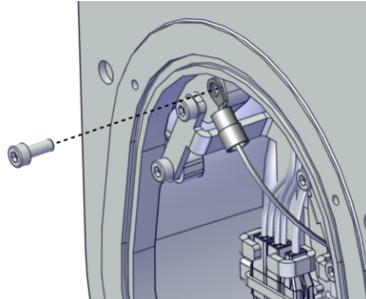
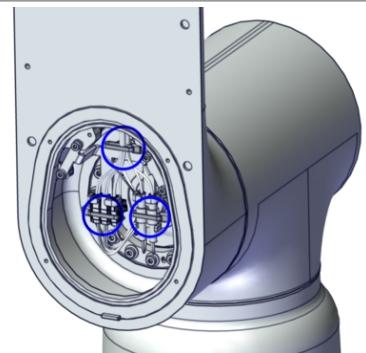
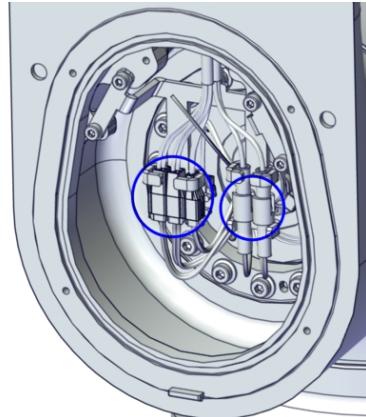
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Removing the lower arm covers

	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	Remove the four lower arm cover screws.	 xx2000001929
3	Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267
4	Remove the inner cover by removing the four screws.	 xx2000001930

Continues on next page

Disconnecting the cabling between the lower arm and the swing

	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936
2	Cut the cable ties.	 xx2000001937
3	Snap loose and disconnect all connectors.	 xx2000001938

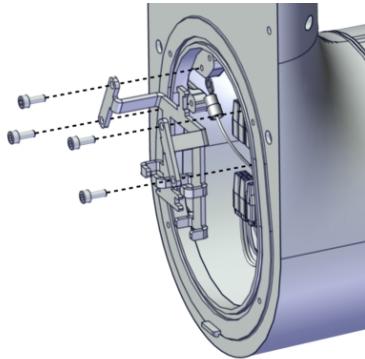
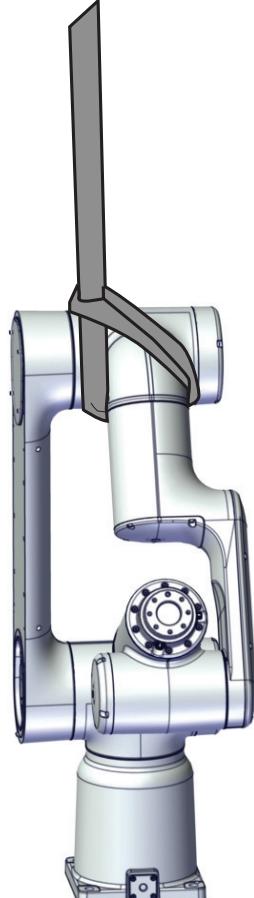
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5 Repair

5.5.1 Replacing the base

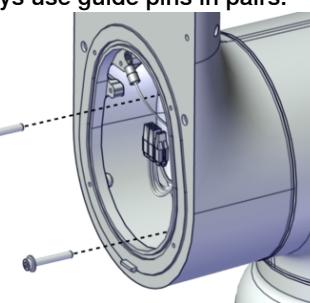
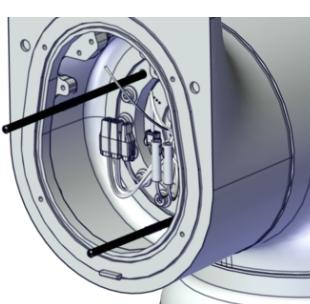
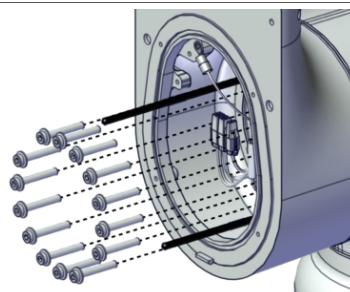
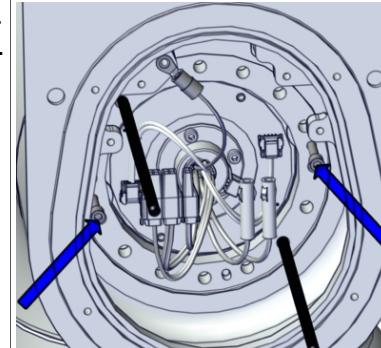
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Removing the lower and upper arm assembled

	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939
2	Secure the weight of the upper and lower arm.  CAUTION The weight of the complete upper and lower arm together is 18 kg	Suggestion with lifting sling and an overhead crane:  xx2100000294

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5.5.1 Replacing the base
Continued

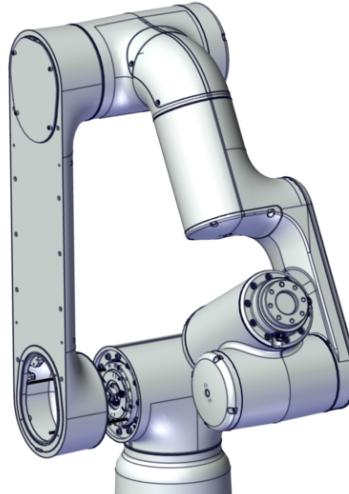
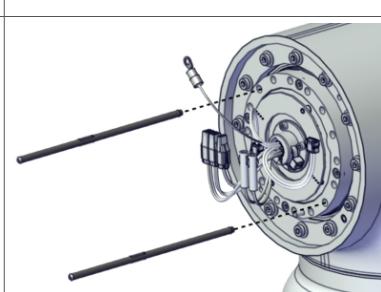
Action	Note
3 Remove two attachment screws and fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.</p>  <p>xx2000001951</p>  <p>xx2000001960</p>
4 Remove the lower arm attachment screws.	 <p>xx2000001940</p>
5 Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 <p>xx2000002151</p>

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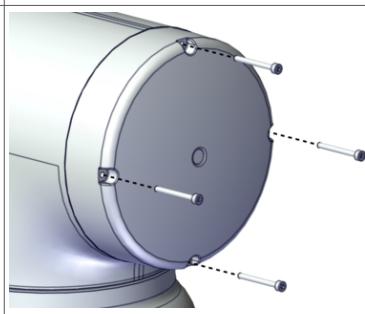
5 Repair

5.5.1 Replacing the base

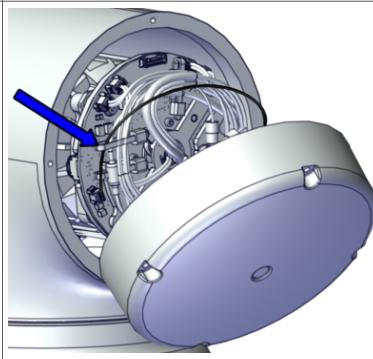
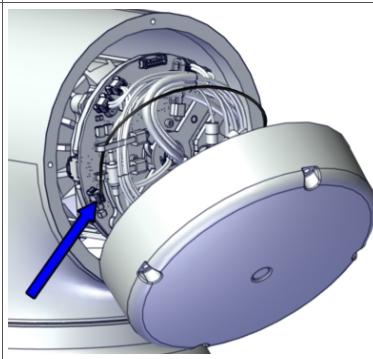
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Action	Note
6 Remove the complete arm system from the swing.	 xx2000001941
7 Remove the guide pins.	 xx2000002432

Removing the swing cover

Action	Note
1  CAUTION Make sure that all supplies for electrical power are turned off.	
2 Remove the cover screws.	 xx2000001935

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Action	Note
<p>3</p> <p> CAUTION</p> <p>There is cabling connected between the cover and the joint unit drive board.</p> <p>Open the cover with care to avoid damage to the cabling or the connector(s).</p> <p>Do not leave the cover in location without being secured with the attachment screws.</p>	
<p>4</p> <p>Open the cover and cut the cable tie that holds the brake release cable.</p>	 <p>xx2000001931</p>
<p>5</p> <p>Disconnect the brake release connector DR.X8 from the drive board.</p> <p>Remove the cover.</p>	 <p>xx2000001932</p>

Disconnecting the axis-2 joint unit cabling

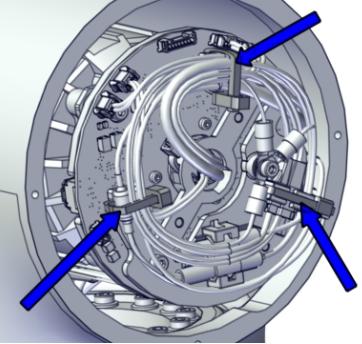
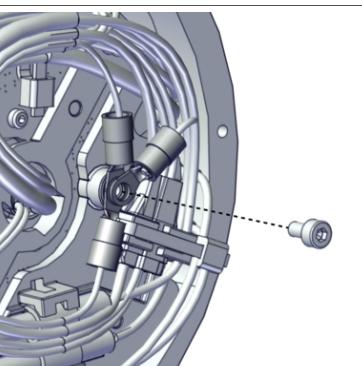
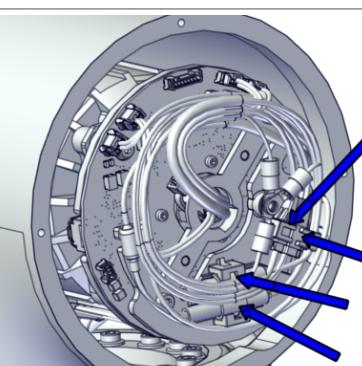
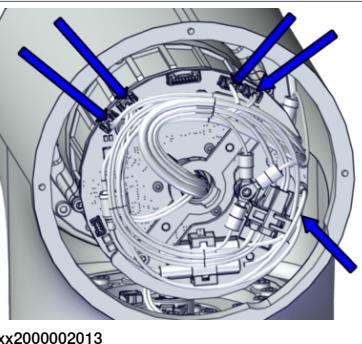
Action	Note
<p>1</p> <p> ELECTROSTATIC DISCHARGE (ESD)</p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	

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5 Repair

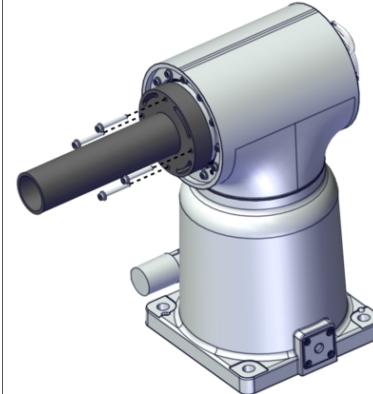
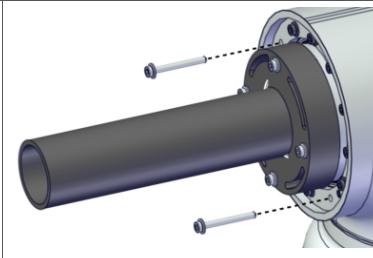
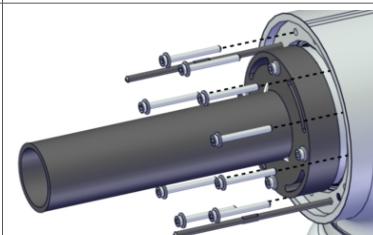
5.5.1 Replacing the base

Continued

Action	Note
2 Cut the cable ties.	 xx2000001946
3 Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J2.DC+ • J2.DC- • J2.CS • J2.CP 	 xx2000001944
5 Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 <p>! CAUTION Use tweezers to unlock connectors and pull them off.</p>	 xx2000002013

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Removing the axis-2 joint unit

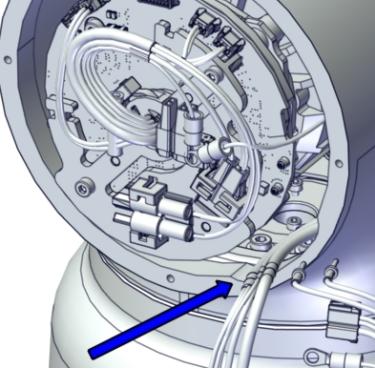
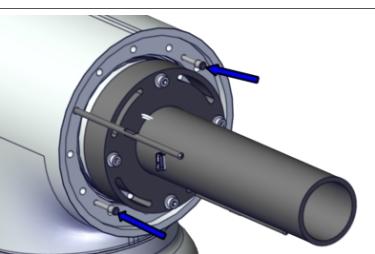
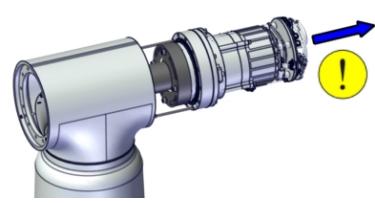
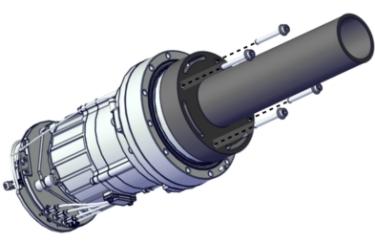
	Action	Note
1	<p>Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)</p>  <p>xx2000001956</p>
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx2100000295</p>
3	Fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002433</p>
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx2000001943</p>

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5 Repair

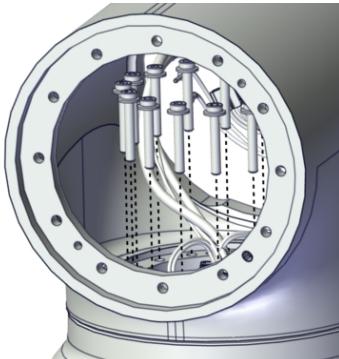
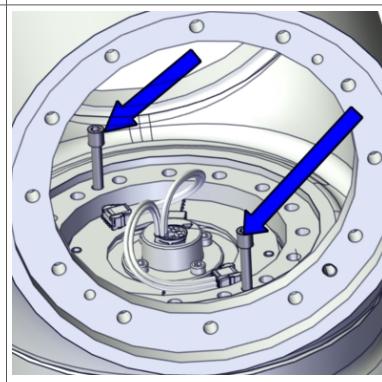
5.5.1 Replacing the base

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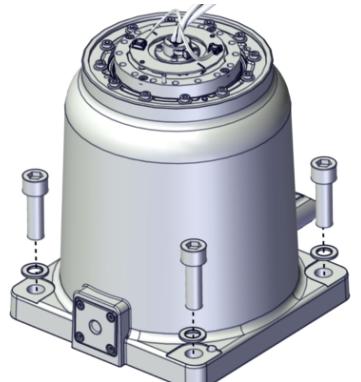
Action	Note
5 Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 xx2100000045
6 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2000002434
7 Remove the joint unit from the swing. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000001958
8 Remove the lifting aid and guide pins.	 xx2000001957

Continues on next page

Removing the swing

	Action	Note
1	Remove the swing attachment screws.	 xx2000001987
2	Use two fully threaded attachment screws as removal tools to press the swing out of position.	 xx2000002152
3	Lift away the swing.  CAUTION The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	

Loosening the base and removing the base cover

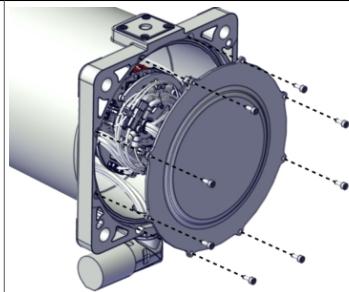
	Action	Note
1	Loosen the base from the foundation by removing the attachment screws and washers.	 xx2000002006

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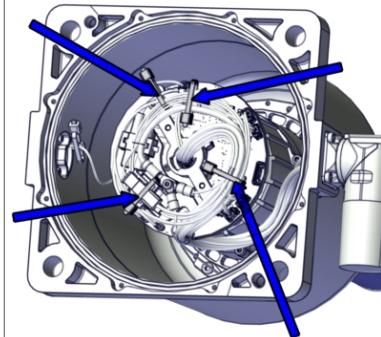
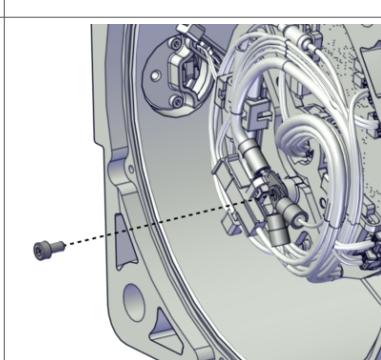
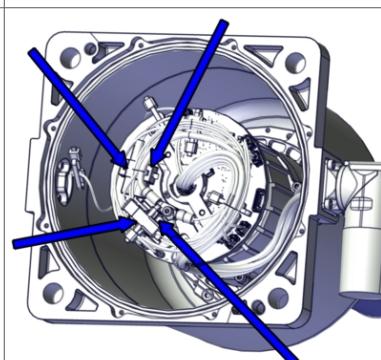
5 Repair

5.5.1 Replacing the base

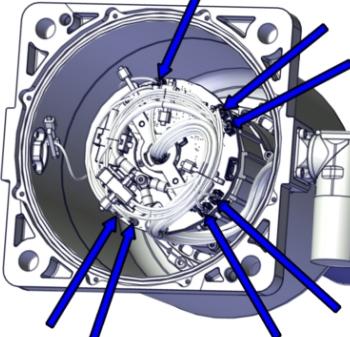
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Action	Note
2 Tilt the base on to its side and remove the bottom cover by removing the attachment screws.	 xx2000002007

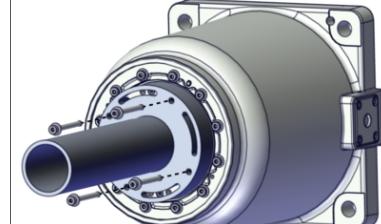
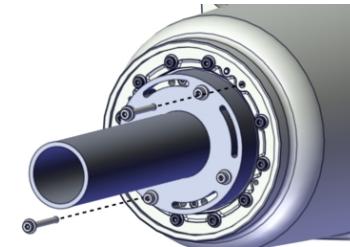
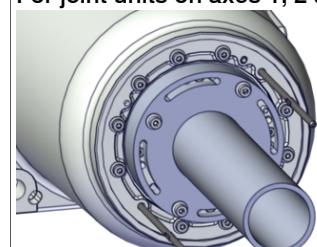
Disconnecting the axis-1 joint unit cabling

Action	Note
1 Cut the cable ties.	 xx2000002012
2 Remove the functional and protective earth cables by removing the screw.	 xx2000002011
3 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J1.DC+ • J1.DC- • J1.CS • J1.CP 	 xx2000002010

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Action	Note
<p>4 Disconnect the connectors from the drive board.</p> <ul style="list-style-type: none"> • D1.X1 from X1 • D1.DC+ from DC+ • D1.DC- from ground • D1.X4 from X4 • D1.X2 from X2 • D1.X5 from X5 • DR.X8 from X8 <p>! CAUTION Use tweezers to unlock connectors and pull them off.</p>	 xx2000002009

Removing the axis-1 joint unit

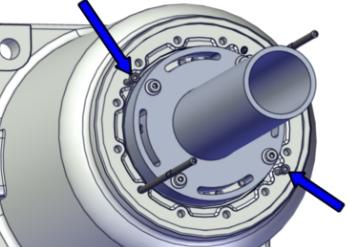
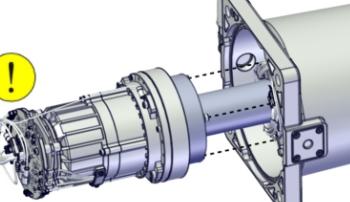
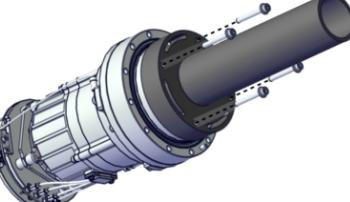
Action	Note
<p>1 Fit the lifting aid to the joint unit.</p> <p>! CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001994
<p>2 Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000296
<p>3 Fit two guide pins to the axis-1 joint unit.</p>	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.  xx2000002435

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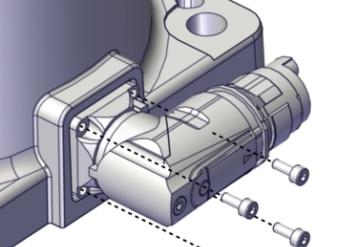
5 Repair

5.5.1 Replacing the base

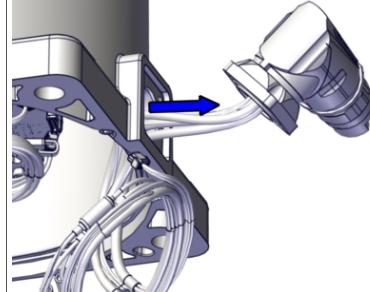
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Action	Note
<p>4 Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002008
<p>5 Press the joint unit out of position using two of the previous attachment screws as removal tools.</p>	 xx2000002436
<p>6 Remove the joint unit from the base.</p> <p>CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002014
<p>7 Remove the lifting aid and guide pins.</p>	 xx2000001957

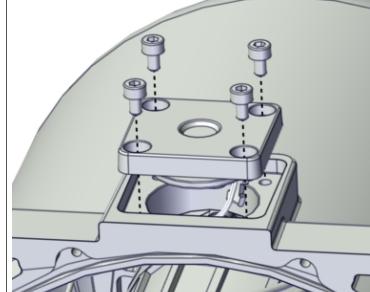
Removing the base cabling

Action	Note
<p>1 Remove the attachment screws.</p>	 xx2100000406

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	Action	Note
2	Pull out the cabling from the base.	 xx2100000407

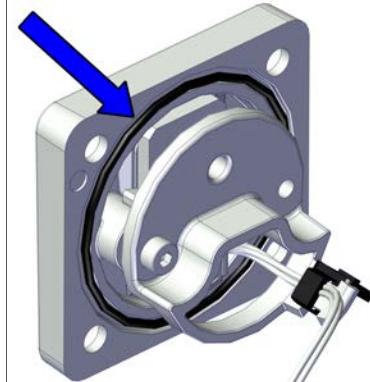
Removing the brake release unit

	Action	Note
1	Remove the brake release unit by removing the screws.	 xx2100000413

Refitting the base

Use these procedures to refit the base.

Refitting the brake release unit

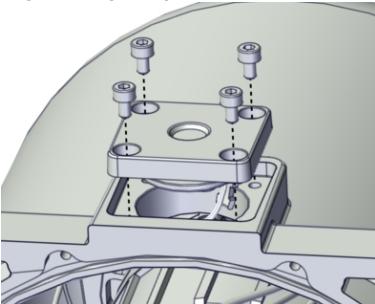
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring, nitrile rubber: 3HAB3772-119 Grease: 3HAC031695-001 Harmonic Grease 4B No.2 Used to lubricate the seals.  xx2100000423

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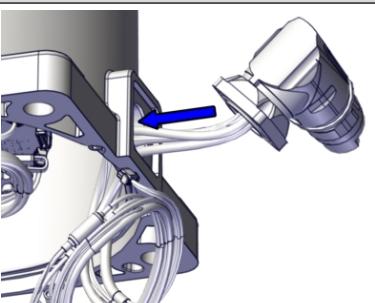
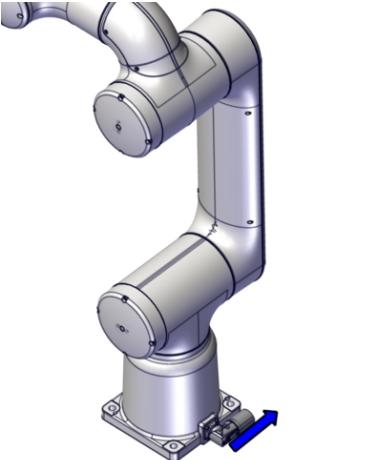
5 Repair

5.5.1 Replacing the base

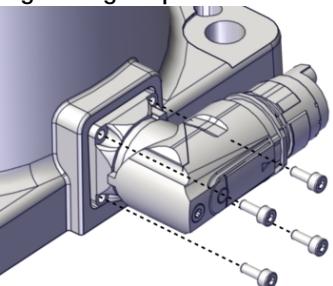
Continued

Action	Note
2 Refit the brake release unit to the new base with the screws.	Base: 3HAC073922-001 Screws: M3x5 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2100000413

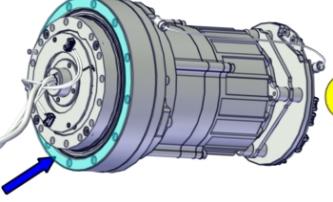
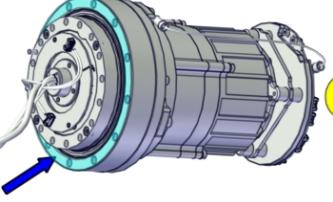
Refitting the base cabling

Action	Note
1 Insert the cabling into the base.	 xx2100000408
2 Orient the base connector so that it points to the right, seen from back of the robot.	 xx2100000409

Continues on next page

Action	Note
3 Secure the base connector with the attachment screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm.  xx2100000406

Preparations before fitting the joint 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 44 .	
2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3 Apply a thin layer of flange sealant to the mounting surface. Do not contaminate the radial sealing with sealant.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	 xx2000001860

Refitting the axis-1 joint unit

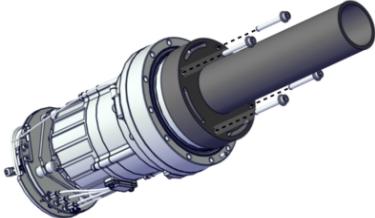
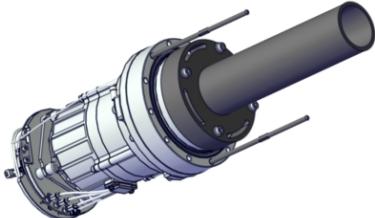
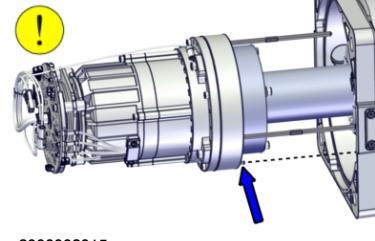
Action	Note
1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	

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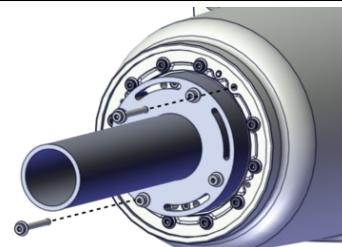
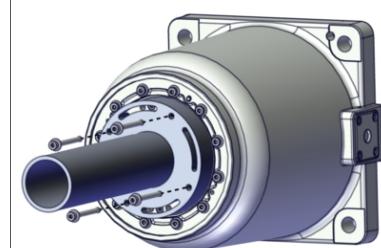
5 Repair

5.5.1 Replacing the base

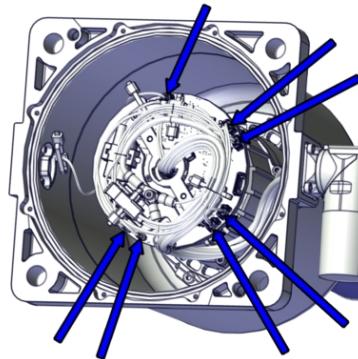
Continued

	Action	Note
2	<p>Fit the lifting aid to the joint unit.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)</p>  <p>xx2000001957</p>
3	Fit two guide pins to the joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002438</p>
4	<p>Fit the joint unit to the base, aligning the pin with the pin hole.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000002015</p>
5	Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2000002008</p>

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Action	Note
6 Remove the guide pins and secure the remaining two attachment screws.	 xx2100000296
7 Pre-tighten the screws crosswise.	
8 Torque tighten all screws crosswise. Tightening torque: 4.3 Nm.	
9 Remove the lifting aid by removing the screws.	 xx2000001994
10 Clean pushed-out flange sealant, if any.	

Connecting the axis-1 joint unit cabling

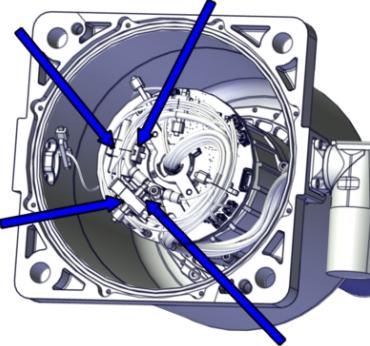
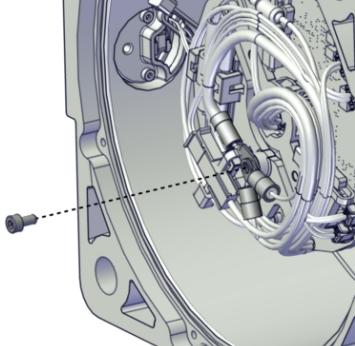
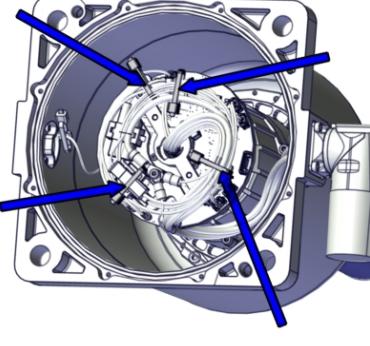
Action	Note
1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2 Reconnect the connectors to the drive board. <ul style="list-style-type: none">• D1.X1 to X1• D1.DC+ to DC+• D1.DC- to Ground• D1.X4 to X4• D1.X2 to X2• D1.X5 to X5• DR.X8 to X8	 xx2000002009

Continues on next page

5 Repair

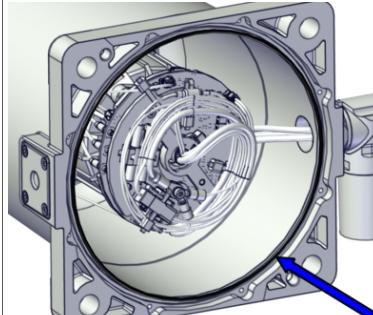
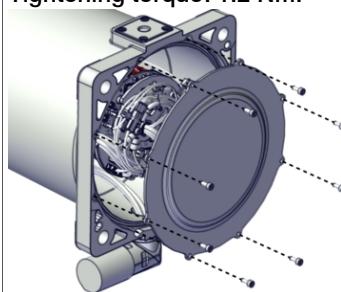
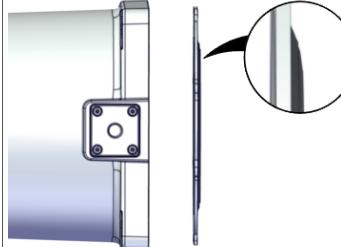
5.5.1 Replacing the base

Continued

	Action	Note
3	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none">• J1.DC+ to J1.DC+• J1.DC- to J1.DC-• J1.CS to J1.CS• J1.CP to J1.CP	 xx2000002010
4	Secure the cables for functional earth and protective earth with a screw.	<p>Hex socket head cap screw: M3x6 (1 pcs).</p> <p>Tightening torque: 0.8 Nm.</p>  xx2000002011
5	Secure the cabling with cable ties.	Cable ties (4 pcs)  xx2000002012

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Refitting the base cover

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring, nitrile rubber: 3HAB3772-64 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016
2	Refit the bottom cover with the attachment screws.  Note Fit the cover in correct direction, the protrusion of the cover must face outwards.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.2 Nm.  xx2000002007  xx2100000268

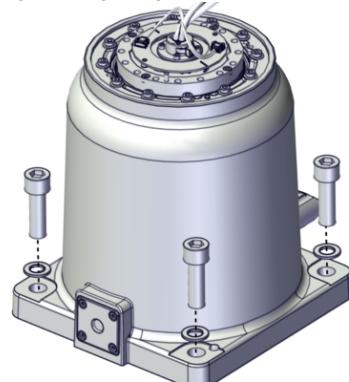
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5 Repair

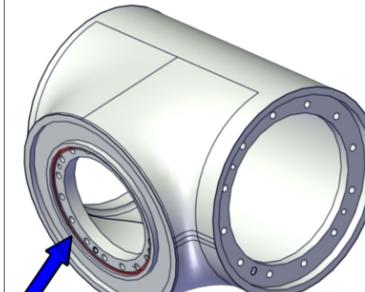
5.5.1 Replacing the base

Continued

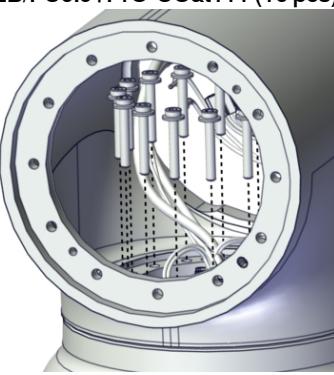
Securing the base

	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 30 Nm $\pm 10\%$.  xx2000002006

Refitting the swing

	Action	Note
1	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the base mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx200001990

Continues on next page

	Action	Note
2	<p>Refit the swing to the base unit, aligning the pin with the pin hole.</p> <p> CAUTION</p> <p>The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000001989
3	<p>Secure the swing with the attachment screws. Pre-tighten the screws crosswise firstly.</p>	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+Pro-COat111 (16 pcs)  xx2000001987
4	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.

Preparations before fitting the joint unit

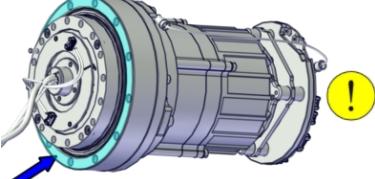
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	

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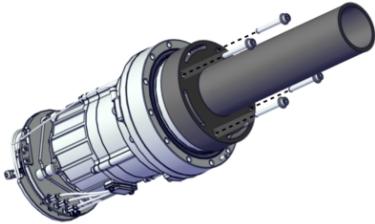
5 Repair

5.5.1 Replacing the base

Continued

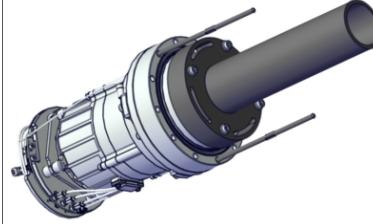
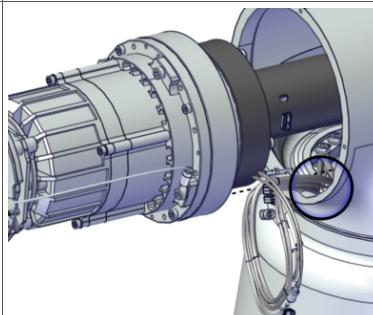
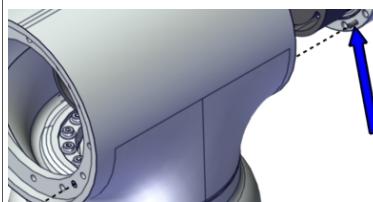
Action	Note
<p>2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol.</p> <p>Joint unit mounting surface is pointed out in the figure.</p>	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000001860</p>
<p>3 Apply a thin layer of flange sealant to the mounting surface. Do not contaminate the radial sealing with sealant.</p> <p> CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p> <p> ELECTROSTATIC DISCHARGE (ESD)</p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i>.</p>	

Refitting the axis-2 joint unit

Action	Note
<p>1  ELECTROSTATIC DISCHARGE (ESD)</p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i>.</p>	
<p>2 Fit the lifting aid to the joint unit.</p> <p> CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)</p>  <p>xx2000001957</p>

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5.5.1 Replacing the base
Continued

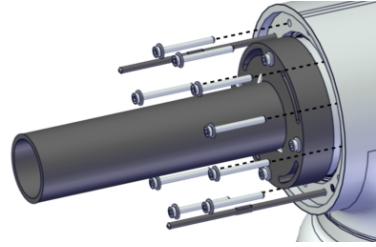
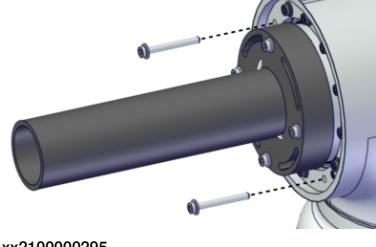
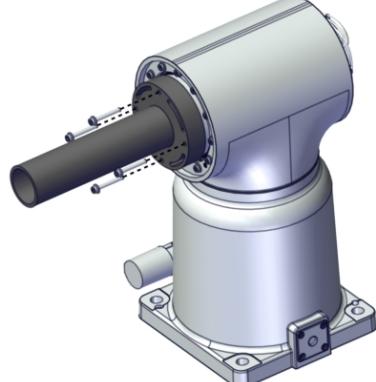
Action	Note
3 Fit two guide pins to the joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002438</p>
4 Place the axis-1 cabling at the notch in the swing.	<p>CAUTION The cabling is sensitive to mechanical damage. Handle it with care to avoid damage to the cabling or the connector, avoid any kind of tilt or skew.</p>  <p>xx2000002153</p>
5 Fit the joint unit to the swing, aligning the pin with the pin hole.	<p>CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>   <p>xx2000001959 xx2000001961</p>

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5 Repair

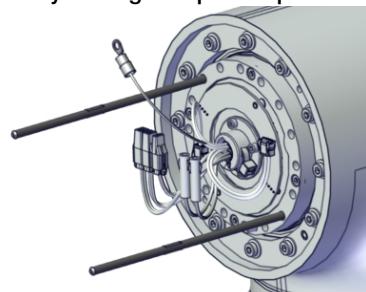
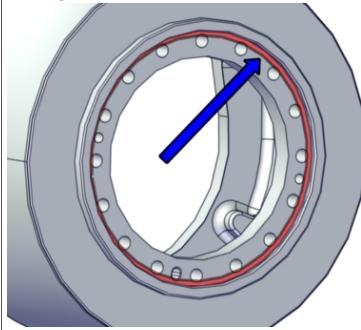
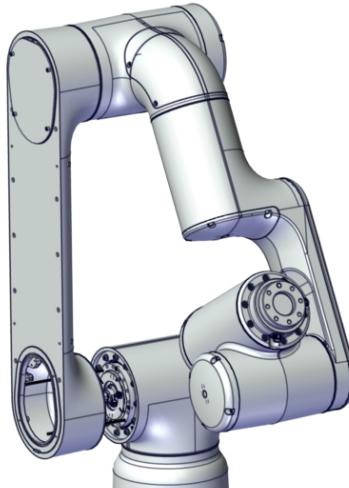
5.5.1 Replacing the base

Continued

	Action	Note
6	Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2000001943</p>
7	Remove the guide pins and secure the remaining two attachment screws.	 <p>xx2100000295</p>
8	Pre-tighten the screws crosswise.	
9	Torque tighten all screws crosswise.	Tightening torque: 4.3 Nm.
10	Remove the lifting aid by removing the screws.	 <p>xx2000001956</p>
11	Clean pushed-out flange sealant, if any.	

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Refitting the lower and upper arm assembled

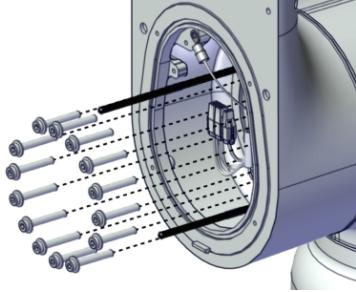
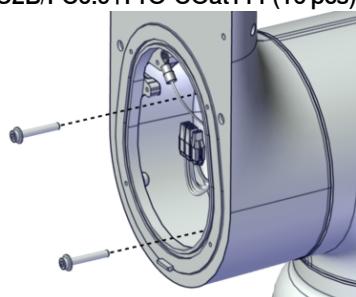
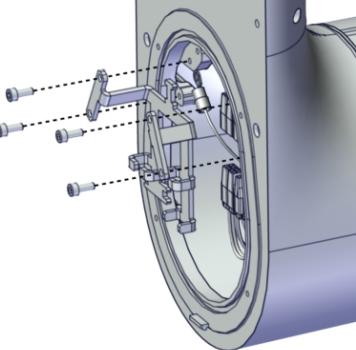
	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001949
2	Remove any old residuals of flange sealant from the lower arm mounting surface and clean with isopropanol. Apply new flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001963
3	 CAUTION The weight of the complete upper and lower arm together is 18 kg	
4	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	 xx2000001941

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5 Repair

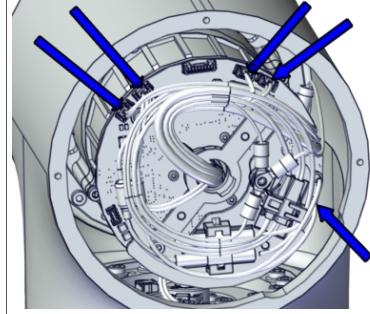
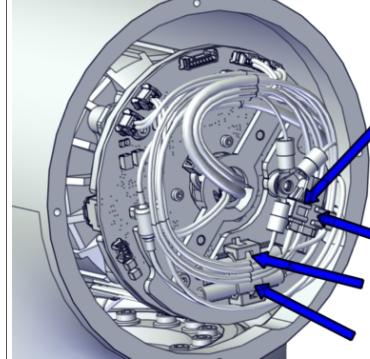
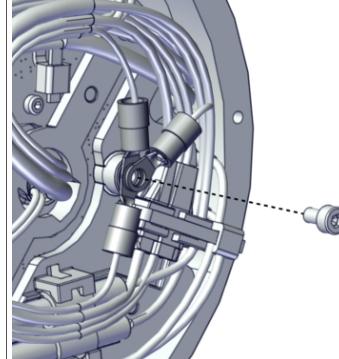
5.5.1 Replacing the base

Continued

	Action	Note
5	<p>Secure the lower arm to the swing with all attachment screws but two. Pre-tighten the screws crosswise firstly.</p>	<p>Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)</p>  <p>xx2000001940</p>
6	<p>Remove the guide pins and fasten the remaining two screws.</p>	<p>Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)</p>  <p>xx2000001951</p>
7	<p>Torque tighten all screws crosswise.</p>	<p>Tightening torque: 4.6 Nm.</p>
8	<p>Refit the cable bracket with four screws.</p>	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm</p>  <p>xx2000001939</p>

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Connecting the axis-2 joint unit cabling

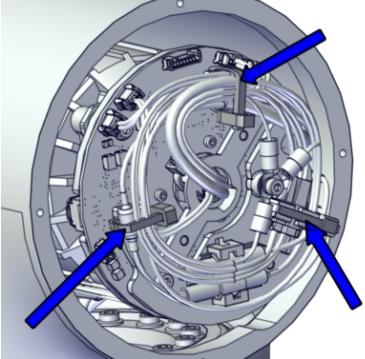
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44.</i>	
2	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D2.X1 to X1 • D2.DC+ to DC+ • D2.DC- to Ground • D2.X4 to X4 • D2.X2 to X2 • D2.X5 to X5 	 xx2000002013
3	Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP 	 xx2000001944
4	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000001945

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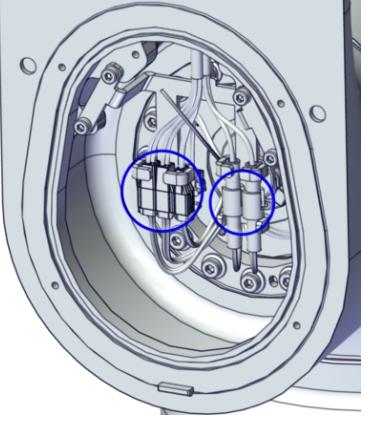
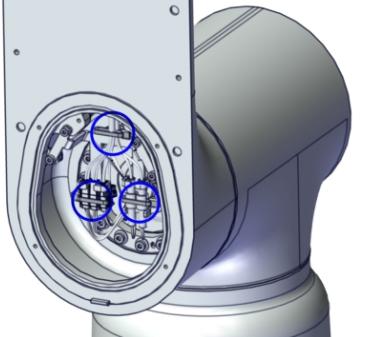
5 Repair

5.5.1 Replacing the base

Continued

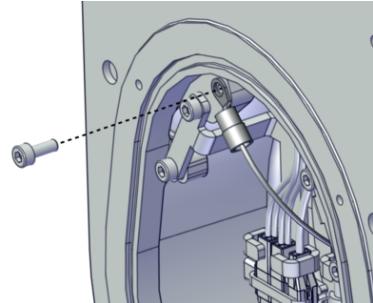
	Action	Note
5	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

Connecting the cabling between the lower arm and swing

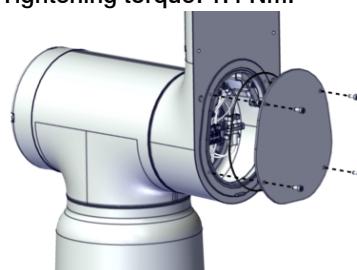
	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938
2	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937

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5.5.1 Replacing the base
Continued

Action	Note
3 Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

Refitting the lower arm covers

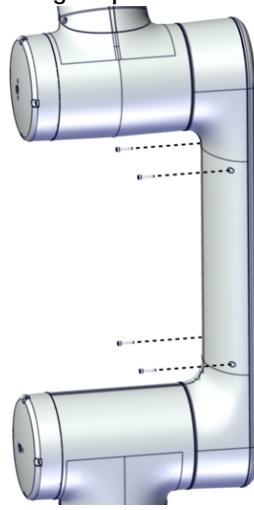
Action	Note
1 Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001954
2 Refit the inner cover with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm.  xx2000001930

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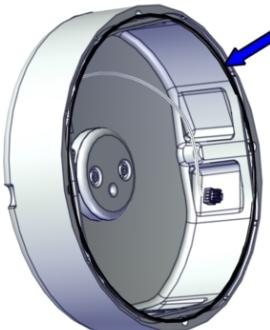
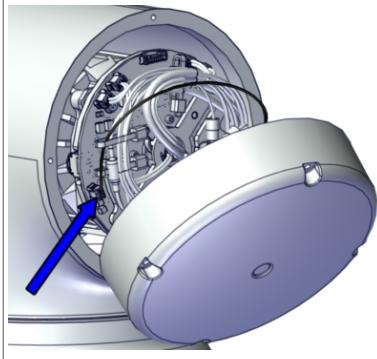
5 Repair

5.5.1 Replacing the base

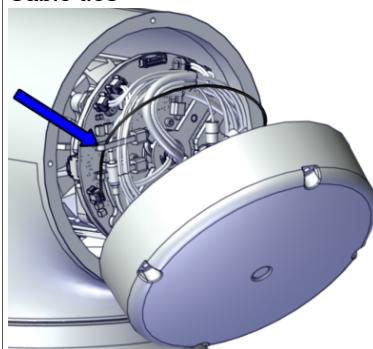
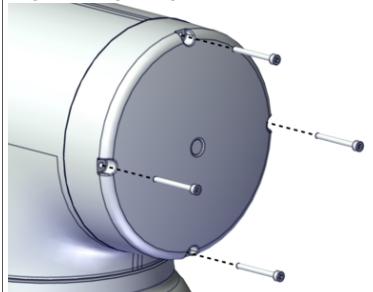
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Action	Note
3 Snap the lower arm cover into place.	
4 Secure the cover with four screws.	Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000001929

Refitting the swing cover

Action	Note
1 Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2 Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000001932

Continues on next page

	Action	Note
3	Secure the brake release cable with a cable tie.	<p>Cable ties</p>  <p>xx2000001931</p>
4	Refit the cover with the four screws.	<p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm</p>  <p>xx2000001935</p>

Concluding procedure

	Action	Note
1	Calibrate the joint unit torque sensor for the axis-1 and axis-2 joint units.	See Calibration on page 719
2	 DANGER Make sure all safety requirements are met when performing the first test run.	

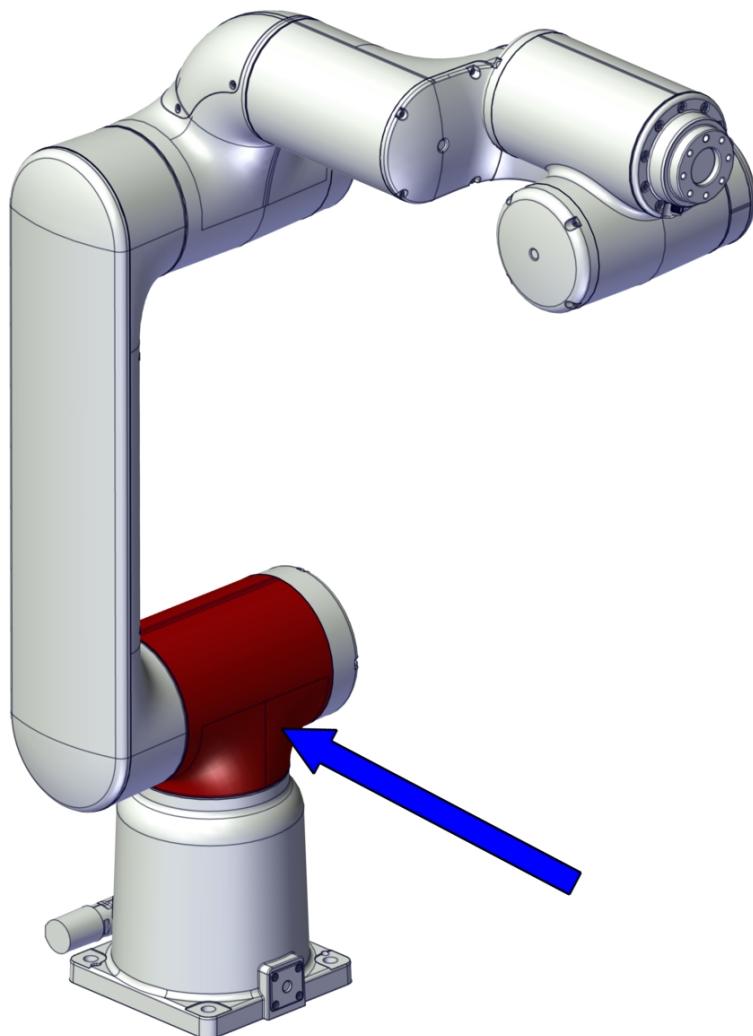
5 Repair

5.5.2 Replacing the swing

5.5.2 Replacing the swing

Location of the swing

The swing is located as shown in the figure.



xx2000001986

Summary of the replacement procedure

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

- 1 Separate the cabling between the swing and the lower arm.
- 2 Remove the lower and upper arm undivided.
- 3 Remove the swing cover.
- 4 Remove the axis-2 joint unit.
- 5 Replace the swing.

Continues on next page

Required spare parts**Note**

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Swing	3HAC073933-001	Also order new attachment screws for the axis-2 joint unit: 3HAB3413-435 (12 pcs).
Flange socket head screw with glue	3HAB3413-435	M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.
Cable tie	3HAC075545-001	For securing joint unit cable.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3. Attachment screws M4x35 (4 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3.
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Grease	3HAC042536-001	Shell Gadus S2
Cable ties	-	
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.
O-ring	3HAC061327-044	Lower arm, inner cover. 1 pcs / cover. Replace if damaged.

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5 Repair

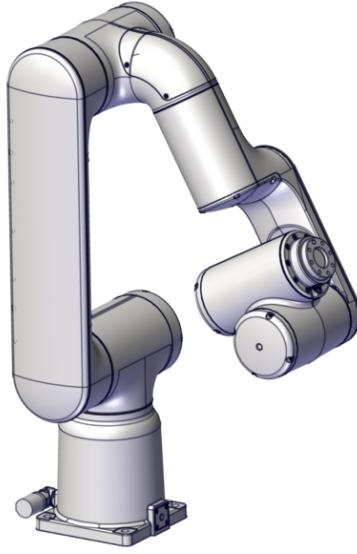
5.5.2 Replacing the swing

Continued

Removing the swing

Use these procedures to remove the swing.

Preparations before removing the swing

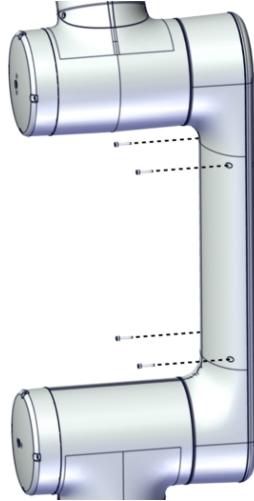
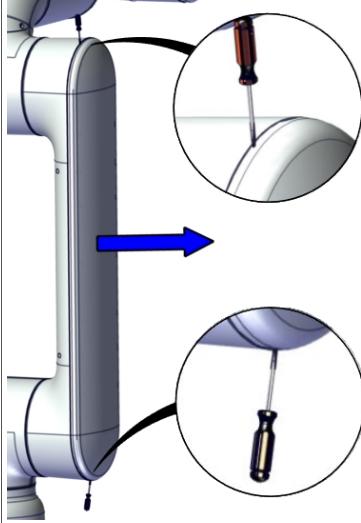
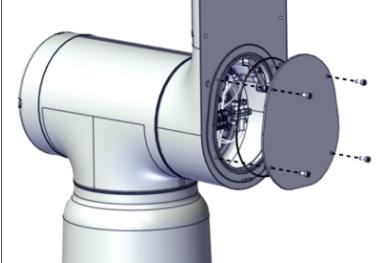
Action	Note
<p>1 Jog the robot to the specified position:</p> <ul style="list-style-type: none">• Axis 1: 0°• Axis 2: 0° (home position)• Axis 3: +60°• Axis 4: 0°• Axis 5: -90°• Axis 6: No significance. <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	 xx2100000044
<p>2 ! DANGER</p> <p>Turn off all:</p> <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply <p>to the robot, before entering the safeguarded space.</p>	

Removing the lower arm covers

Action	Note
<p>1 ! CAUTION</p> <p>Make sure that all supplies for electrical power are turned off.</p>	

Continues on next page

**5.5.2 Replacing the swing
Continued**

Action	Note
2 Remove the four lower arm cover screws.	 xx2000001929
3 Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267
4 Remove the inner cover by removing the four screws.	 xx2000001930

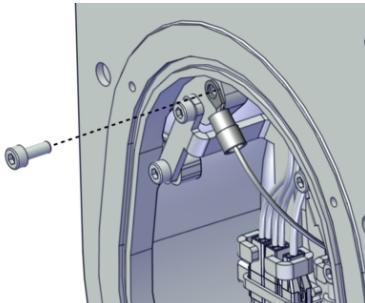
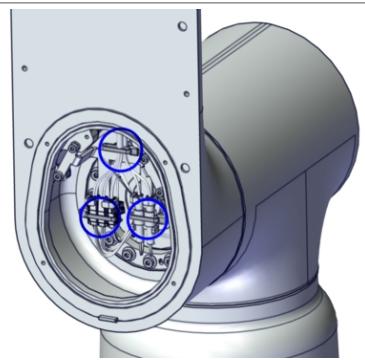
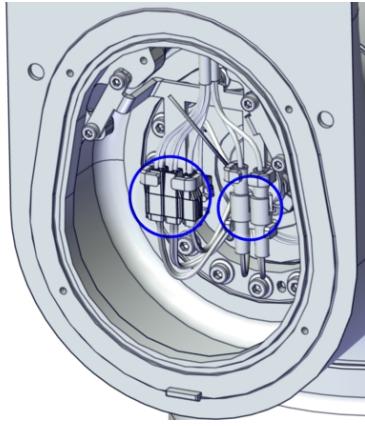
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5 Repair

5.5.2 Replacing the swing

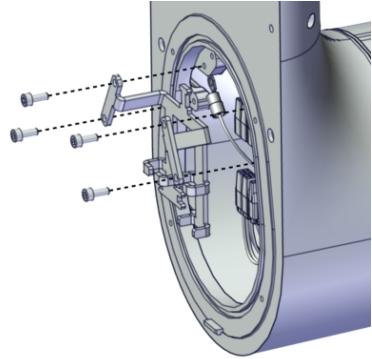
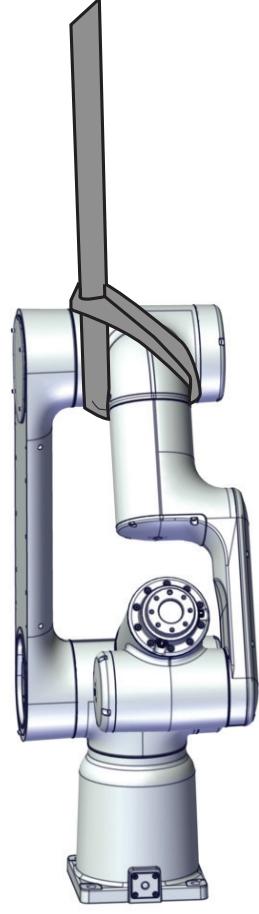
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Disconnecting the cabling between the lower arm and the swing

	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936
2	Cut the cable ties.	 xx2000001937
3	Snap loose and disconnect all connectors.	 xx2000001938

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Removing the lower and upper arm assembled

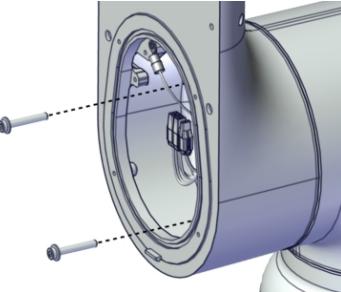
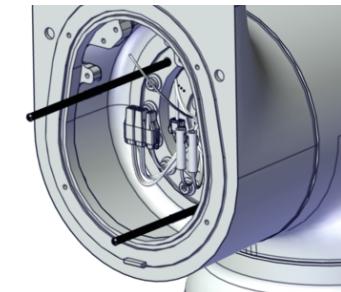
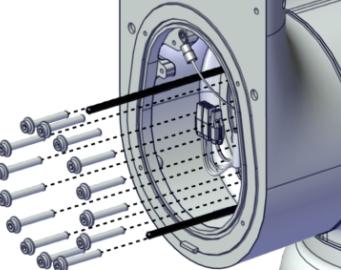
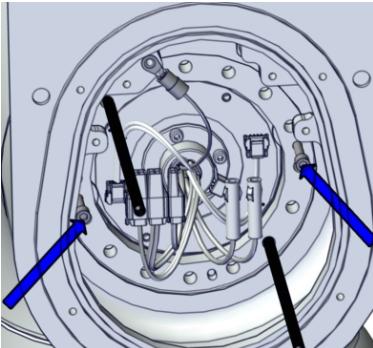
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939
2	Secure the weight of the upper and lower arm. CAUTION The weight of the complete upper and lower arm together is 18 kg	Suggestion with lifting sling and an overhead crane:  xx2100000294

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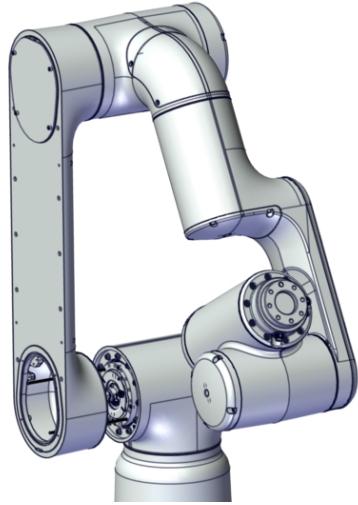
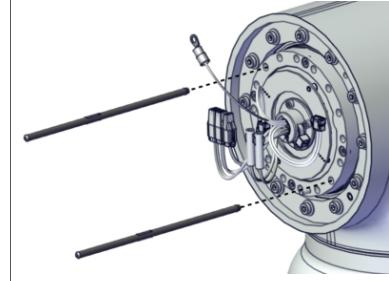
5 Repair

5.5.2 Replacing the swing

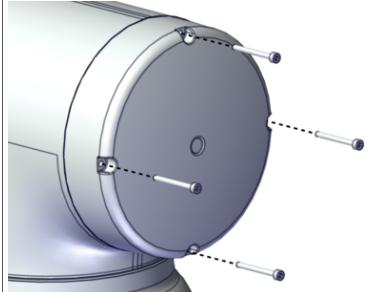
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	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.</p>  <p>xx2000001951</p>  <p>xx2000001960</p>
4	Remove the lower arm attachment screws.	 <p>xx2000001940</p>
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 <p>xx2000002151</p>

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	Action	Note
6	Remove the complete arm system from the swing.	 xx2000001941
7	Remove the guide pins.	 xx2000002432

Removing the swing cover

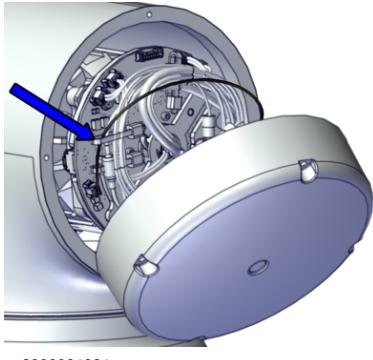
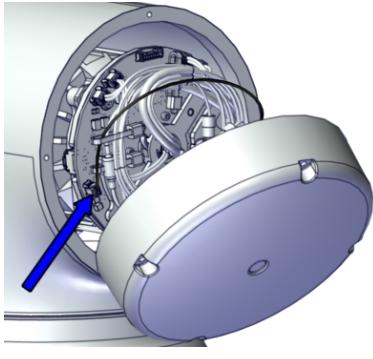
	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	Remove the cover screws.	 xx2000001935

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5 Repair

5.5.2 Replacing the swing

Continued

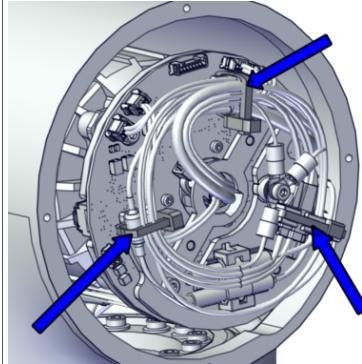
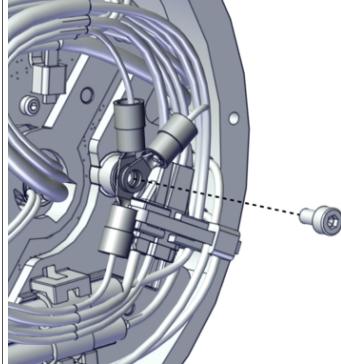
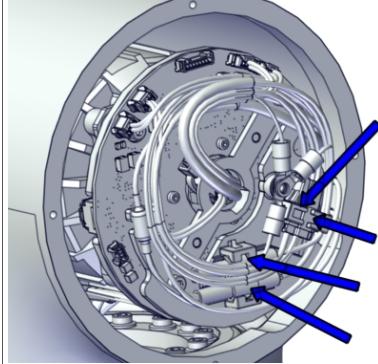
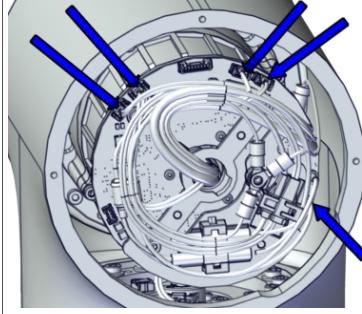
	Action	Note
3	 CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000001931
5	Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000001932

Disconnecting the axis-2 joint unit cabling

	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 44 .	

Continues on next page

5.5.2 Replacing the swing Continued

Action	Note
2 Cut the cable ties.	 xx2000001946
3 Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J2.DC+ • J2.DC- • J2.CS • J2.CP 	 xx2000001944
5 Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 <p> CAUTION Use tweezers to unlock connectors and pull them off.</p>	 xx2000002013

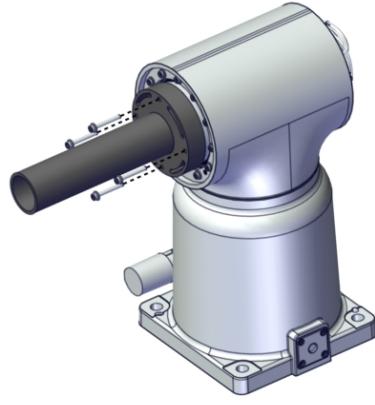
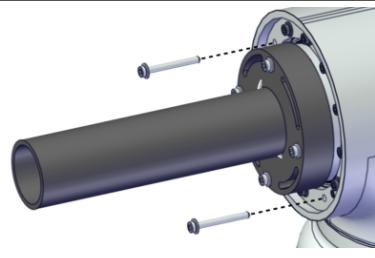
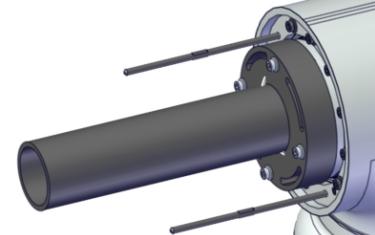
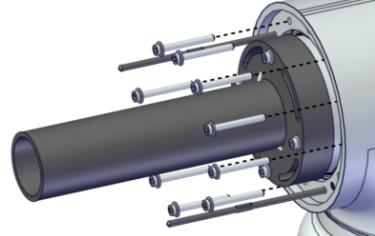
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5 Repair

5.5.2 Replacing the swing

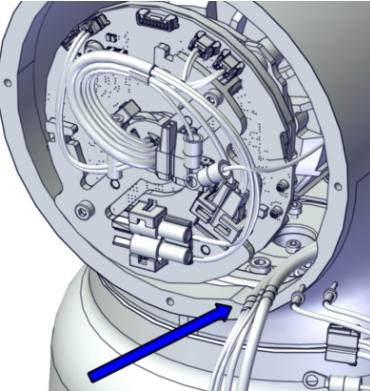
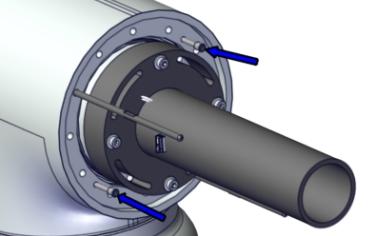
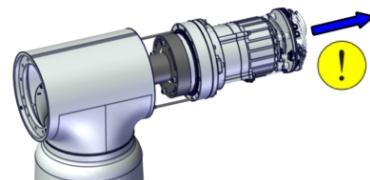
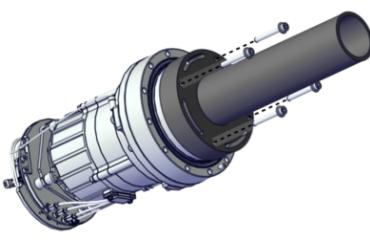
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Removing the axis-2 joint unit

	Action	Note
1	<p>Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)</p>  <p>xx2000001956</p>
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx2100000295</p>
3	Fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002433</p>
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx200001943</p>

Continues on next page

**5.5.2 Replacing the swing
Continued**

Action	Note
5 Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 xx210000045
6 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2000002434
7 Remove the joint unit from the swing. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000001958
8 Remove the lifting aid and guide pins.	 xx2000001957

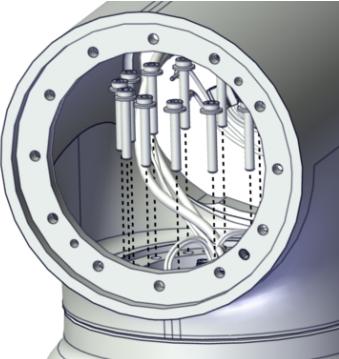
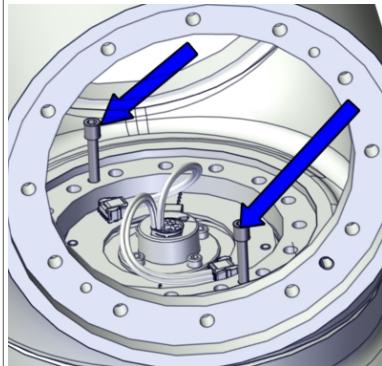
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5 Repair

5.5.2 Replacing the swing

Continued

Removing the swing

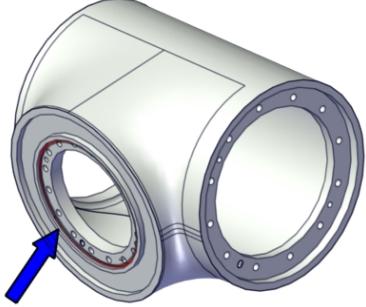
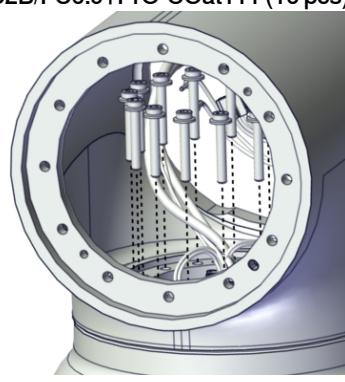
	Action	Note
1	Remove the swing attachment screws.	 xx2000001987
2	Use two fully threaded attachment screws as removal tools to press the swing out of position.	 xx2000002152
3	Lift away the swing.  CAUTION The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	

Continues on next page

Refitting the swing

Use these procedures to refit the swing.

Refitting the swing

	Action	Note
1	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the base mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001990
2	Refit the swing to the base unit, aligning the pin with the pin hole.  CAUTION The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	 xx2000001989
3	Secure the swing with the attachment screws. Pre-tighten the screws crosswise firstly.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001987
4	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.

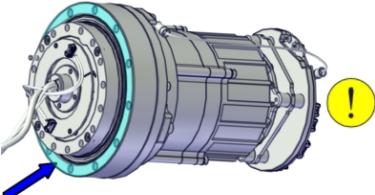
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5 Repair

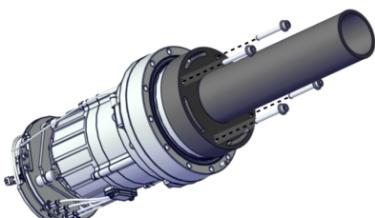
5.5.2 Replacing the swing

Continued

Preparations before fitting the joint unit

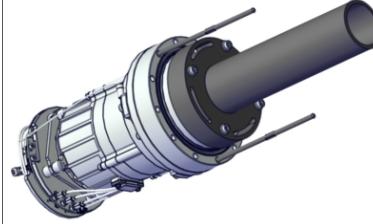
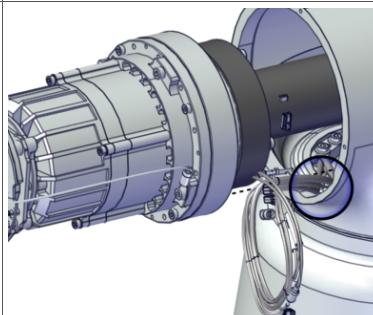
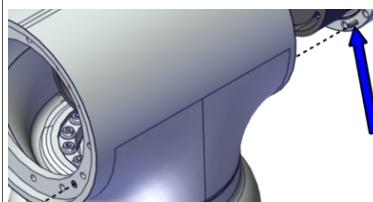
Action	Note
<p>1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	
<p>2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.</p>	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
<p>3 Apply a thin layer of flange sealant to the mounting surface. Do not contaminate the radial sealing with sealant.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44.</p>	

Refitting the axis-2 joint unit

Action	Note
<p>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 44.</p>	
<p>2 Fit the lifting aid to the joint unit.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957

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5.5.2 Replacing the swing Continued

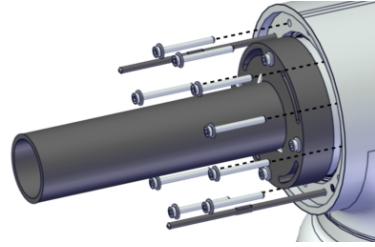
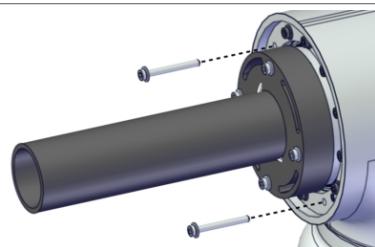
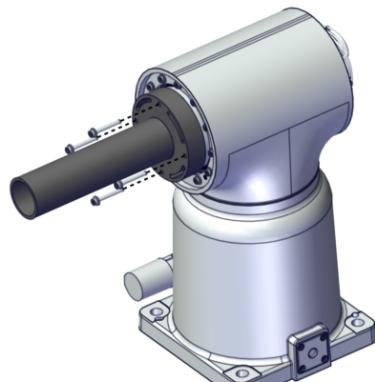
Action	Note
3 Fit two guide pins to the joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002438</p>
4 Place the axis-1 cabling at the notch in the swing.	<p>! CAUTION The cabling is sensitive to mechanical damage. Handle it with care to avoid damage to the cabling or the connector, avoid any kind of tilt or skew.</p>  <p>xx2000002153</p>
5 Fit the joint unit to the swing, aligning the pin with the pin hole.	<p>! CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>  <p>xx2000001959</p>  <p>xx2000001961</p>

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5 Repair

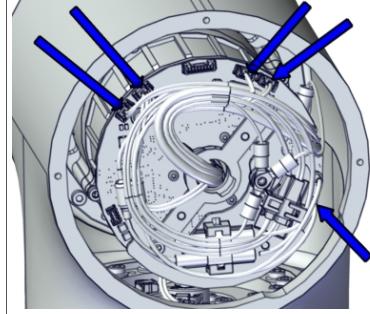
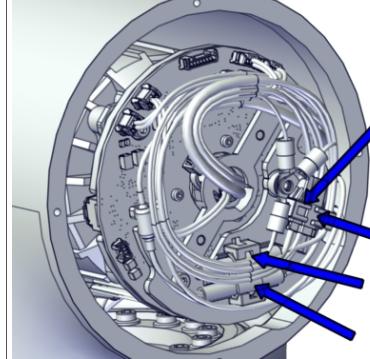
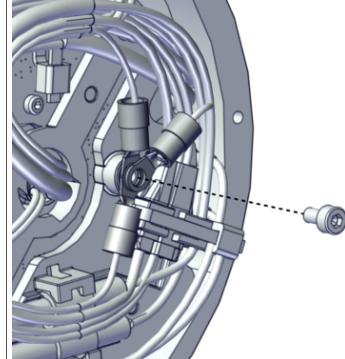
5.5.2 Replacing the swing

Continued

	Action	Note
6	Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs</p> <p>Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2000001943</p>
7	Remove the guide pins and secure the remaining two attachment screws.	 <p>xx2100000295</p>
8	Pre-tighten the screws crosswise.	
9	Torque tighten all screws crosswise.	Tightening torque: 4.3 Nm.
10	Remove the lifting aid by removing the screws.	 <p>xx2000001956</p>
11	Clean pushed-out flange sealant, if any.	

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Connecting the axis-2 joint unit cabling

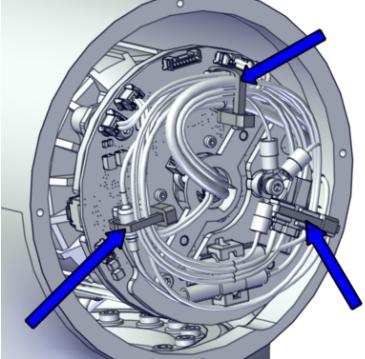
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44.</i>	
2	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D2.X1 to X1 • D2.DC+ to DC+ • D2.DC- to Ground • D2.X4 to X4 • D2.X2 to X2 • D2.X5 to X5 	 xx2000002013
3	Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP 	 xx2000001944
4	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000001945

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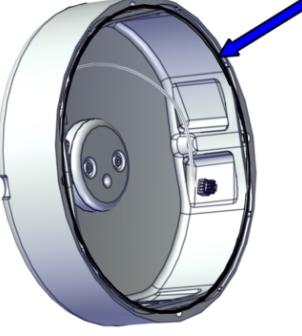
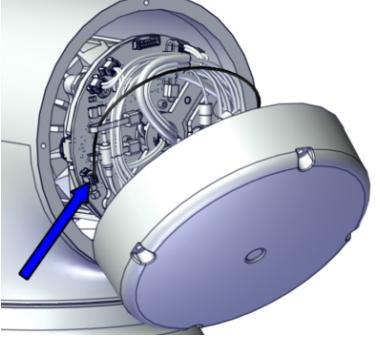
5 Repair

5.5.2 Replacing the swing

Continued

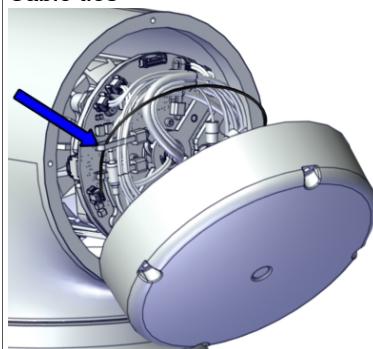
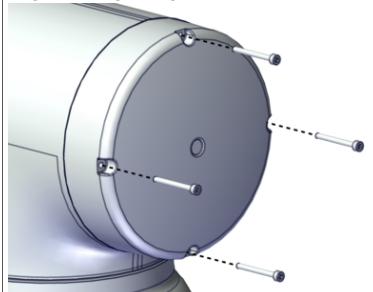
	Action	Note
5	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

Refitting the swing cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000001932

Continues on next page

**5.5.2 Replacing the swing
Continued**

Action	Note
3 Secure the brake release cable with a cable tie.	Cable ties  xx2000001931
4 Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000001935

Refitting the lower and upper arm assembled

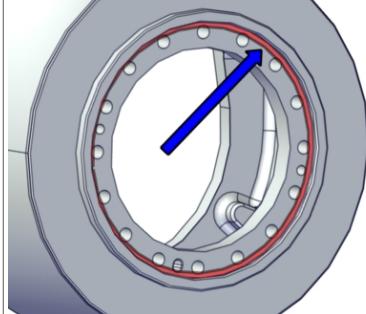
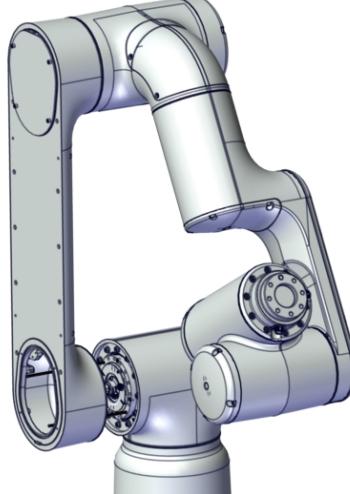
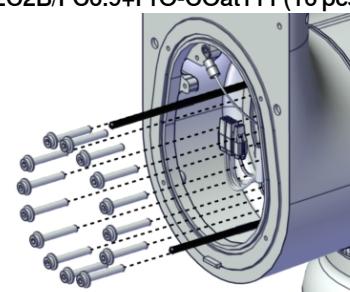
Action	Note
1 Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001949

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5 Repair

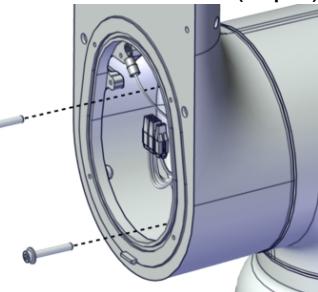
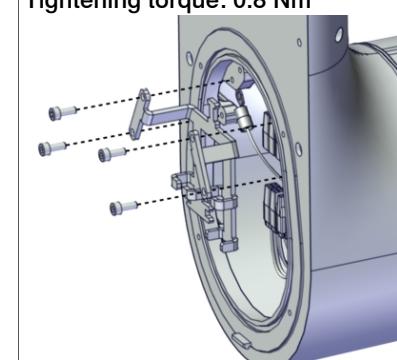
5.5.2 Replacing the swing

Continued

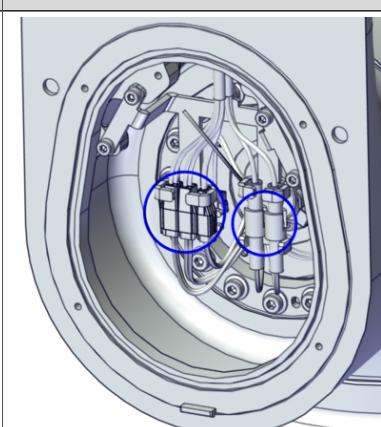
Action	Note
<p>2 Remove any old residuals of flange sealant from the lower arm mounting surface and clean with isopropanol.</p> <p>Apply new flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.</p>	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000001963</p>
<p>3  CAUTION</p> <p>The weight of the complete upper and lower arm together is 18 kg</p>	
<p>4 Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.</p>	 <p>xx2000001941</p>
<p>5 Secure the lower arm to the swing with all attachment screws but two.</p> <p>Pre-tighten the screws crosswise firstly.</p>	<p>Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)</p>  <p>xx2000001940</p>

Continues on next page

**5.5.2 Replacing the swing
Continued**

Action	Note
6 Remove the guide pins and fasten the remaining two screws.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001951
7 Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.
8 Refit the cable bracket with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm  xx2000001939

Connecting the cabling between the lower arm and swing

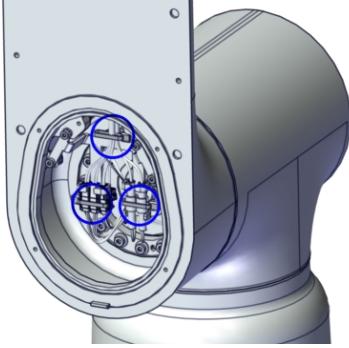
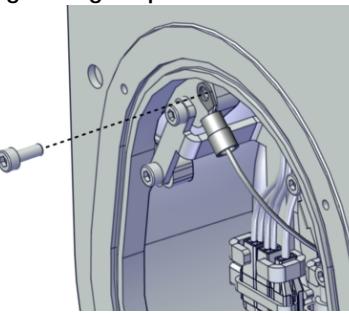
Action	Note
1 Connect the connectors to each other and snap them to the cable holders.	 xx2000001938

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5 Repair

5.5.2 Replacing the swing

Continued

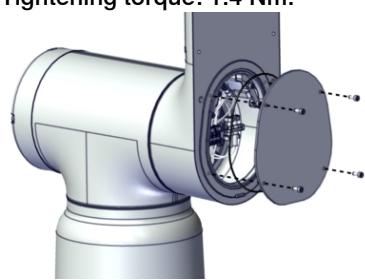
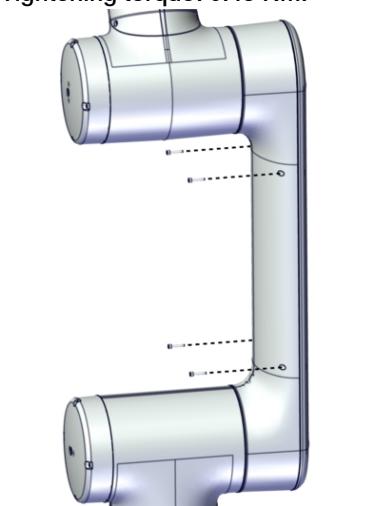
Action	Note
2 Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937
3 Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

Refitting the lower arm covers

Action	Note
1 Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001954

Continues on next page

**5.5.2 Replacing the swing
Continued**

	Action	Note
2	Refit the inner cover with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm.  xx2000001930
3	Snap the lower arm cover into place.	Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.
4	Secure the cover with four screws.	 xx2000001929

Concluding procedure

	Action	Note
1	Calibrate the joint unit torque sensor for the axis-2 joint unit.	See Calibration on page 719
2	 DANGER Make sure all safety requirements are met when performing the first test run.	

5 Repair

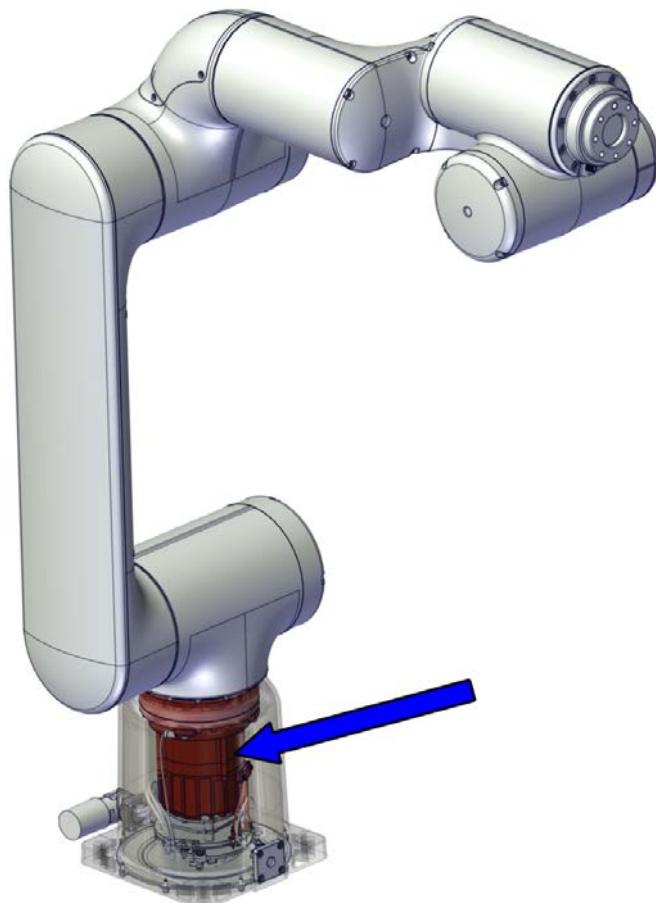
5.6.1 Replacing the axis-1 joint unit

5.6 Joint units

5.6.1 Replacing the axis-1 joint unit

Location of the axis-1 joint unit

The joint unit is located as shown in the figure.



xx2000002018

Summary of the replacement procedure

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

- 1 Separate the cabling between the swing and the lower arm.
- 2 Remove the lower and upper arm undivided.
- 3 Remove the axis-2 joint unit.
- 4 Remove the swing.
- 5 Loosen the base from the foundation and lay it down on its side.
- 6 Replace the axis-1 joint unit. Move the cabling from old to new joint unit.

Continues on next page

Required spare parts**Note**

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal,
www.abb.com/myABB.

Spare part	Article number	Note
Joint unit	3HAC079141-001	New attachment screws and cable tie 3HAC075545-001 are included in the delivery.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3. Attachment screws M4x35 (4 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Cable ties	-	

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5 Repair

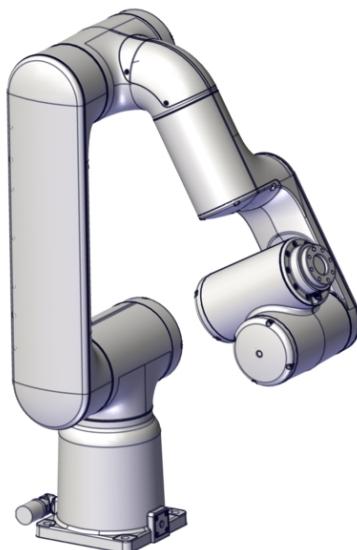
5.6.1 Replacing the axis-1 joint unit

Continued

Removing the joint unit

Use these procedures to remove the joint unit.

Preparations before removing the joint unit

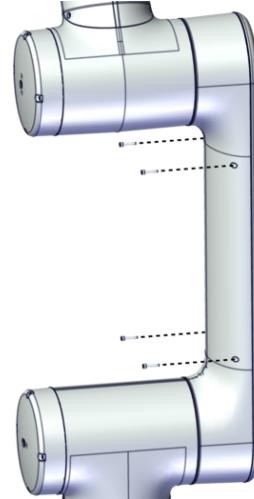
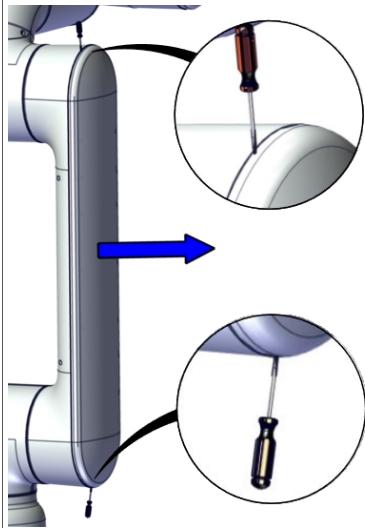
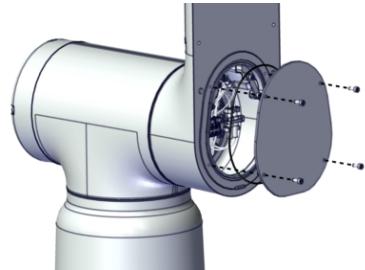
	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none">• Axis 1: 0° (home position)• Axis 2: 0°• Axis 3: +60°• Axis 4: 0°• Axis 5: -90°• Axis 6: No significance. <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	 xx2100000044
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

Removing the lower arm covers

	Action	Note
1	<p>! CAUTION</p> <p>Make sure that all supplies for electrical power are turned off.</p>	

Continues on next page

5.6.1 Replacing the axis-1 joint unit
Continued

Action	Note
2 Remove the four lower arm cover screws.	 xx2000001929
3 Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267
4 Remove the inner cover by removing the four screws.	 xx2000001930

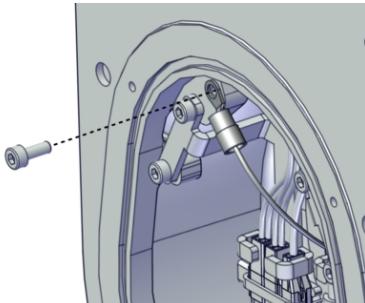
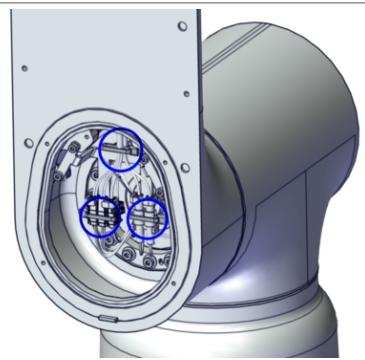
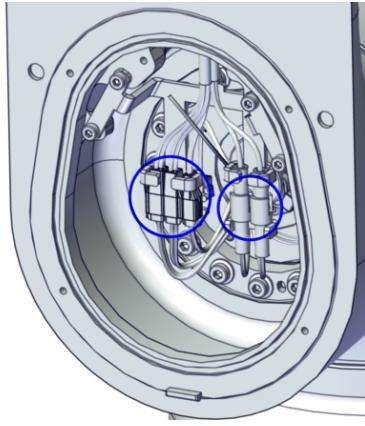
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5 Repair

5.6.1 Replacing the axis-1 joint unit

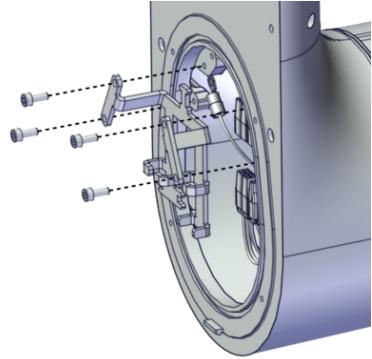
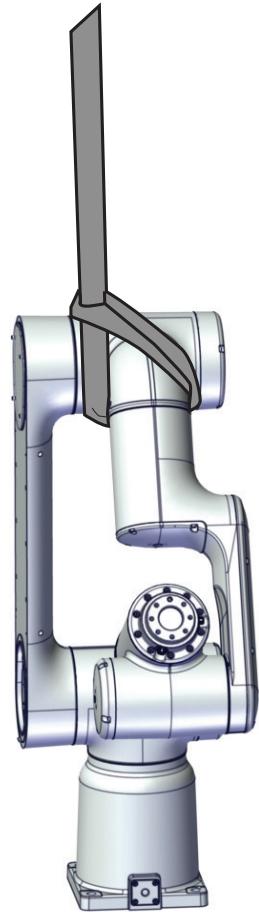
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Disconnecting the cabling between the lower arm and the swing

	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936
2	Cut the cable ties.	 xx2000001937
3	Snap loose and disconnect all connectors.	 xx2000001938

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Removing the lower and upper arm assembled

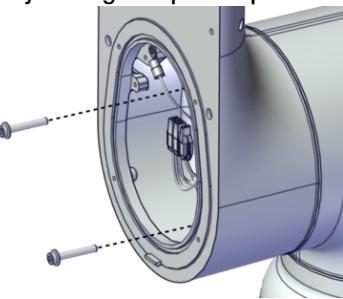
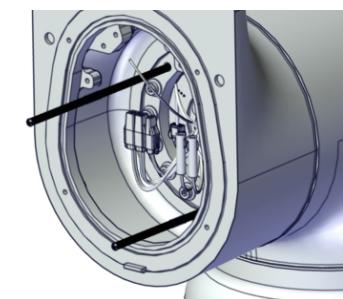
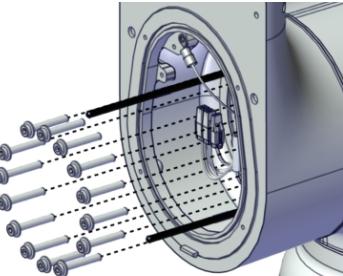
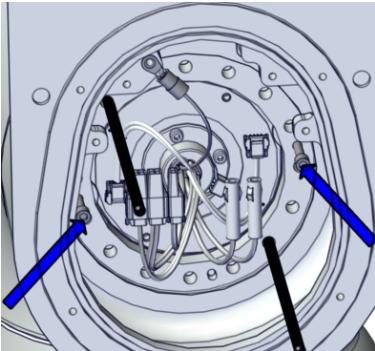
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939
2	Secure the weight of the upper and lower arm. CAUTION The weight of the complete upper and lower arm together is 18 kg	Suggestion with lifting sling and an overhead crane:  xx2100000294

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5 Repair

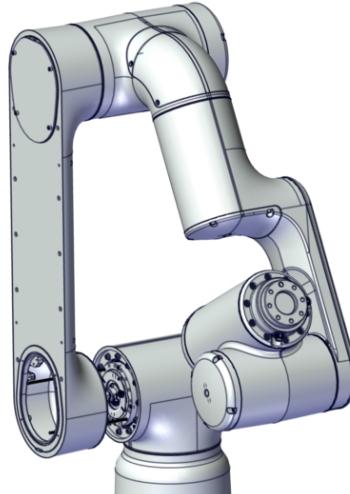
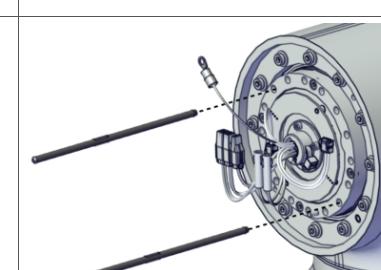
5.6.1 Replacing the axis-1 joint unit

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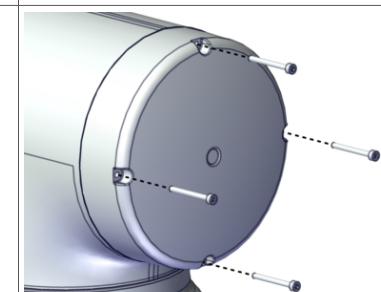
	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.</p>  <p>xx2000001951</p>  <p>xx2000001960</p>
4	Remove the lower arm attachment screws.	 <p>xx2000001940</p>
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 <p>xx2000002151</p>

Continues on next page

5.6.1 Replacing the axis-1 joint unit
Continued

Action	Note
6 Remove the complete arm system from the swing.	 xx2000001941
7 Remove the guide pins.	 xx2000002432

Removing the swing cover

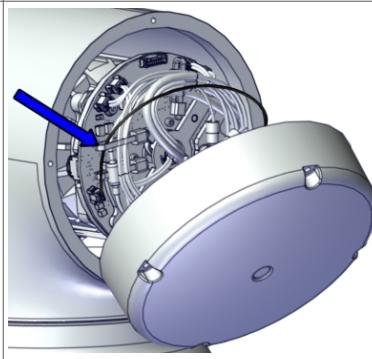
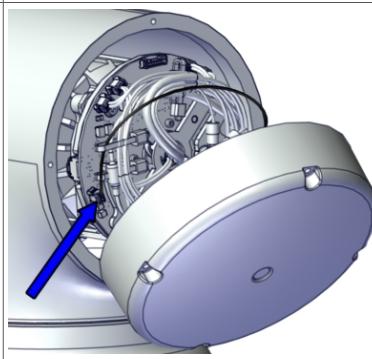
Action	Note
1  CAUTION Make sure that all supplies for electrical power are turned off.	
2 Remove the cover screws.	 xx2000001935

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5 Repair

5.6.1 Replacing the axis-1 joint unit

Continued

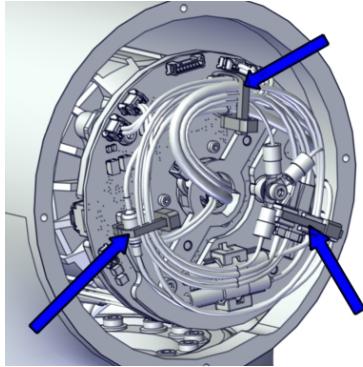
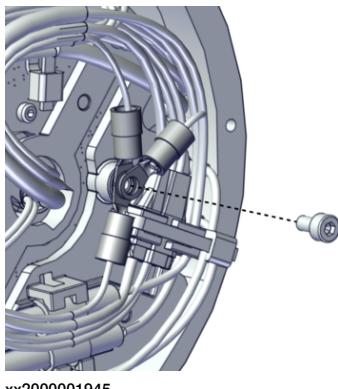
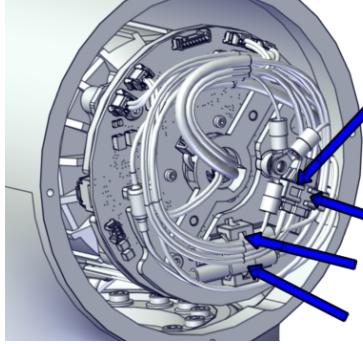
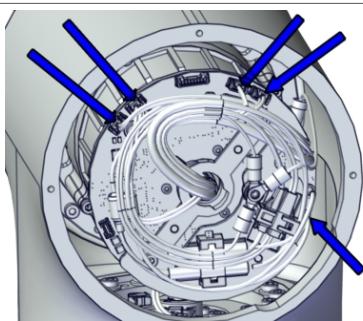
	Action	Note
3	 CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000001931
5	Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000001932

Disconnecting the axis-2 joint unit cabling

	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 44 .	

Continues on next page

5.6.1 Replacing the axis-1 joint unit
Continued

	Action	Note
2	Cut the cable ties.	 xx2000001946
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J2.DC+ • J2.DC- • J2.CS • J2.CP 	 xx2000001944
5	Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 <p>CAUTION</p> <p>Use tweezers to unlock connectors and pull them off.</p>	 xx2000002013

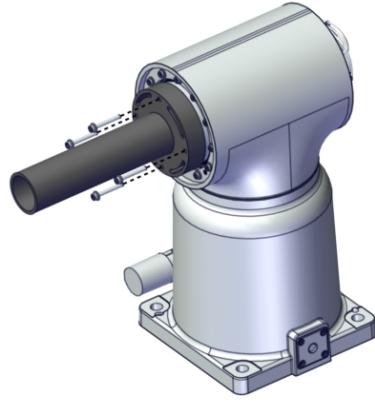
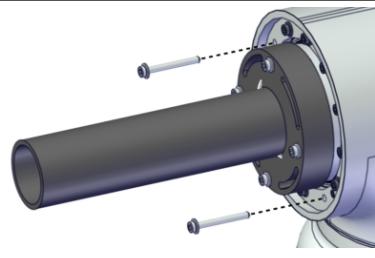
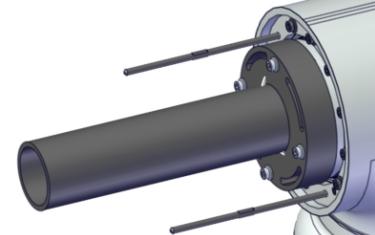
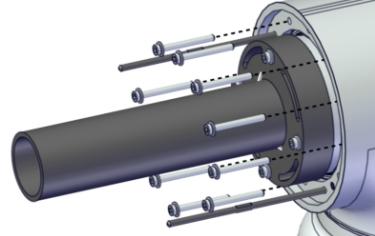
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5 Repair

5.6.1 Replacing the axis-1 joint unit

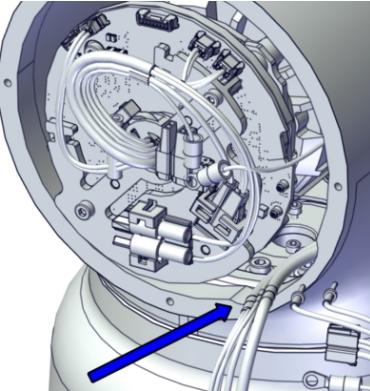
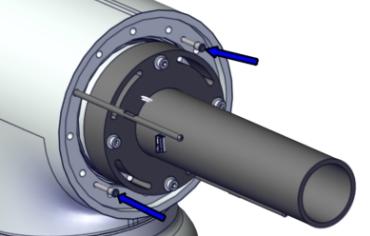
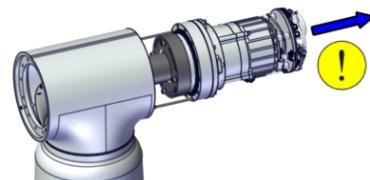
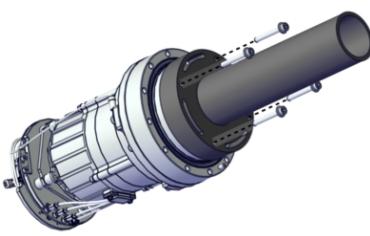
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Removing the axis-2 joint unit

	Action	Note
1	<p>Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)</p>  <p>xx2000001956</p>
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx2100000295</p>
3	Fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002433</p>
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx200001943</p>

Continues on next page

5.6.1 Replacing the axis-1 joint unit
Continued

Action	Note
5 Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 xx210000045
6 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2000002434
7 Remove the joint unit from the swing. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000001958
8 Remove the lifting aid and guide pins.	 xx2000001957

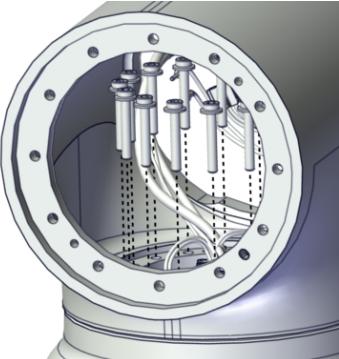
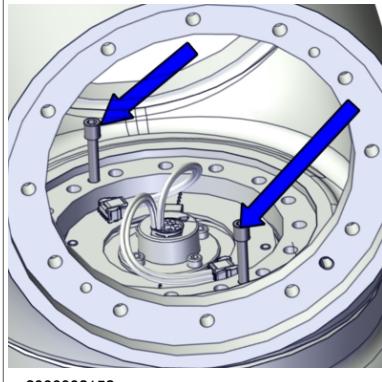
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5 Repair

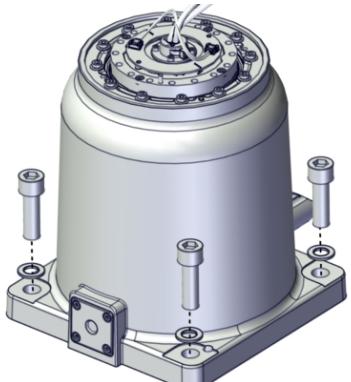
5.6.1 Replacing the axis-1 joint unit

Continued

Removing the swing

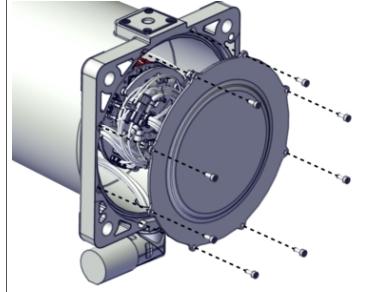
	Action	Note
1	Remove the swing attachment screws.	 xx2000001987
2	Use two fully threaded attachment screws as removal tools to press the swing out of position.	 xx2000002152
3	Lift away the swing.  CAUTION The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	

Loosening the base and removing the base cover

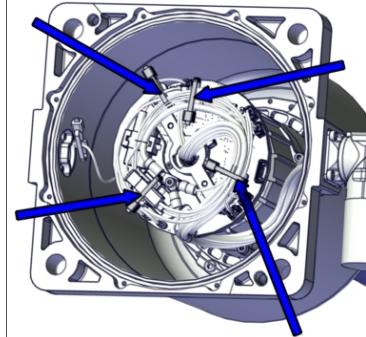
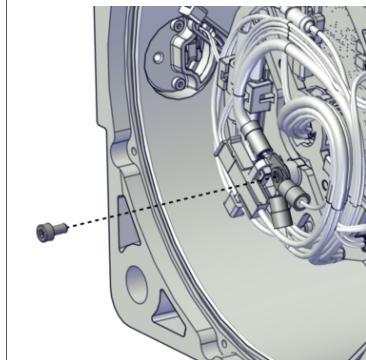
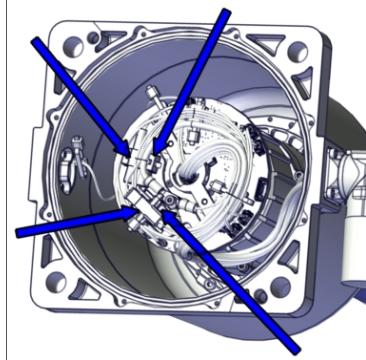
	Action	Note
1	Loosen the base from the foundation by removing the attachment screws and washers.	 xx2000002006

Continues on next page

5.6.1 Replacing the axis-1 joint unit
Continued

Action	Note
2 Tilt the base on to its side and remove the bottom cover by removing the attachment screws.	 xx2000002007

Disconnecting the axis-1 joint unit cabling

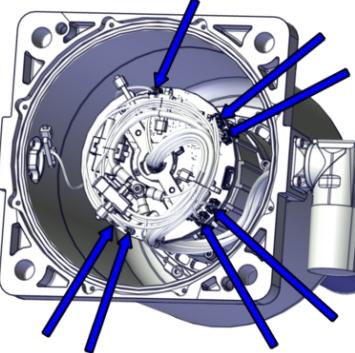
Action	Note
1 Cut the cable ties.	 xx2000002012
2 Remove the functional and protective earth cables by removing the screw.	 xx2000002011
3 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J1.DC+ • J1.DC- • J1.CS • J1.CP 	 xx2000002010

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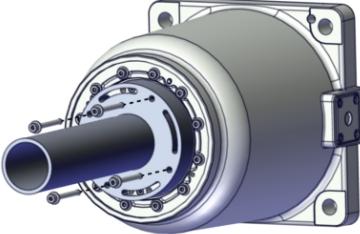
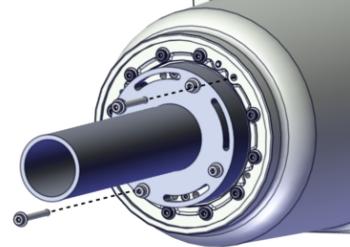
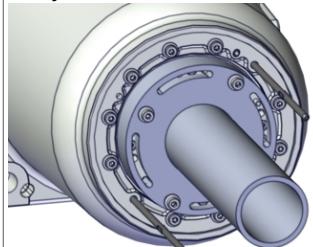
5 Repair

5.6.1 Replacing the axis-1 joint unit

Continued

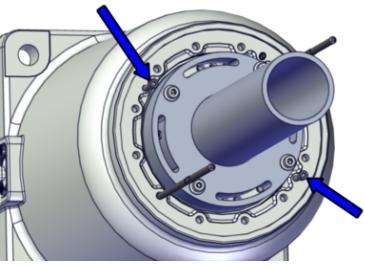
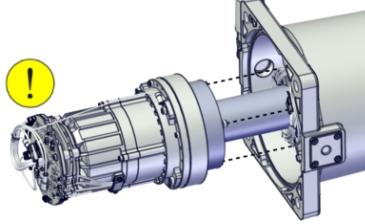
Action	Note
<p>4 Disconnect the connectors from the drive board.</p> <ul style="list-style-type: none"> • D1.X1 from X1 • D1.DC+ from DC+ • D1.DC- from ground • D1.X4 from X4 • D1.X2 from X2 • D1.X5 from X5 • DR.X8 from X8 <p>! CAUTION</p> <p>Use tweezers to unlock connectors and pull them off.</p>	 xx2000002009

Removing the axis-1 joint unit

Action	Note
<p>1 Fit the lifting aid to the joint unit.</p> <p>! CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001994
<p>2 Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000296
<p>3 Fit two guide pins to the axis-1 joint unit.</p>	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.  xx2000002435

Continues on next page

5.6.1 Replacing the axis-1 joint unit
Continued

Action	Note
4 Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.	 xx2000002008
5 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2000002436
6 Remove the joint unit from the base.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002014
7 Remove the lifting aid and guide pins.	 xx2000001957

Removing the joint cable

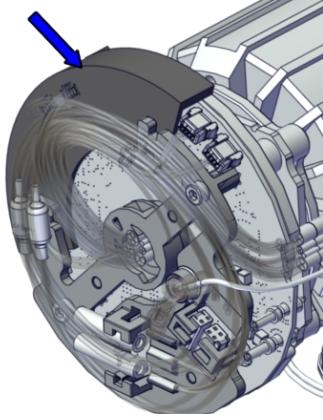
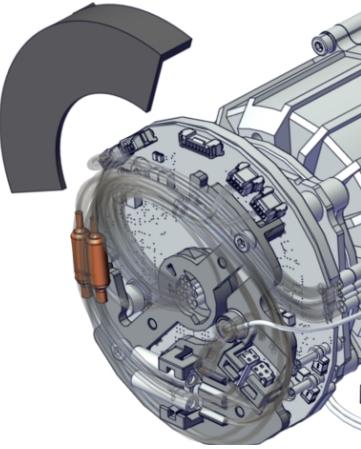
Action	Note
1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	

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5 Repair

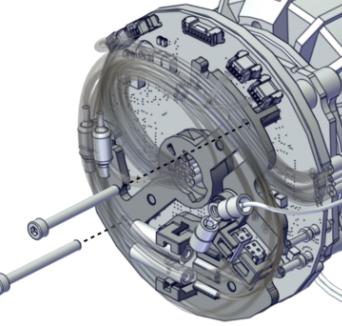
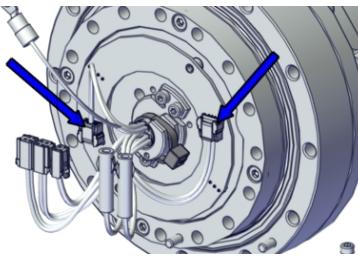
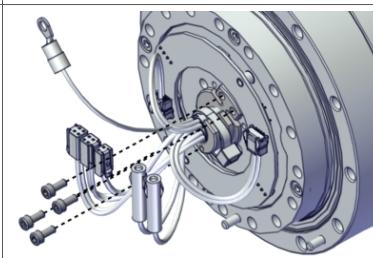
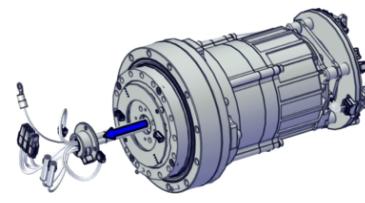
5.6.1 Replacing the axis-1 joint unit

Continued

	Action	Note
2	<p>Fit the protection plate to the drive board unit.</p> <p> Tip</p> <p>Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.</p>	<p>Protection plate: 3HAC077790-001</p>  <p>xx2000002057</p>
3	Cut the cable tie at the drive board.	 <p>xx2000002058</p>
4	Remove the protection plate.	 <p>xx2100000301</p>

Continues on next page

5.6.1 Replacing the axis-1 joint unit
Continued

Action	Note
5 Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6 Disconnect the two connectors from the torque sensor board. <ul style="list-style-type: none"> • TQ.A • TQ.B 	 xx2000002053
7 Remove the cable plate by removing the attachment screws.	 xx2000002049
8 Remove the joint cable from the hollow shaft from the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002060

Refitting the joint unit

Use these procedures to refit the joint unit.

Refitting the joint cable

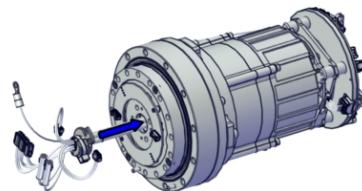
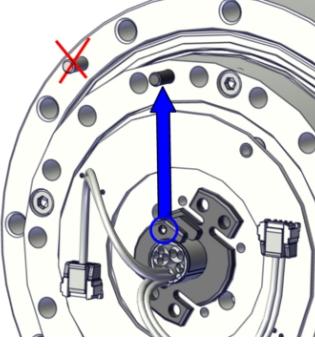
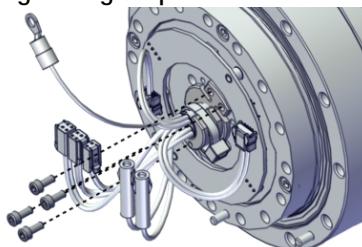
Action	Note
1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	

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5 Repair

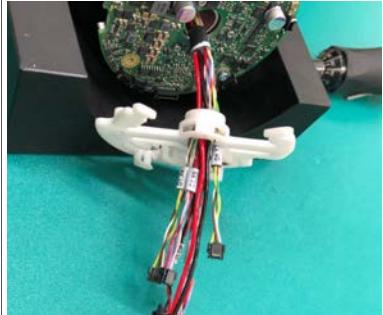
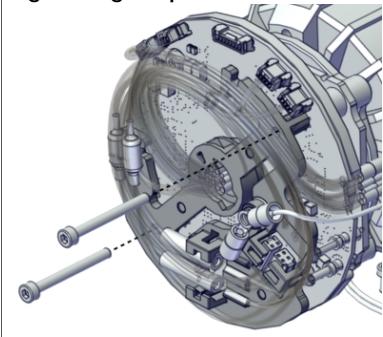
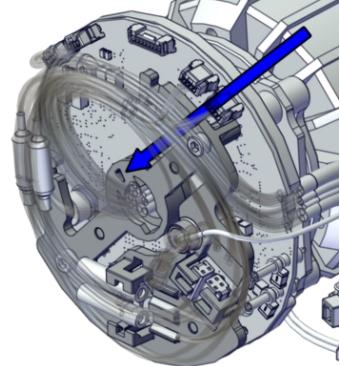
5.6.1 Replacing the axis-1 joint unit

Continued

	Action	Note
2	<p>Place the joint cable through the hollow shaft from the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002048
3	<p>Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.</p>	 xx2000002051
4	<p>Secure the cable plate to the joint unit with the attachment screws.</p>	<p>Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs)</p> <p>Tightening torque: 0.45 Nm.</p>  xx2000002049
5	<p>Connect the two connectors to the torque sensor board.</p> <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 xx2000002053

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5.6.1 Replacing the axis-1 joint unit
Continued

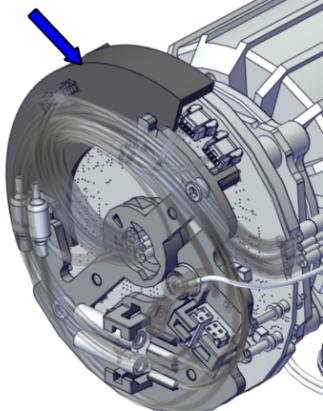
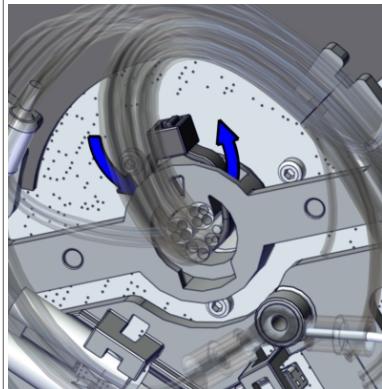
Action	Note
6 Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 xx2000002056 <p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.</p>  xx2000002055
7 Keep the cabling loose, making sure not to twist or strain it. Use the cable tie to pre-fix the cable by hand.	 xx2100000507

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5 Repair

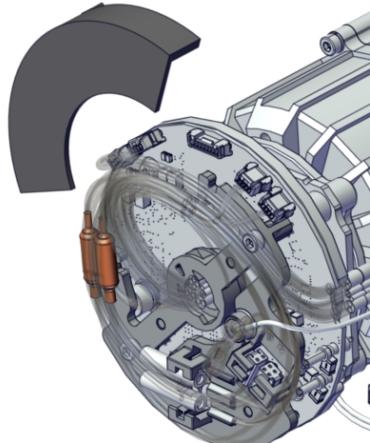
5.6.1 Replacing the axis-1 joint unit

Continued

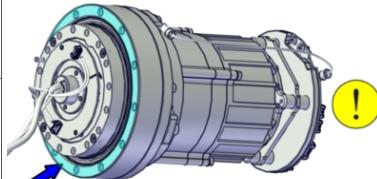
	Action	Note
8	Fit the protection plate to the drive board unit.	<p>Protection plate: 3HAC077790-001</p>  <p>xx2000002057</p>
9	<p>Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.</p>	<p>Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO7 Setting for cable tie gun: 6.75.</p>  <p>xx2000002058</p>  <p>xx2000002059</p>

Continues on next page

5.6.1 Replacing the axis-1 joint unit
Continued

Action	Note
10 Remove the protection plate.	 xx2100000301

Preparations before fitting the joint 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 44 .	
2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574
3  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	 xx2000001860

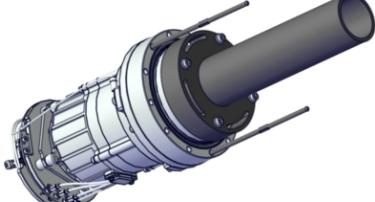
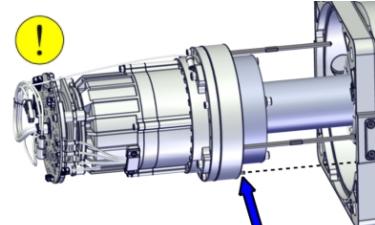
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5 Repair

5.6.1 Replacing the axis-1 joint unit

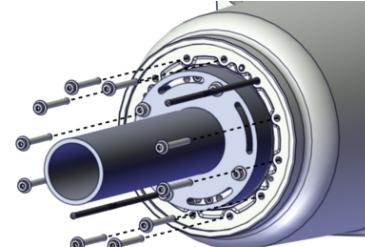
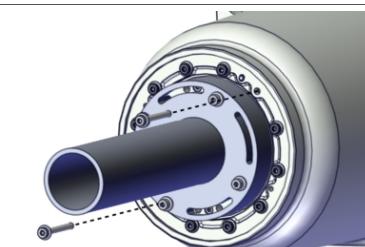
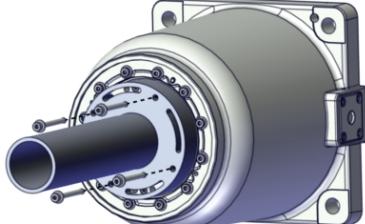
Continued

Refitting the axis-1 joint 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 44 .	
2	Fit the lifting aid to the joint unit.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957
3	Fit two guide pins to the joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.  xx2000002438
4	Fit the joint unit to the base, aligning the pin with the pin hole.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002015

Continues on next page

5.6.1 Replacing the axis-1 joint unit
Continued

Action	Note
5 Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+Pro-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2000002008</p>
6 Remove the guide pins and secure the remaining two attachment screws.	 <p>xx2100000296</p>
7 Pre-tighten the screws crosswise.	
8 Torque tighten all screws crosswise.	Tightening torque: 4.3 Nm.
9 Remove the lifting aid by removing the screws.	 <p>xx2000001994</p>
10 Clean pushed-out flange sealant, if any.	

Connecting the axis-1 joint unit cabling

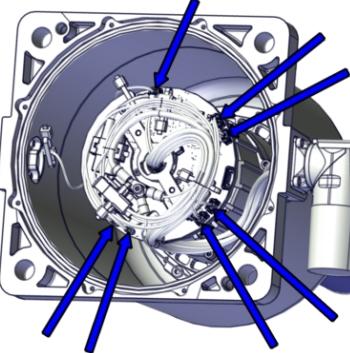
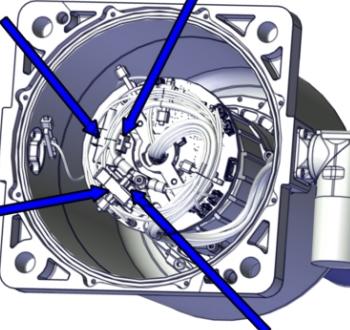
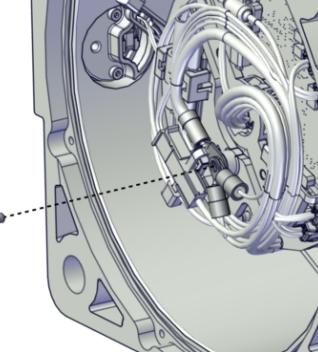
Action	Note
 ELECTROSTATIC DISCHARGE (ESD) <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	

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5 Repair

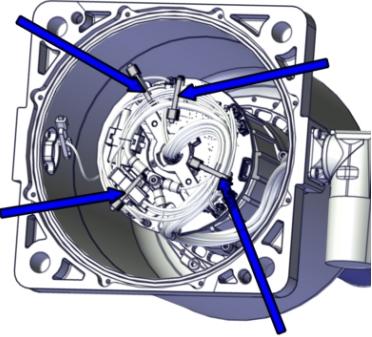
5.6.1 Replacing the axis-1 joint unit

Continued

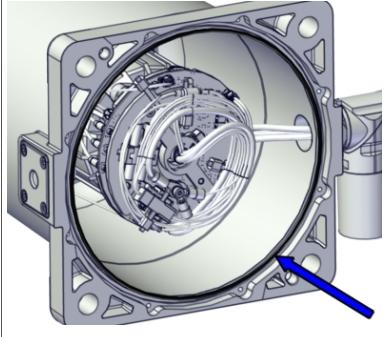
Action	Note
<p>2 Reconnect the connectors to the drive board.</p> <ul style="list-style-type: none"> • D1.X1 to X1 • D1.DC+ to DC+ • D1.DC- to Ground • D1.X4 to X4 • D1.X2 to X2 • D1.X5 to X5 • DR.X8 to X8 	 xx2000002009
<p>3 Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J1.DC+ to J1.DC+ • J1.DC- to J1.DC- • J1.CS to J1.CS • J1.CP to J1.CP 	 xx2000002010
<p>4 Secure the cables for functional earth and protective earth with a screw.</p>	<p>Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.</p>  xx2000002011

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5.6.1 Replacing the axis-1 joint unit
Continued

Action	Note
5 Secure the cabling with cable ties.	Cable ties (4 pcs)  xx2000002012

Refitting the base cover

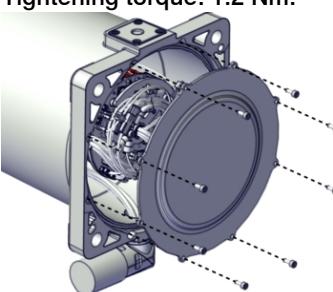
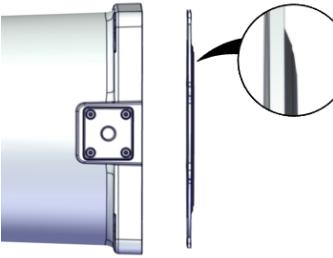
Action	Note
1 Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring, nitrile rubber: 3HAB3772-64 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016

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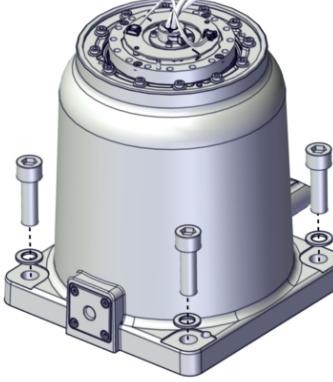
5 Repair

5.6.1 Replacing the axis-1 joint unit

Continued

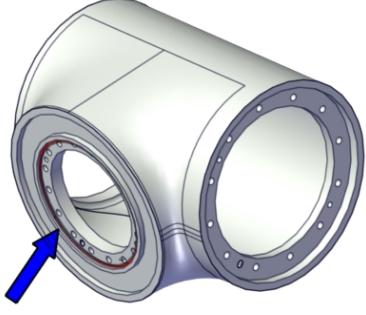
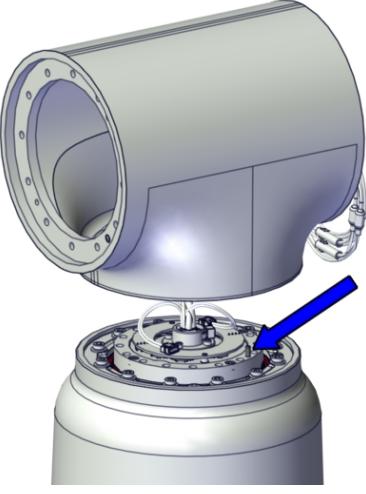
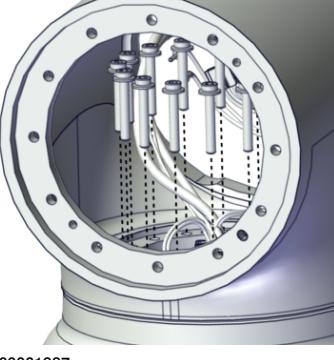
	Action	Note
2	<p>Refit the bottom cover with the attachment screws.</p> <p> Note</p> <p>Fit the cover in correct direction, the protrusion of the cover must face outwards.</p>	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs)</p> <p>Tightening torque: 1.2 Nm.</p>  <p>xx2000002007</p>  <p>xx2100000268</p>

Securing the base

	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	<p>Attachment screws: M10x35 8.8 (4 pcs).</p> <p>Washers: 23/10.5/2.5 mm Steel (4 pcs).</p> <p>Tightening torque: 30 Nm $\pm 10\%$.</p>  <p>xx2000002006</p>

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Refitting the swing

	Action	Note
1	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the base mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001990
2	Refit the swing to the base unit, aligning the pin with the pin hole.  CAUTION The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	 xx2000001989
3	Secure the swing with the attachment screws. Pre-tighten the screws crosswise firstly.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001987
4	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.

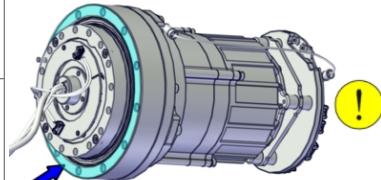
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5 Repair

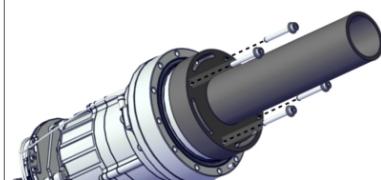
5.6.1 Replacing the axis-1 joint unit

Continued

Preparations before fitting the joint unit

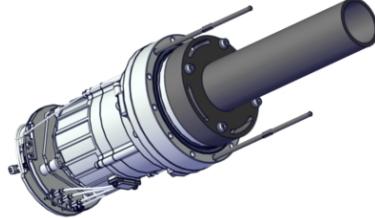
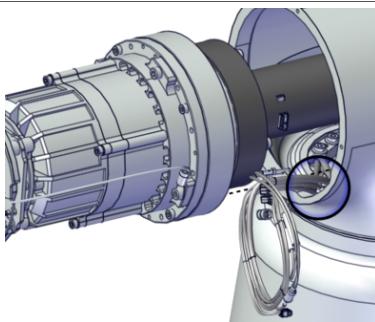
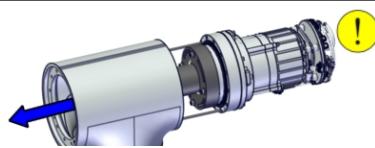
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3	Apply a thin layer of flange sealant to the mounting surface. Do not contaminate the radial sealing with sealant.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	

Refitting the axis-2 joint 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 44 .	
2	Fit the lifting aid to the joint unit.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957

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5.6.1 Replacing the axis-1 joint unit
Continued

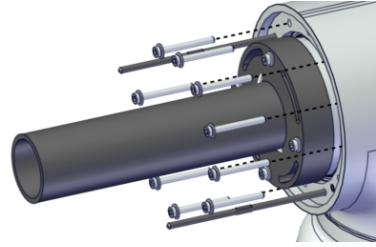
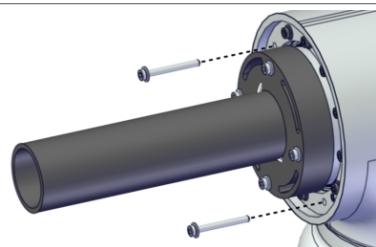
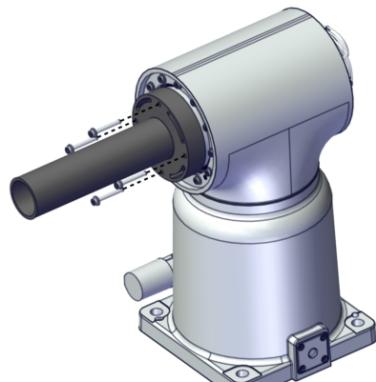
	Action	Note
3	Fit two guide pins to the joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002438</p>
4	<p>Place the axis-1 cabling at the notch in the swing.</p> <p> CAUTION The cabling is sensitive to mechanical damage. Handle it with care to avoid damage to the cabling or the connector, avoid any kind of tilt or skew.</p>	 <p>xx2000002153</p>
5	<p>Fit the joint unit to the swing, aligning the pin with the pin hole.</p> <p> CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000001959</p>  <p>xx2000001961</p>

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5 Repair

5.6.1 Replacing the axis-1 joint unit

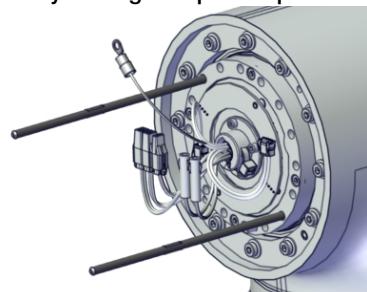
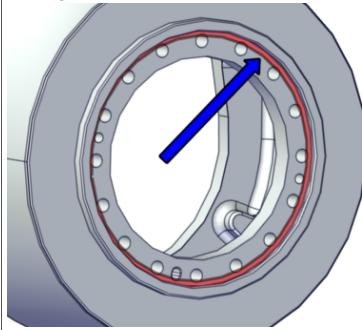
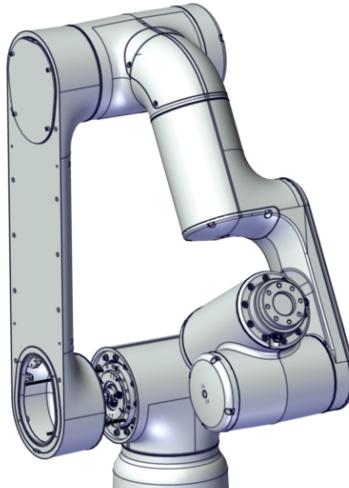
Continued

	Action	Note
6	Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2000001943</p>
7	Remove the guide pins and secure the remaining two attachment screws.	 <p>xx2100000295</p>
8	Pre-tighten the screws crosswise.	
9	Torque tighten all screws crosswise.	Tightening torque: 4.3 Nm.
10	Remove the lifting aid by removing the screws.	 <p>xx2000001956</p>
11	Clean pushed-out flange sealant, if any.	

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5.6.1 Replacing the axis-1 joint unit
Continued

Refitting the lower and upper arm assembled

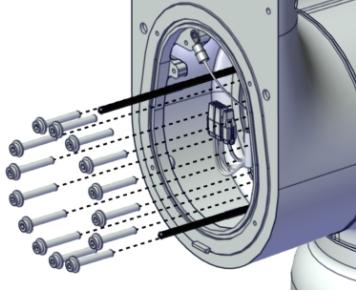
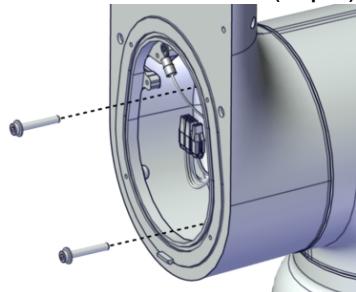
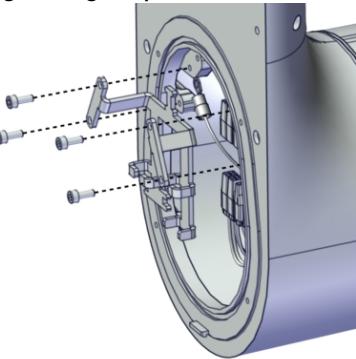
	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.</p>  <p>xx2000001949</p>
2	<p>Remove any old residuals of flange sealant from the lower arm mounting surface and clean with isopropanol. Apply new flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.</p>	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000001963</p>
3	<p> CAUTION The weight of the complete upper and lower arm together is 18 kg</p>	
4	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	 <p>xx2000001941</p>

Continues on next page

5 Repair

5.6.1 Replacing the axis-1 joint unit

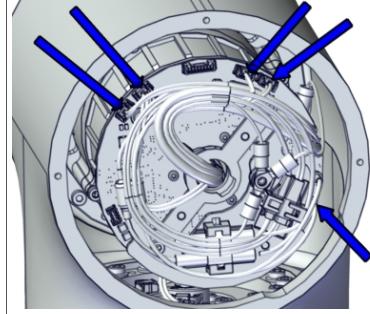
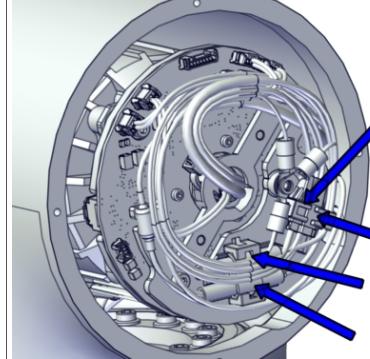
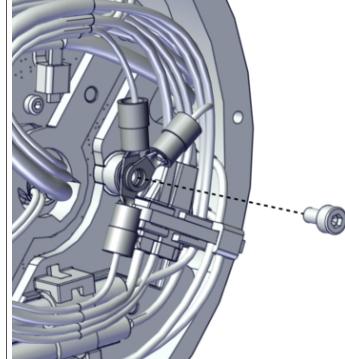
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	Action	Note
5	<p>Secure the lower arm to the swing with all attachment screws but two. Pre-tighten the screws crosswise firstly.</p>	<p>Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)</p>  <p>xx2000001940</p>
6	<p>Remove the guide pins and fasten the remaining two screws.</p>	<p>Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)</p>  <p>xx2000001951</p>
7	<p>Torque tighten all screws crosswise.</p>	<p>Tightening torque: 4.6 Nm.</p>
8	<p>Refit the cable bracket with four screws.</p>	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm</p>  <p>xx2000001939</p>

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5.6.1 Replacing the axis-1 joint unit
Continued

Connecting the axis-2 joint unit cabling

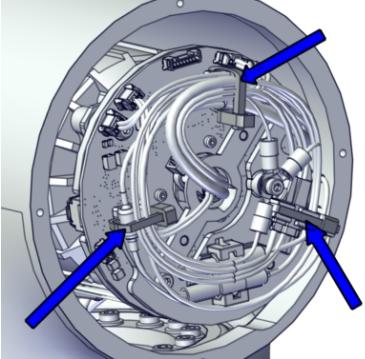
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44.</i>	
2	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D2.X1 to X1 • D2.DC+ to DC+ • D2.DC- to Ground • D2.X4 to X4 • D2.X2 to X2 • D2.X5 to X5 	 xx2000002013
3	Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP 	 xx2000001944
4	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000001945

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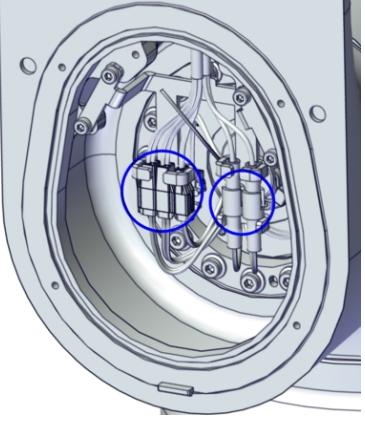
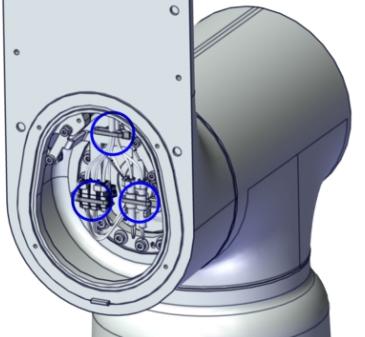
5 Repair

5.6.1 Replacing the axis-1 joint unit

Continued

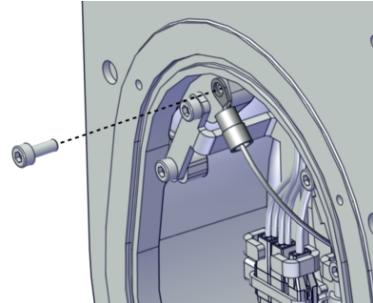
	Action	Note
5	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

Connecting the cabling between the lower arm and swing

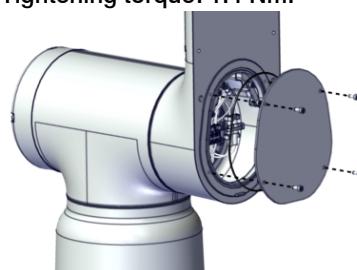
	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938
2	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937

Continues on next page

5.6.1 Replacing the axis-1 joint unit
Continued

Action	Note
3 Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

Refitting the lower arm covers

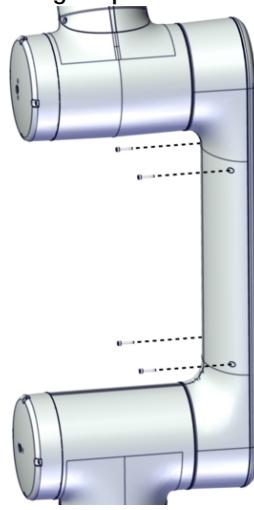
Action	Note
1 Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001954
2 Refit the inner cover with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm.  xx2000001930

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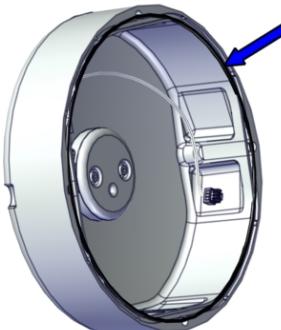
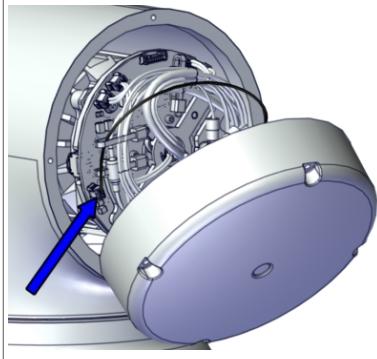
5 Repair

5.6.1 Replacing the axis-1 joint unit

Continued

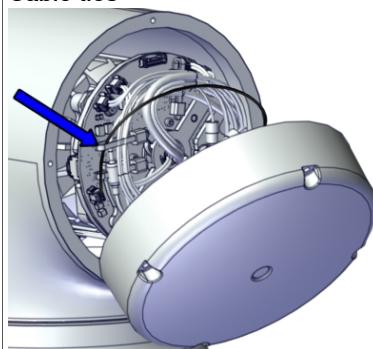
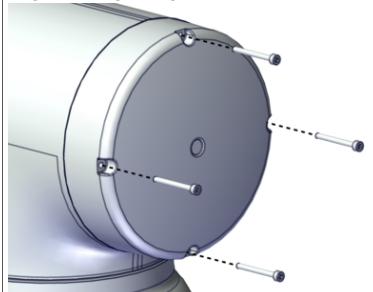
Action	Note
3 Snap the lower arm cover into place.	
4 Secure the cover with four screws.	Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000001929

Refitting the swing cover

Action	Note
1 Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2 Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000001932

Continues on next page

5.6.1 Replacing the axis-1 joint unit
Continued

	Action	Note
3	Secure the brake release cable with a cable tie.	<p>Cable ties</p>  <p>xx2000001931</p>
4	Refit the cover with the four screws.	<p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm</p>  <p>xx2000001935</p>

Concluding procedure

	Action	Note
1	Calibrate the joint unit torque sensor.	See Calibration on page 719
2	 DANGER <p>Make sure all safety requirements are met when performing the first test run.</p>	

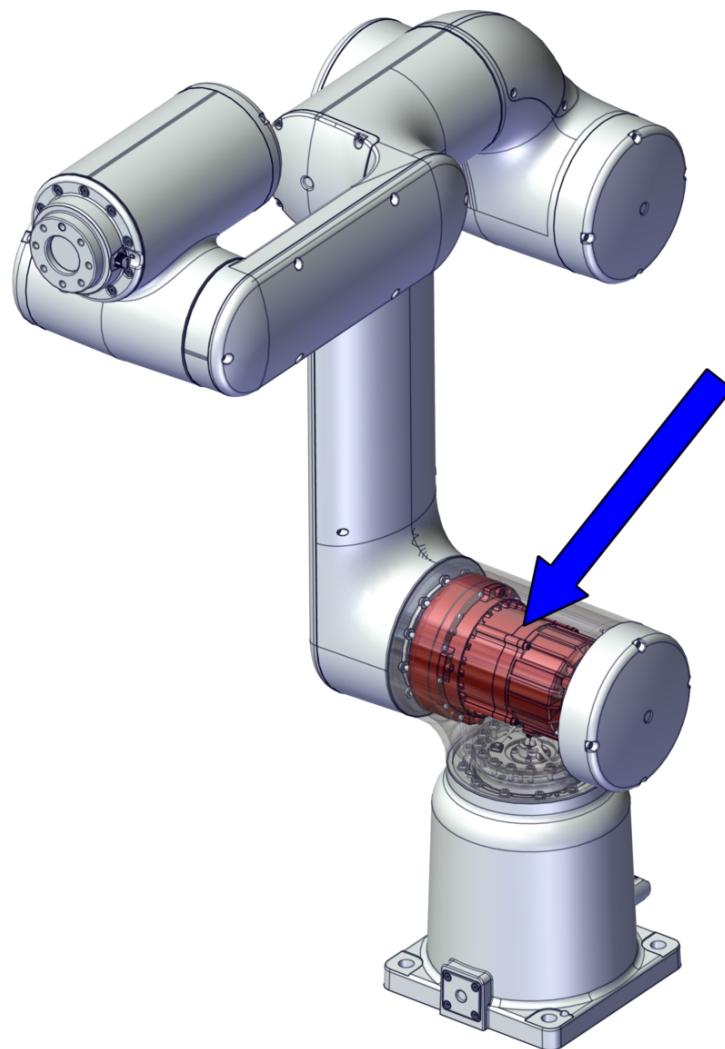
5 Repair

5.6.2 Replacing the axis-2 joint unit

5.6.2 Replacing the axis-2 joint unit

Location of the axis-2 joint unit

The joint unit is located as shown in the figure.



xx2000001948

Summary of the replacement procedure

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

- 1 Separate the cabling between the swing and the lower arm.
- 2 Remove the lower and upper arm undivided.
- 3 Remove the swing cover.
- 4 Replace the joint unit. Move the cabling from old to new joint unit.

Continues on next page

Required spare parts**Note**

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal,
www.abb.com/myABB.

Spare part	Article number	Note
Joint unit	3HAC079141-001	New attachment screws and cable tie 3HAC075545-001 are included in the delivery.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3. Attachment screws M4x35 (4 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Cable ties	-	
O-ring, nitrile rubber	3HAB3772-64	Base cover
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.
O-ring	3HAC061327-044	Lower arm, inner cover. 1 pcs / cover. Replace if damaged.

Continues on next page

5 Repair

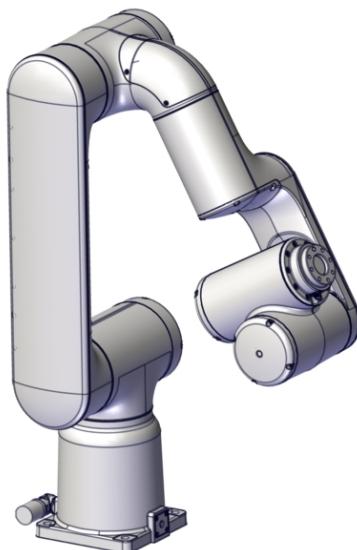
5.6.2 Replacing the axis-2 joint unit

Continued

Removing the joint unit

Use these procedures to remove the joint unit.

Preparations before removing the joint unit

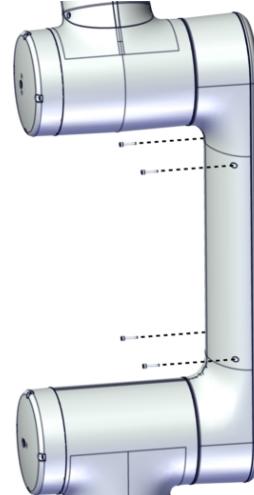
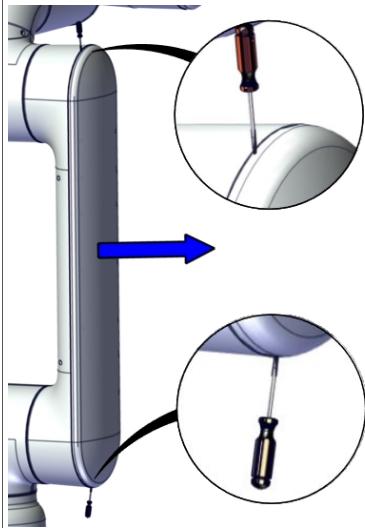
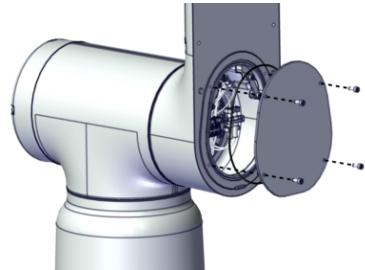
	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none">• Axis 1: 0°• Axis 2: 0° (home position)• Axis 3: +60°• Axis 4: 0°• Axis 5: -90°• Axis 6: No significance. <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	 xx2100000044
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

Removing the lower arm covers

	Action	Note
1	<p>! CAUTION</p> <p>Make sure that all supplies for electrical power are turned off.</p>	

Continues on next page

5.6.2 Replacing the axis-2 joint unit
Continued

Action	Note
2 Remove the four lower arm cover screws.	 xx2000001929
3 Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267
4 Remove the inner cover by removing the four screws.	 xx2000001930

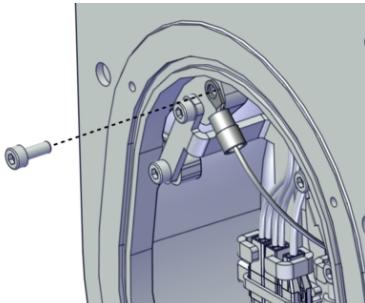
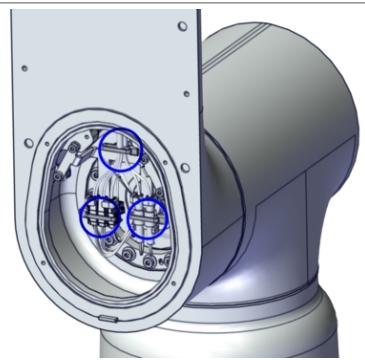
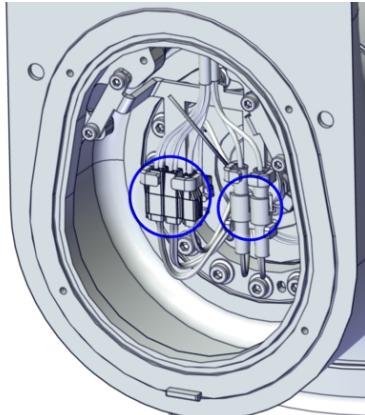
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5 Repair

5.6.2 Replacing the axis-2 joint unit

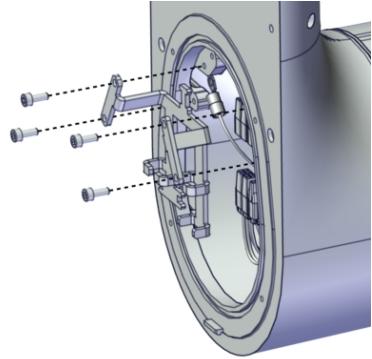
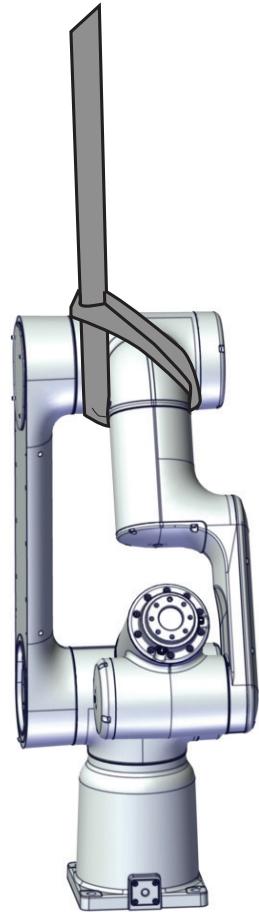
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Disconnecting the cabling between the lower arm and the swing

	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936
2	Cut the cable ties.	 xx2000001937
3	Snap loose and disconnect all connectors.	 xx2000001938

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Removing the lower and upper arm assembled

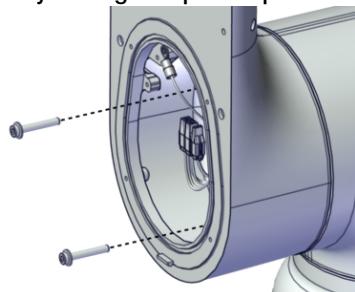
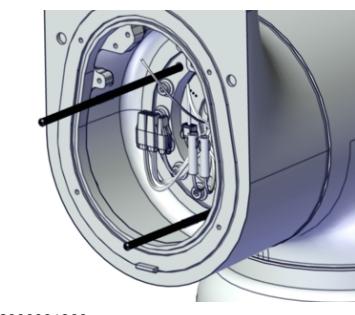
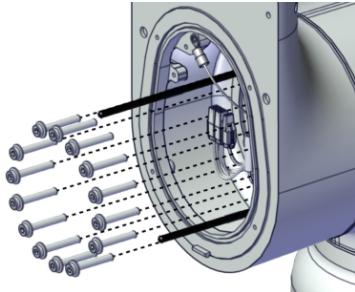
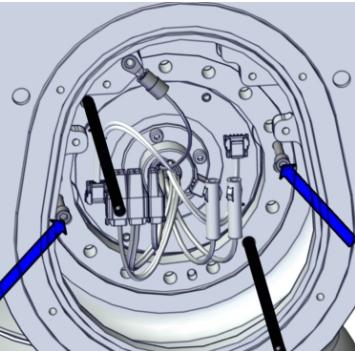
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939
2	Secure the weight of the upper and lower arm.  CAUTION The weight of the complete upper and lower arm together is 18 kg	Suggestion with lifting sling and an overhead crane:  xx2100000294

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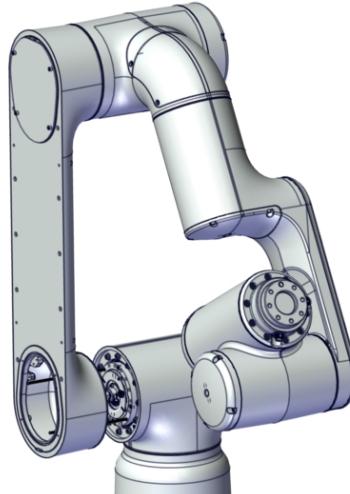
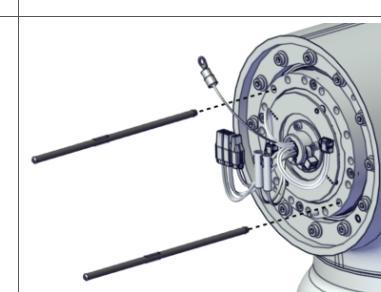
5 Repair

5.6.2 Replacing the axis-2 joint unit

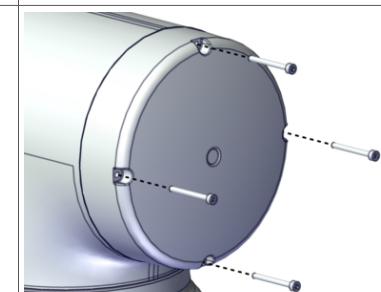
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	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.</p>  <p>xx2000001951</p>  <p>xx2000001960</p>
4	Remove the lower arm attachment screws.	 <p>xx2000001940</p>
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 <p>xx2000002151</p>

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	Action	Note
6	Remove the complete arm system from the swing.	 xx2000001941
7	Remove the guide pins.	 xx2000002432

Removing the swing cover

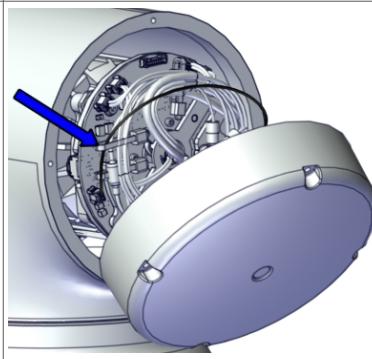
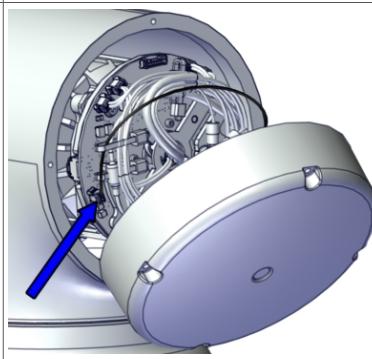
	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	Remove the cover screws.	 xx2000001935

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5 Repair

5.6.2 Replacing the axis-2 joint unit

Continued

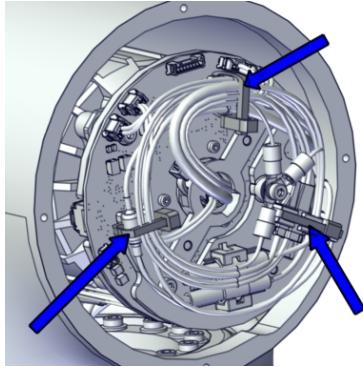
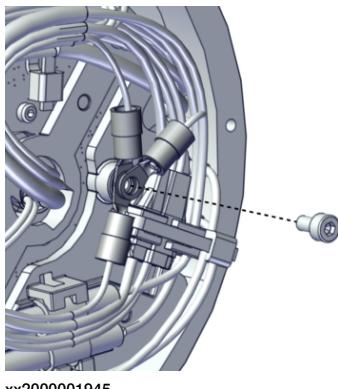
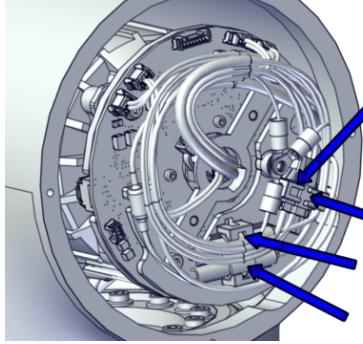
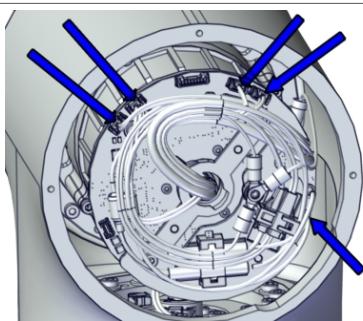
	Action	Note
3	 CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000001931
5	Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000001932

Disconnecting the axis-2 joint unit cabling

	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 44 .	

Continues on next page

5.6.2 Replacing the axis-2 joint unit
Continued

	Action	Note
2	Cut the cable ties.	 xx2000001946
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J2.DC+ • J2.DC- • J2.CS • J2.CP 	 xx2000001944
5	Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 <p>CAUTION</p> <p>Use tweezers to unlock connectors and pull them off.</p>	 xx2000002013

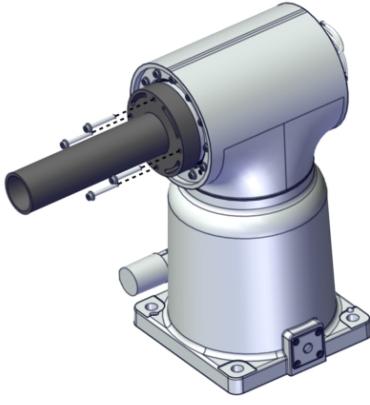
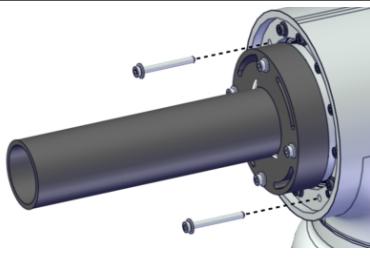
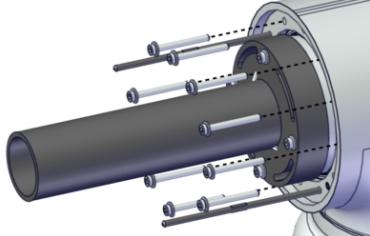
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5 Repair

5.6.2 Replacing the axis-2 joint unit

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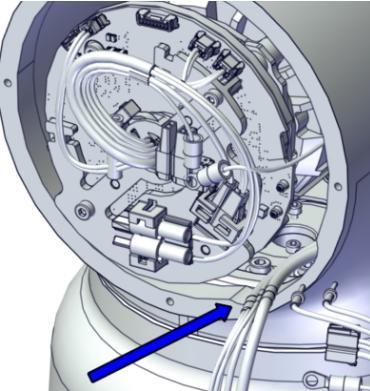
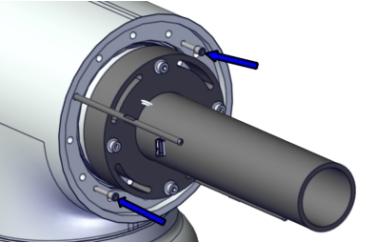
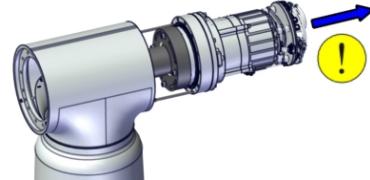
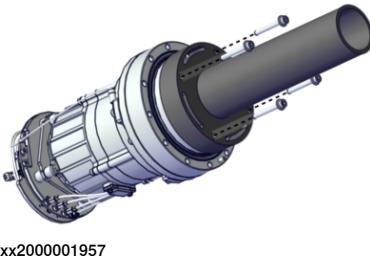
Removing the axis-2 joint unit

	Action	Note
1	<p>Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)</p>  <p>xx2000001956</p>
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx2100000295</p>
3	Fit two guide pins to the axis-2 joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002433</p>
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 <p>xx200001943</p>

Continues on next page

5.6.2 Replacing the axis-2 joint unit

Continued

Action	Note
5 Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 xx2100000045
6 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2000002434
7 Remove the joint unit from the swing.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000001958
8 Remove the lifting aid and guide pins.	 xx2000001957

Removing the joint cable

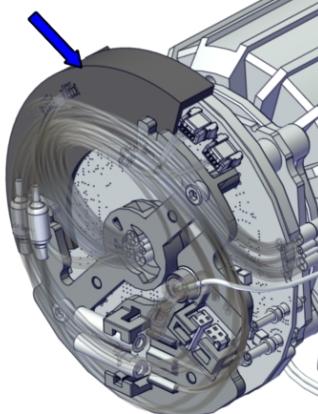
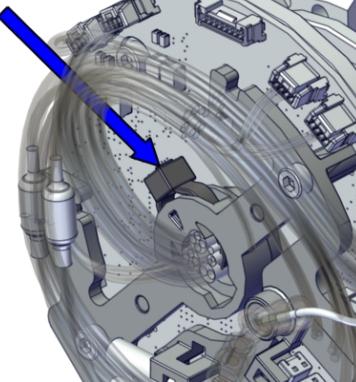
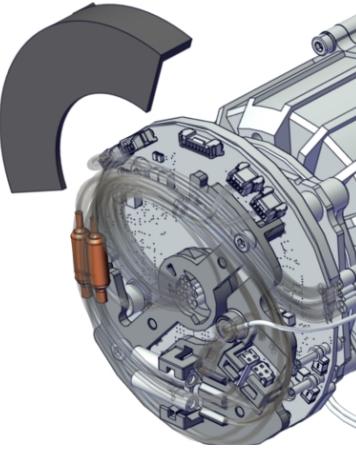
Action	Note
1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	

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5 Repair

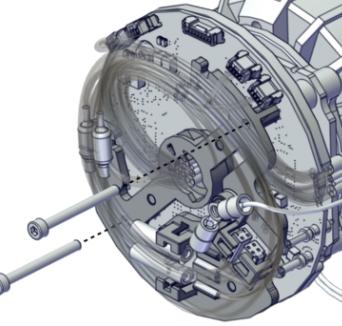
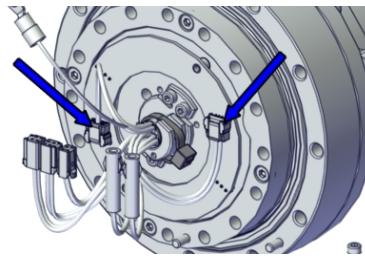
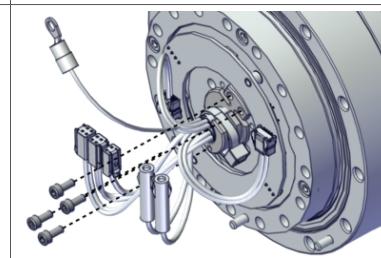
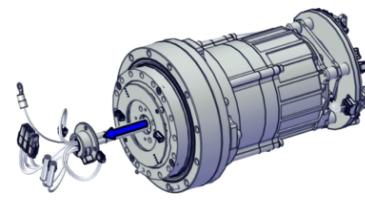
5.6.2 Replacing the axis-2 joint unit

Continued

Action	Note
2 Fit the protection plate to the drive board unit.  Tip Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001  xx2000002057
3 Cut the cable tie at the drive board.	 xx2000002058
4 Remove the protection plate.	 xx2100000301

Continues on next page

5.6.2 Replacing the axis-2 joint unit
Continued

Action	Note
5 Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6 Disconnect the two connectors from the torque sensor board. <ul style="list-style-type: none"> • TQ.A • TQ.B 	 xx2000002053
7 Remove the cable plate by removing the attachment screws.	 xx2000002049
8 Remove the joint cable from the hollow shaft from the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002060

Refitting the joint unit

Use these procedures to refit the joint unit.

Refitting the joint cable

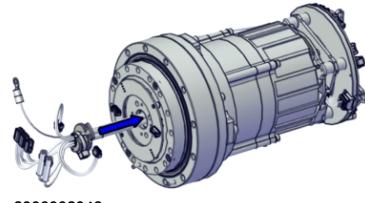
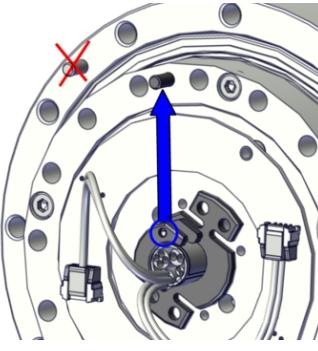
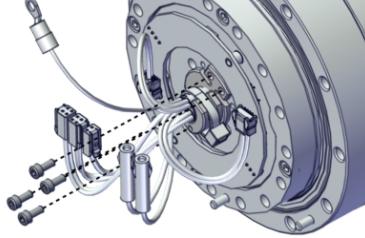
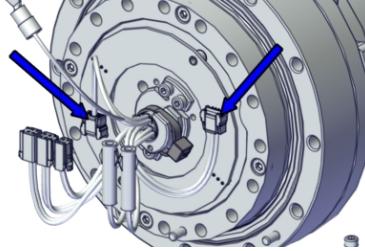
Action	Note
1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	

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5 Repair

5.6.2 Replacing the axis-2 joint unit

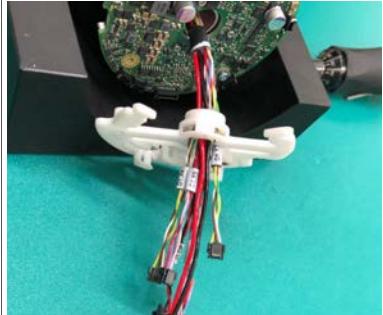
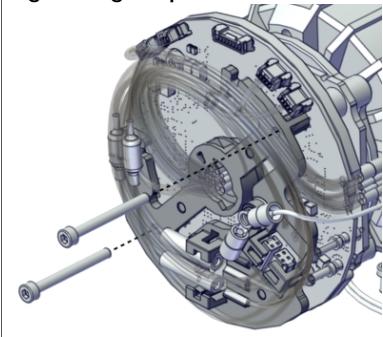
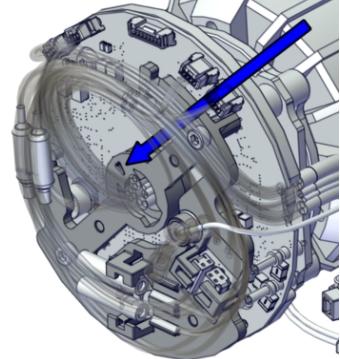
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	Action	Note
2	<p>Place the joint cable through the hollow shaft from the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002048
3	<p>Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.</p>	 xx2000002051
4	<p>Secure the cable plate to the joint unit with the attachment screws.</p>	<p>Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs)</p> <p>Tightening torque: 0.45 Nm.</p>  xx2000002049
5	<p>Connect the two connectors to the torque sensor board.</p> <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 xx2000002053

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5.6.2 Replacing the axis-2 joint unit

Continued

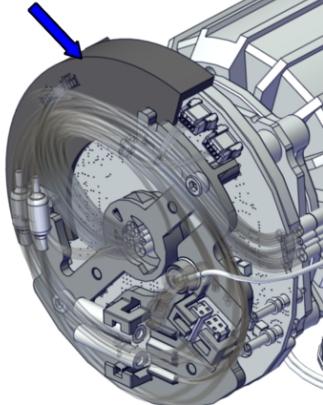
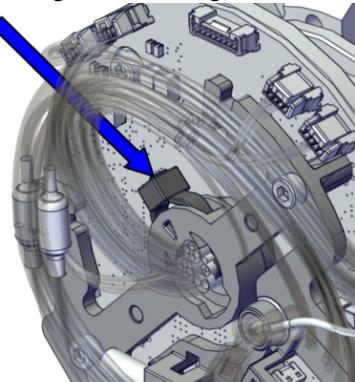
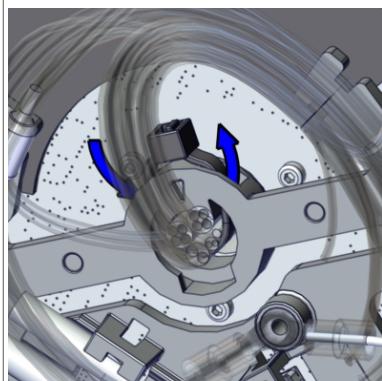
Action	Note
6 Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 xx2000002056 <p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.</p>  xx2000002055
7 Keep the cabling loose, making sure not to twist or strain it. Use the cable tie to pre-fix the cable by hand.	 xx2100000507

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5 Repair

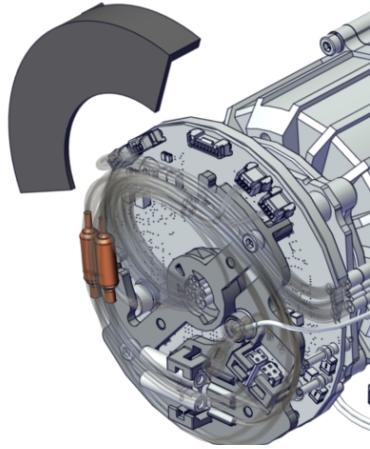
5.6.2 Replacing the axis-2 joint unit

Continued

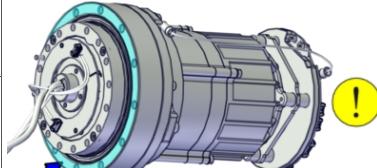
	Action	Note
8	Fit the protection plate to the drive board unit.	<p>Protection plate: 3HAC077790-001</p>  <p>xx2000002057</p>
9	<p>Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.</p>	<p>Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO7 Setting for cable tie gun: 6.75.</p>  <p>xx2000002058</p>  <p>xx2000002059</p>

Continues on next page

5.6.2 Replacing the axis-2 joint unit
Continued

Action	Note
10 Remove the protection plate.	 xx2100000301

Preparations before fitting the joint 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 44 .	
2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574
3  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	 xx2000001860

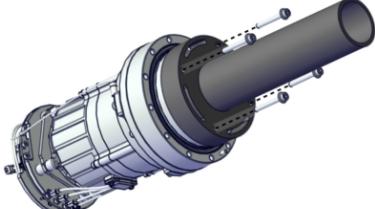
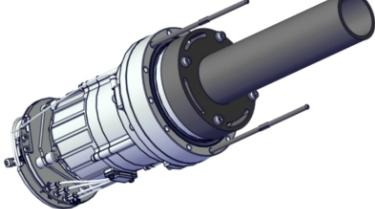
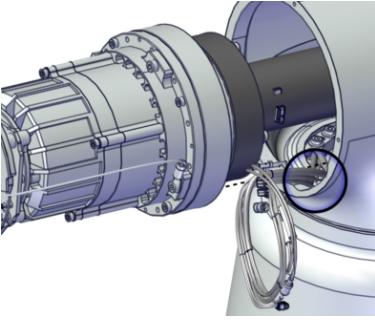
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5 Repair

5.6.2 Replacing the axis-2 joint unit

Continued

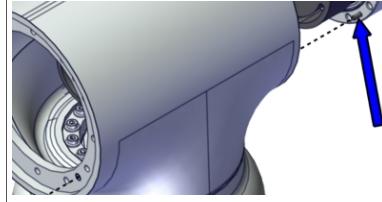
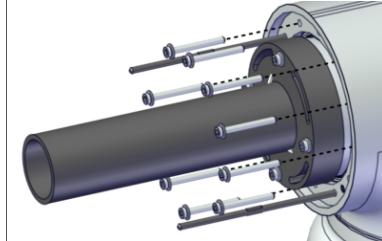
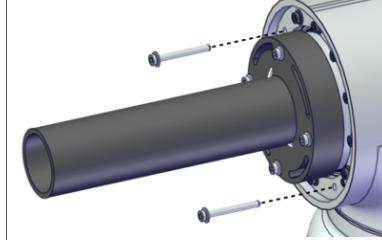
Refitting the axis-2 joint unit

	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44.</i>	
2	Fit the lifting aid to the joint unit.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957
3	Fit two guide pins to the joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.  xx2000002438
4	Place the axis-1 cabling at the notch in the swing.  CAUTION The cabling is sensitive to mechanical damage. Handle it with care to avoid damage to the cabling or the connector, avoid any kind of tilt or skew.	  xx2000002153

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5.6.2 Replacing the axis-2 joint unit

Continued

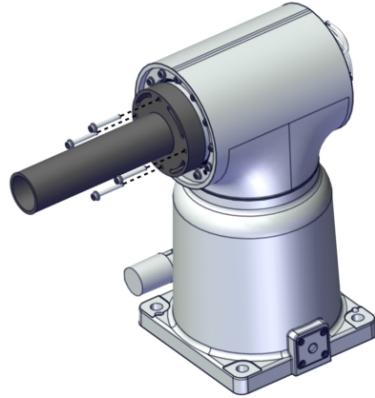
Action	Note
5 Fit the joint unit to the swing, aligning the pin with the pin hole.	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  xx2000001959 xx2000001961
6 Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2000001943
7 Remove the guide pins and secure the remaining two attachment screws.	 xx2100000295
8 Pre-tighten the screws crosswise.	
9 Torque tighten all screws crosswise.	Tightening torque: 4.3 Nm.

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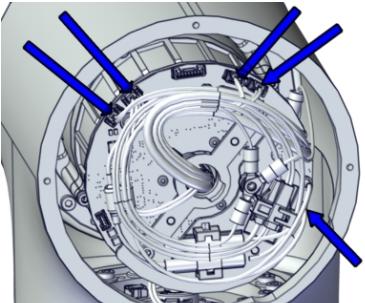
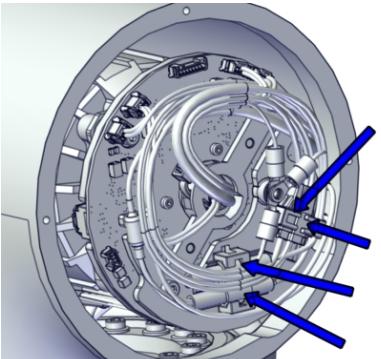
5 Repair

5.6.2 Replacing the axis-2 joint unit

Continued

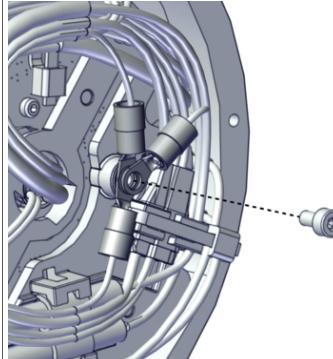
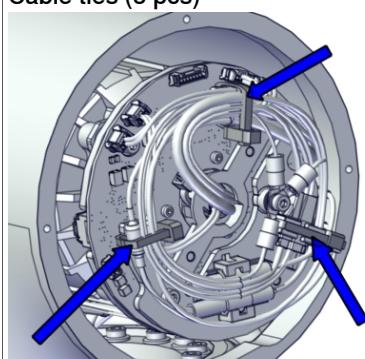
Action	Note
10 Remove the lifting aid by removing the screws.	 xx2000001956
11 Clean pushed-out flange sealant, if any.	

Connecting the axis-2 joint unit cabling

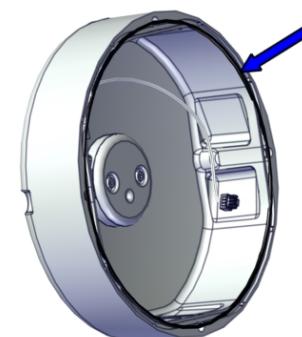
Action	Note
1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2 Reconnect the connectors to the drive board. <ul style="list-style-type: none">• D2.X1 to X1• D2.DC+ to DC+• D2.DC- to Ground• D2.X4 to X4• D2.X2 to X2• D2.X5 to X5	 xx2000002013
3 Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none">• J2.DC+ to J2.DC+• J2.DC- to J2.DC-• J2.CS to J2.CS• J2.CP to J2.CP	 xx2000001944

Continues on next page

5.6.2 Replacing the axis-2 joint unit
Continued

	Action	Note
4	Secure the cables for functional earth and protective earth with a screw.	<p>Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.</p>  <p>xx2000001945</p>
5	Secure the cabling with cable ties.	<p>Cable ties (3 pcs)</p>  <p>xx2000001946</p>

Refitting the swing cover

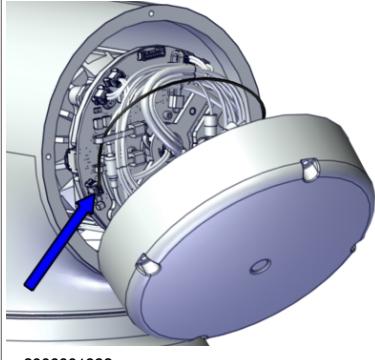
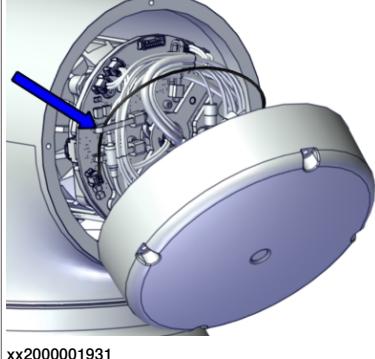
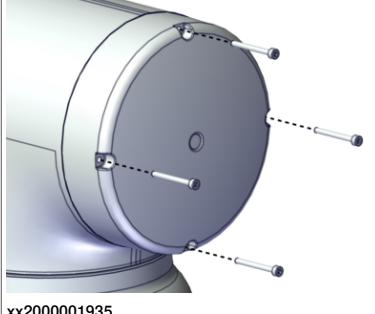
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	<p>O-ring: 3HAC061327-047</p>  <p>xx2000001962</p>

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5 Repair

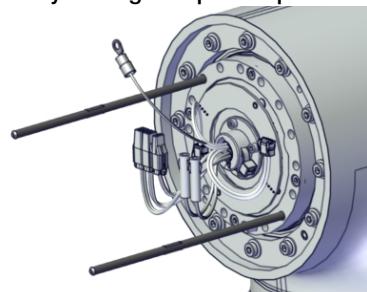
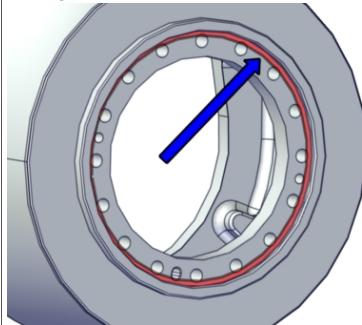
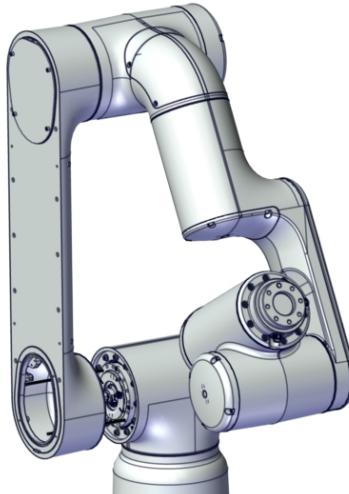
5.6.2 Replacing the axis-2 joint unit

Continued

	Action	Note
2	<p>Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.</p> <p>Orient the cover for proper arrangement of the brake release cable.</p>	 xx2000001932
3	Secure the brake release cable with a cable tie.	<p>Cable ties</p>  xx2000001931
4	Refit the cover with the four screws.	<p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs)</p> <p>Tightening torque: 0.45 Nm</p>  xx2000001935

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Refitting the lower and upper arm assembled

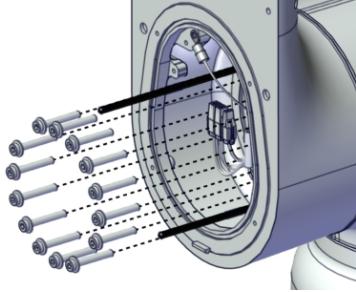
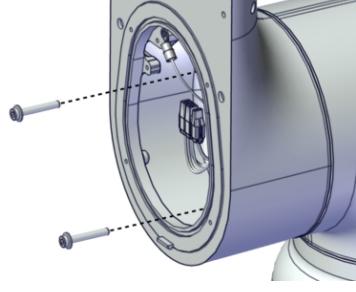
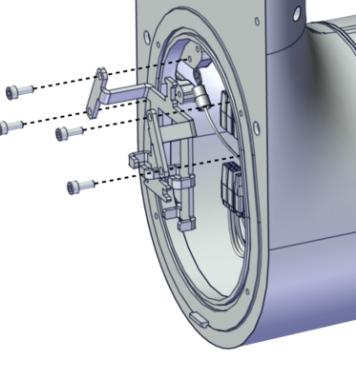
	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001949
2	Remove any old residuals of flange sealant from the lower arm mounting surface and clean with isopropanol. Apply new flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001963
3	 CAUTION The weight of the complete upper and lower arm together is 18 kg	
4	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	 xx2000001941

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5 Repair

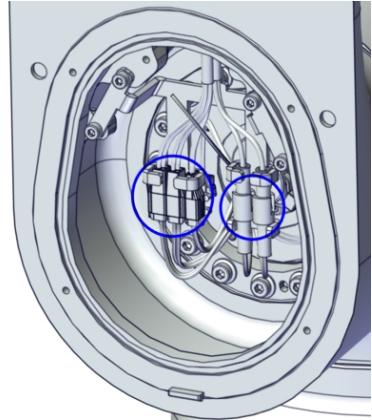
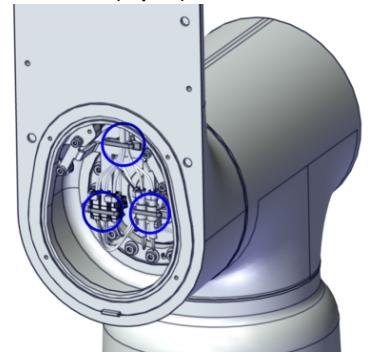
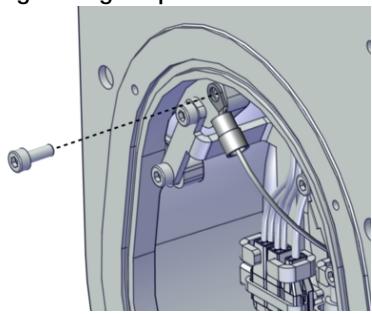
5.6.2 Replacing the axis-2 joint unit

Continued

	Action	Note
5	<p>Secure the lower arm to the swing with all attachment screws but two.</p> <p>Pre-tighten the screws crosswise firstly.</p>	<p>Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)</p>  <p>xx2000001940</p>
6	Remove the guide pins and fasten the remaining two screws.	<p>Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)</p>  <p>xx2000001951</p>
7	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.
8	Refit the cable bracket with four screws.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs).</p> <p>Tightening torque: 0.8 Nm</p>  <p>xx2000001939</p>

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Connecting the cabling between the lower arm and swing

	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938
2	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937
3	Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

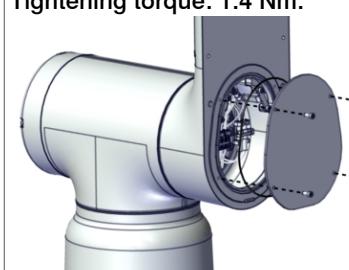
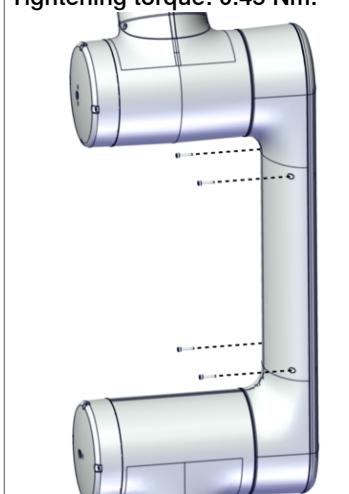
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5 Repair

5.6.2 Replacing the axis-2 joint unit

Continued

Refitting the lower arm covers

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001954
2	Refit the inner cover with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm.  xx2000001930
3	Snap the lower arm cover into place.	Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs)
4	Secure the cover with four screws.	Tightening torque: 0.45 Nm.  xx2000001929

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Concluding procedure

	Action	Note
1	Calibrate the joint unit torque sensor.	See Calibration on page 719
2	 DANGER Make sure all safety requirements are met when performing the first test run.	

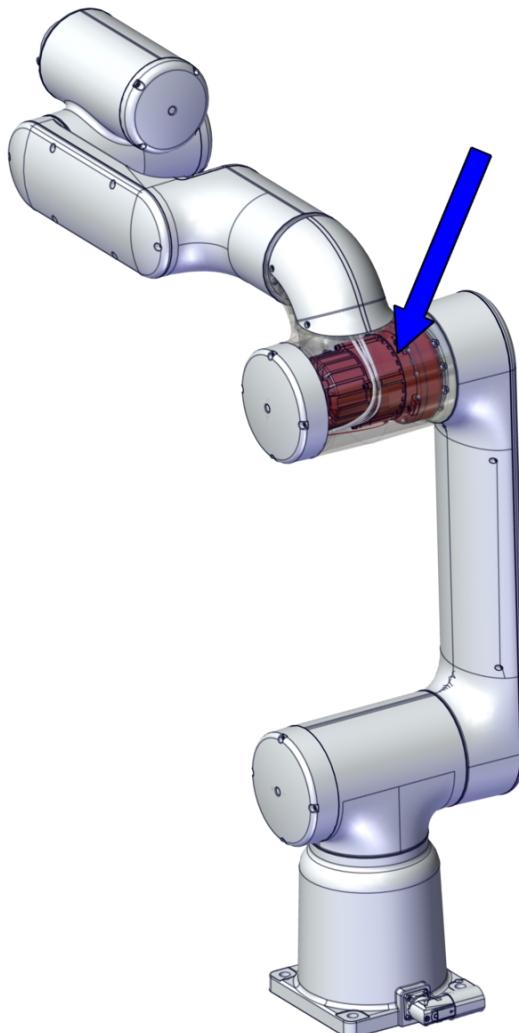
5 Repair

5.6.3 Replacing the axis-3 joint unit

5.6.3 Replacing the axis-3 joint unit

Location of the axis-3 joint unit

The joint unit is located as shown in the figure.



xx2000002020

Summary of the replacement procedure

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

- 1 Disconnect the cabling between the lower arm and the upper arm.
- 2 Remove the upper arm and place on a workbench.
- 3 Remove the housing cover.
- 4 Replace the joint unit. Move the cabling from old to new joint unit.

Continues on next page

Required spare parts**Note**

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal,
www.abb.com/myABB.

Spare part	Article number	Note
Joint unit	3HAC079141-001	New attachment screws and cable tie 3HAC075545-001 are included in the delivery.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3. Attachment screws M4x35 (4 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Cable ties	-	
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.
O-ring	3HAC061327-044	Lower arm, inner cover. 1 pcs / cover. Replace if damaged.

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5 Repair

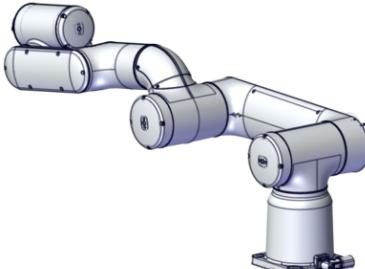
5.6.3 Replacing the axis-3 joint unit

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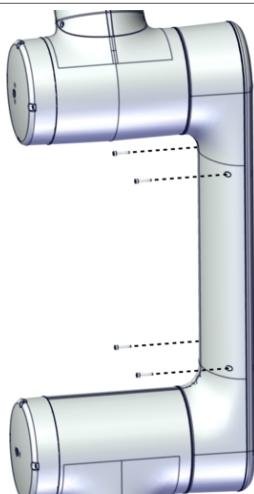
Removing the joint unit

Use these procedures to remove the joint unit.

Preparations before removing the joint unit

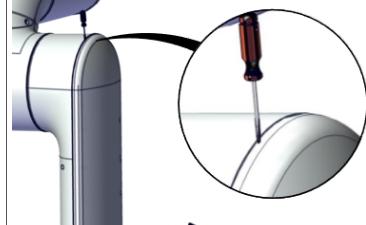
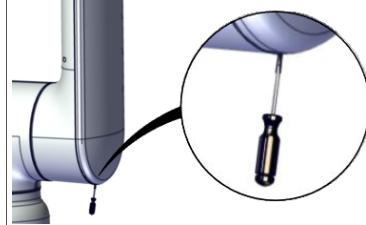
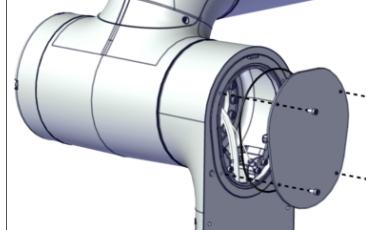
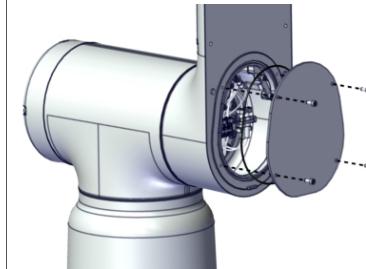
	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none">• Axis 1: 0°• Axis 2: +90° (suggested position for convenient working position)• Axis 3: -80° (home position)• Axis 4: 0°• Axis 5: 0°• Axis 6: 0° <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	 xx2100000002
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

Removing the lower arm covers

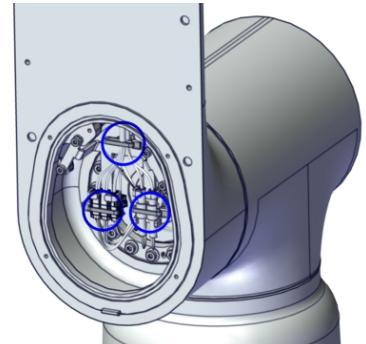
	Action	Note
1	<p>! CAUTION</p> <p>Make sure that all supplies for electrical power are turned off.</p>	
2	Remove the four lower arm cover screws.	 xx2000001929

Continues on next page

5.6.3 Replacing the axis-3 joint unit
Continued

Action	Note
3 Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	  xx2100000267
4 Remove the inner covers by removing the screws.	 xx2000001947  xx2000001930

Disconnecting the upper arm cabling

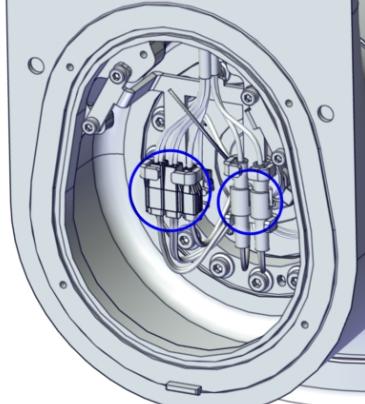
Action	Note
1 Cut the cable ties.	 xx2000001937

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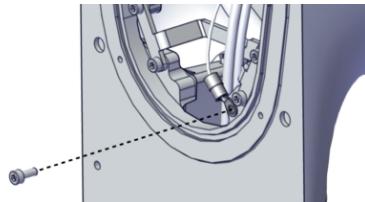
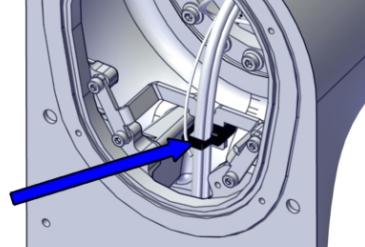
5 Repair

5.6.3 Replacing the axis-3 joint unit

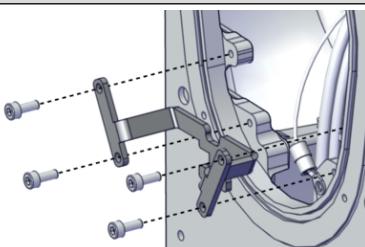
Continued

Action	Note
2 Snap loose and disconnect all connectors.	 xx2000001938

Loosening the cabling between the lower and upper arm

Action	Note
1 Remove the functional earth cable by removing the screw.	 xx2000001964
2 Cut the cable tie.	 xx2000001965

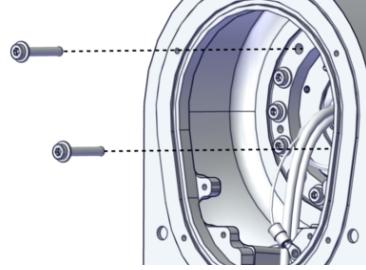
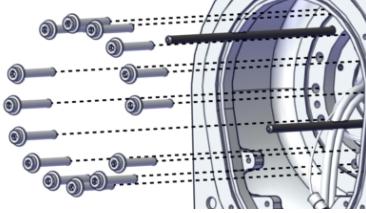
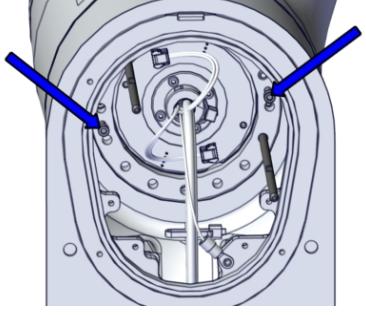
Removing the upper arm

Action	Note
1 Remove the cable bracket by removing the four screws.	 xx2000001966

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5.6.3 Replacing the axis-3 joint unit

Continued

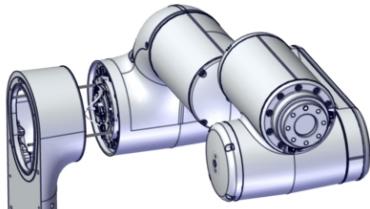
Action	Note
2 Secure the weight of the upper arm. ! CAUTION The weight of the complete upper arm is 14 kg.	
3 Remove two attachment screws.	 xx2000001967
4 Fit two guide pins to the axis-3 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001968
5 Remove the remaining attachment screws.	 xx2000001969
6 Press the upper arm out of position by using two fully threaded attachment screws as removal tools.	 xx2100000001

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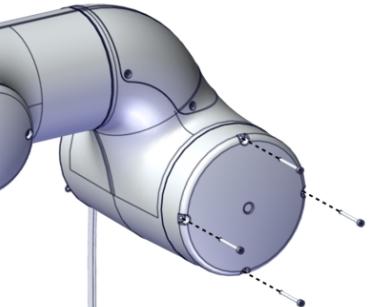
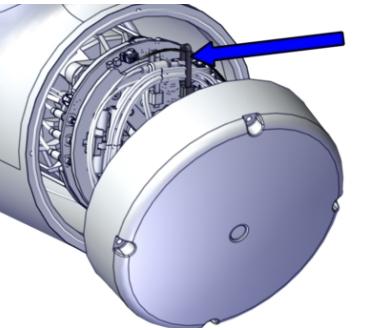
5 Repair

5.6.3 Replacing the axis-3 joint unit

Continued

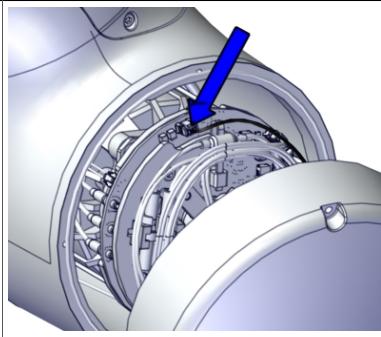
	Action	Note
7	Remove the upper arm from the lower arm. Assist the cabling to be removed from the lower arm while lifting away the complete upper arm. Place the upper arm on a workbench.	 xx2000001970

Removing the housing cover

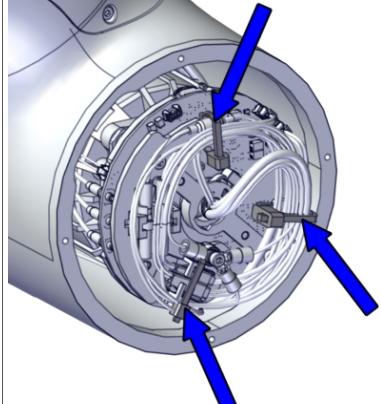
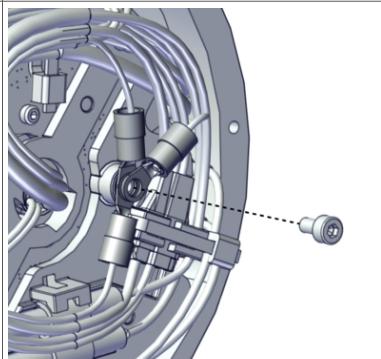
	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	Remove the cover screws.	 xx2000002021
3	 CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002022

Continues on next page

5.6.3 Replacing the axis-3 joint unit
Continued

Action	Note
5 Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002023

Disconnecting the axis-3 joint unit cabling

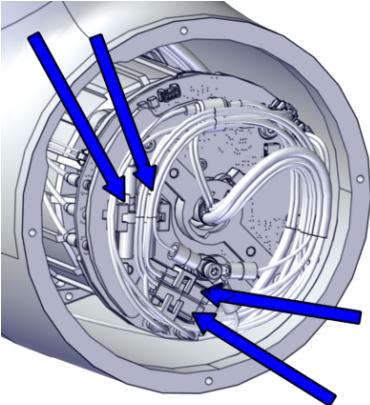
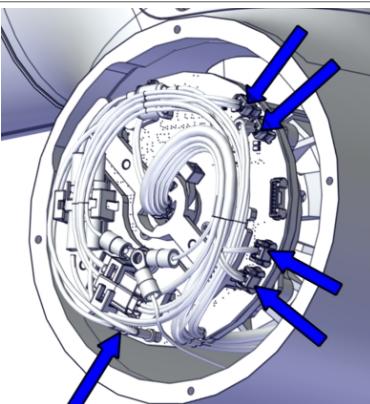
Action	Note
1 Cut the cable ties.	 xx2000002066
2 Remove the functional and protective earth cables by removing the screw.	 xx2000001945

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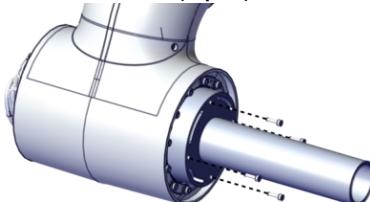
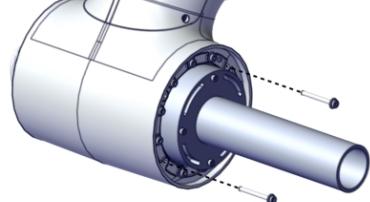
5 Repair

5.6.3 Replacing the axis-3 joint unit

Continued

Action	Note
<p>3 Snap loose and disconnect the connectors:</p> <ul style="list-style-type: none"> • J4.DC+ • J4.DC- • J4.CS • J4.CP 	 xx2000002067
<p>4 Disconnect the connectors from the drive board.</p> <ul style="list-style-type: none"> • D3.X1 • D3/4.DC+ • D3/4.DC- • D3.X4 • D3/4.X2 • D3.X5 <p>! CAUTION Use tweezers to unlock connectors and pull them off.</p>	 xx2000002068

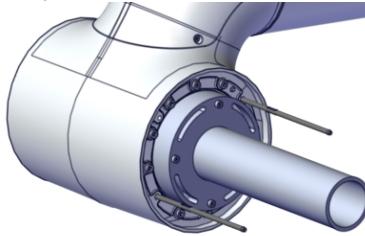
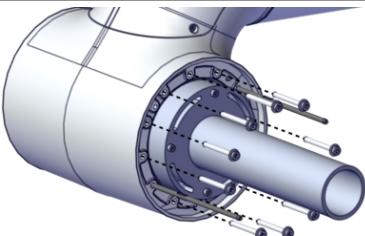
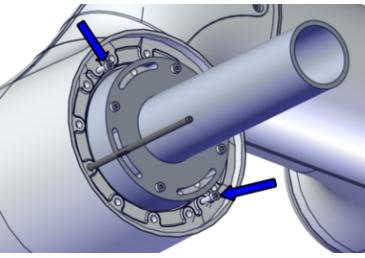
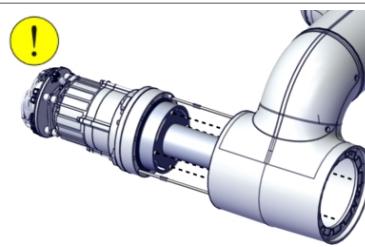
Removing the axis-3 joint unit

Action	Note
<p>1 Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>! CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000002069
<p>2 Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002070

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5.6.3 Replacing the axis-3 joint unit

Continued

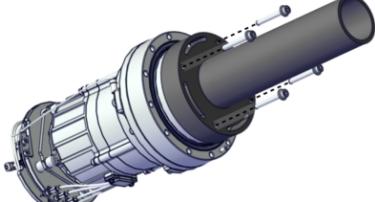
Action	Note
3 Fit two guide pins to the axis-3 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.  xx2000002576
4 Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000320
5 Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 xx2100000003
6 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2000002577
7 Remove the joint unit from the housing.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002071

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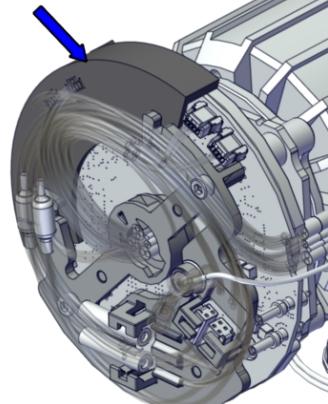
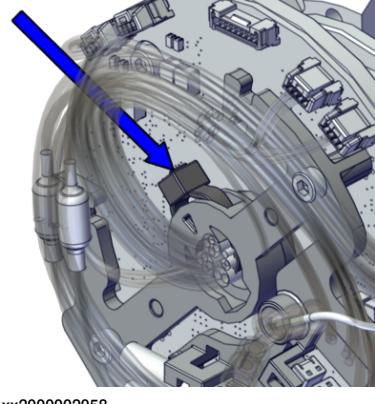
5 Repair

5.6.3 Replacing the axis-3 joint unit

Continued

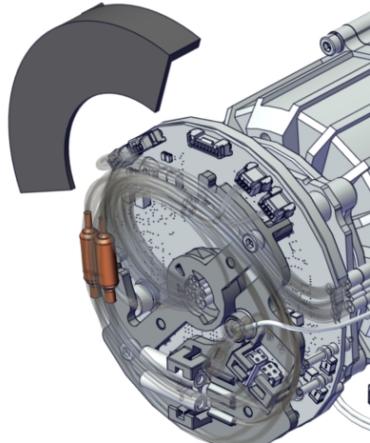
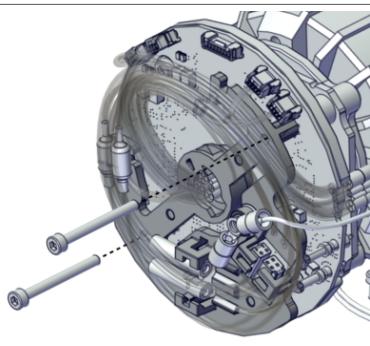
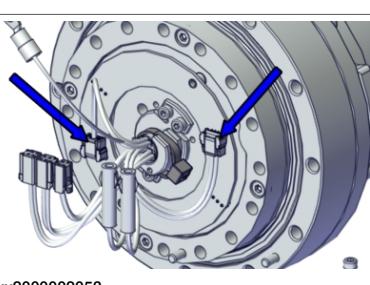
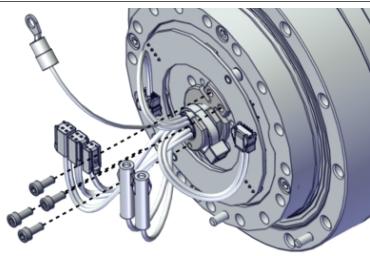
Action	Note
8 Remove the lifting aid and guide pins.	 xx2000001957

Removing the joint cable

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 44 .	
2 Fit the protection plate to the drive board unit.  Tip Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001  xx2000002057
3 Cut the cable tie at the drive board.	 xx2000002058

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5.6.3 Replacing the axis-3 joint unit
Continued

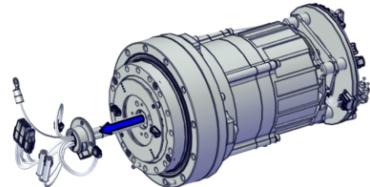
	Action	Note
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. • TQ.A • TQ.B	 xx2000002053
7	Remove the cable plate by removing the attachment screws.	 xx2000002049

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5 Repair

5.6.3 Replacing the axis-3 joint unit

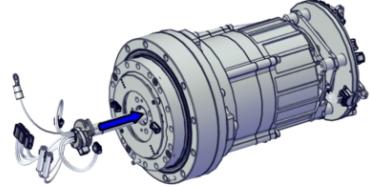
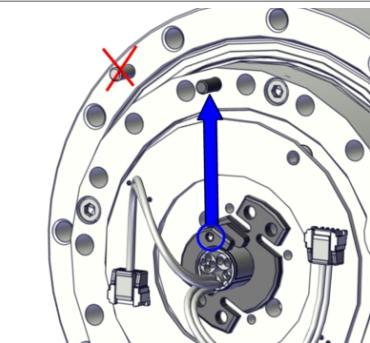
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	Action	Note
8	<p>Remove the joint cable from the hollow shaft from the torque sensor side.</p> <p>! CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002060

Refitting the joint unit

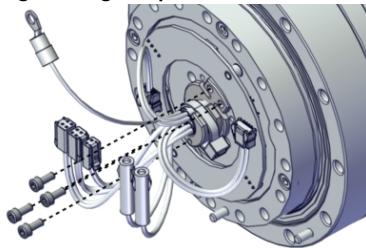
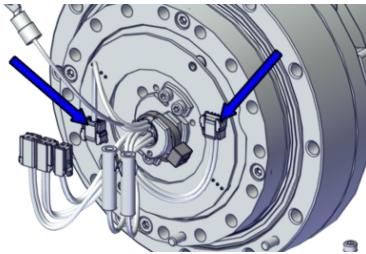
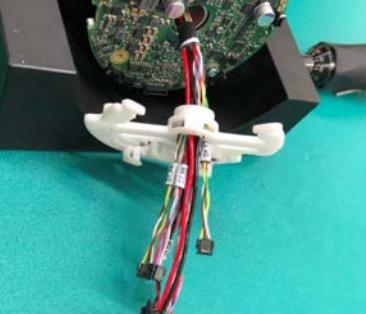
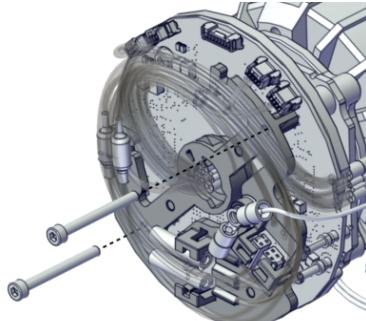
Use these procedures to refit the joint unit.

Refitting the joint cable

	Action	Note
1	<p>! ELECTROSTATIC DISCHARGE (ESD)</p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	
2	<p>Place the joint cable through the hollow shaft from the torque sensor side.</p> <p>! CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002048
3	Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.	 xx2000002051

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5.6.3 Replacing the axis-3 joint unit
Continued

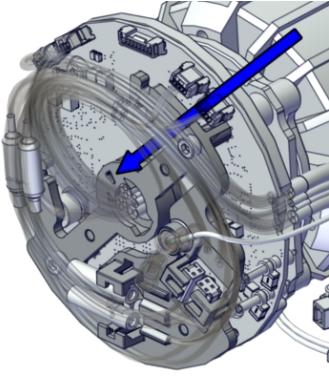
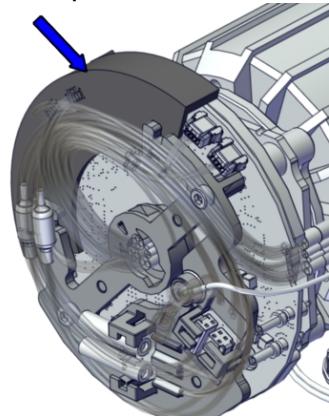
	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	<p>Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002049</p>
5	<p>Connect the two connectors to the torque sensor board.</p> <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 <p>xx2000002053</p>
6	Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 <p>xx2000002056</p> <p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002055</p>

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5 Repair

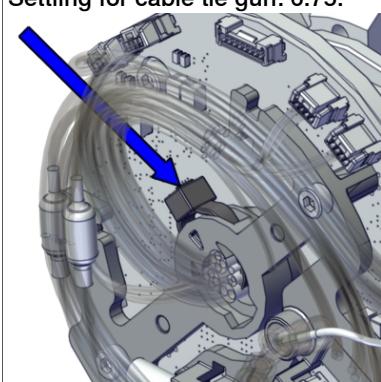
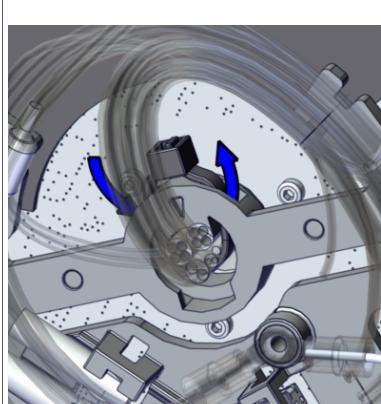
5.6.3 Replacing the axis-3 joint unit

Continued

	Action	Note
7	Keep the cabling loose, making sure not to twist or strain it. Use the cable tie to pre-fix the cable by hand.	 xx2100000507
8	Fit the protection plate to the drive board unit.	Protection plate: 3HAC077790-001  xx2000002057

Continues on next page

5.6.3 Replacing the axis-3 joint unit
Continued

Action	Note
9 Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.	Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO7 Setting for cable tie gun: 6.75.  xx2000002058
10 Remove the protection plate.	 xx2100000301

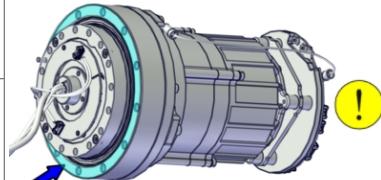
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5 Repair

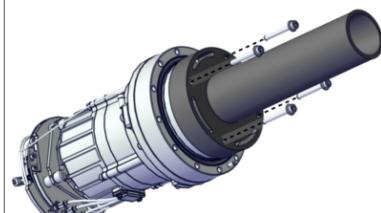
5.6.3 Replacing the axis-3 joint unit

Continued

Preparations before fitting the joint unit

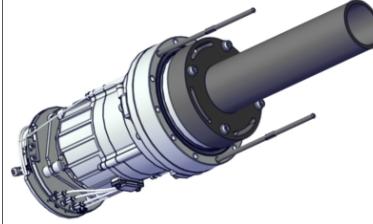
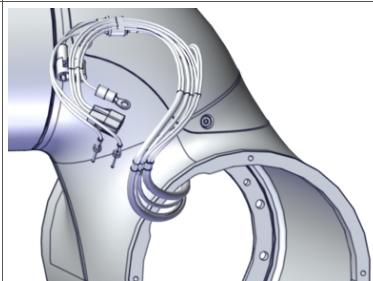
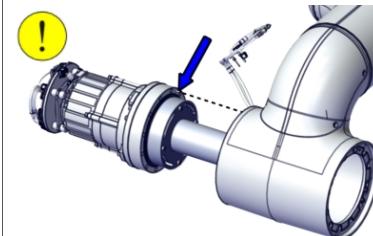
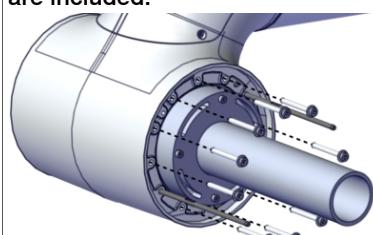
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	

Refitting the axis-3 joint unit

	Action	Note
1	Fit the lifting aid to the joint unit.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957

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5.6.3 Replacing the axis-3 joint unit
Continued

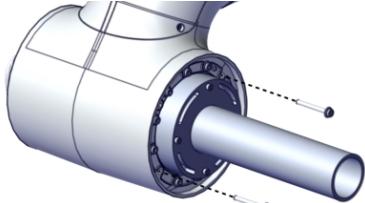
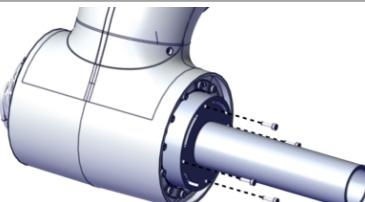
Action	Note
2 Fit two guide pins to the joint unit.	<p>Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3.</p>  <p>xx2000002438</p>
3 Place the cabling at the slot before refitting the joint unit.	 <p>xx2100000004</p>
4 Fit the joint unit to the housing, aligning the pin with the pin hole.	<p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>  <p>xx2000002072</p>
5 Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2100000320</p>

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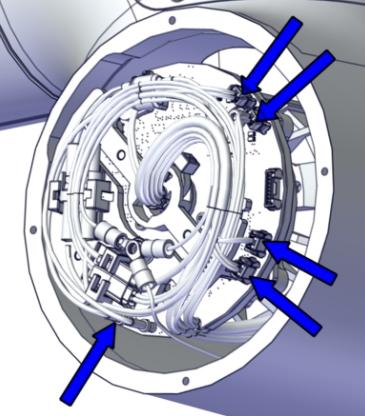
5 Repair

5.6.3 Replacing the axis-3 joint unit

Continued

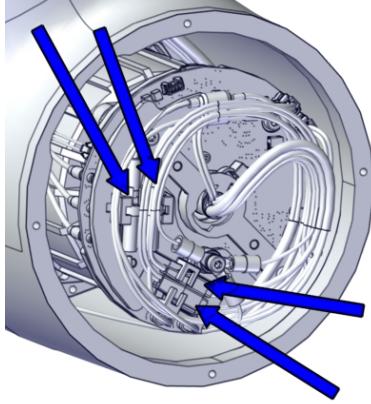
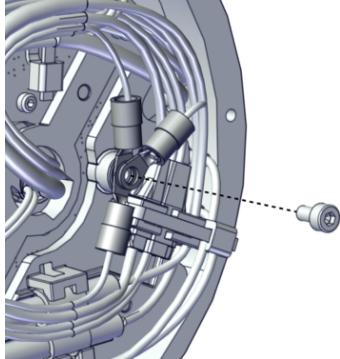
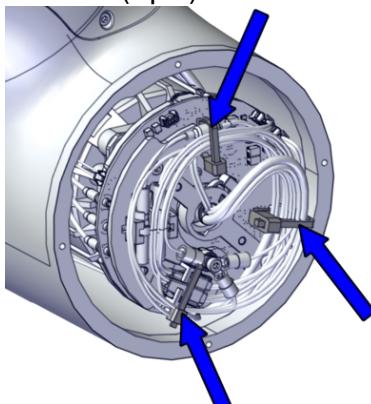
Action	Note
6 Remove the guide pins and secure the remaining two attachment screws.	 xx2000002070
7 Pre-tighten the screws crosswise.	
8 Torque tighten all screws crosswise. Tightening torque: 4.3 Nm.	
9 Remove the lifting aid by removing the screws.	 xx2000002069
10 Clean pushed-out flange sealant, if any.	

Connecting the axis-3 joint unit cabling

Action	Note
1 Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D3.X1 to X1 • D3/4.DC+ to DC+ • D3/4.DC- to Ground • D3.X4 to X4 • D3/4.X2 to X2 • D3.X5 to X5 	 xx2000002068

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5.6.3 Replacing the axis-3 joint unit
Continued

	Action	Note
2	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J4.DC+ to J4/5.DC+ • J4.DC- to J4/5.DC- • J4.CS to J4/5.CS • J4.CP to J4/5.CP 	 xx2000002067
3	<p>Secure the cables for functional earth and protective earth with a screw.</p>	<p>Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.</p>  xx2000001945
4	<p>Secure the cabling with cable ties.</p>	<p>Cable ties (3 pcs)</p>  xx2000002066

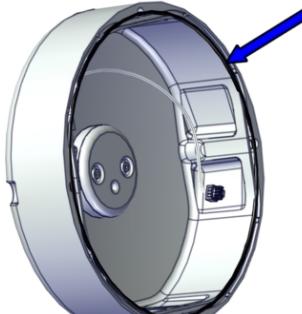
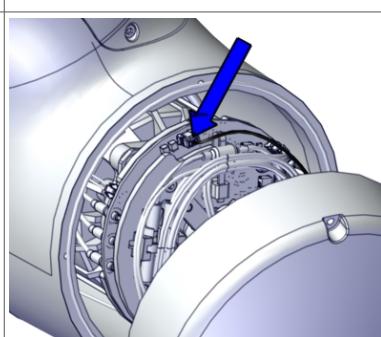
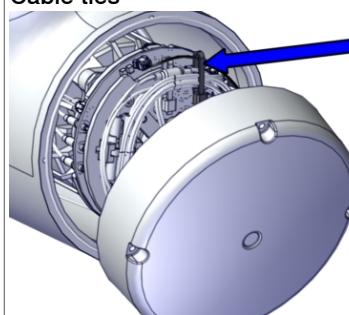
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5 Repair

5.6.3 Replacing the axis-3 joint unit

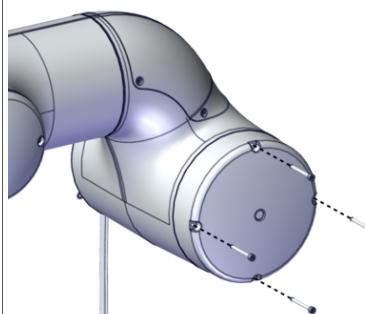
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Refitting the housing cover

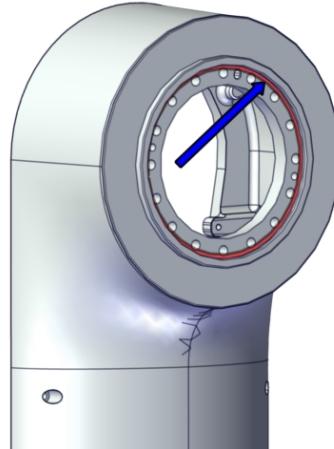
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000002023
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000002022

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5.6.3 Replacing the axis-3 joint unit
Continued

Action	Note
4 Refit the cover with the four screws.	<p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm</p>  <p>xx2000002021</p>

Refitting the upper arm

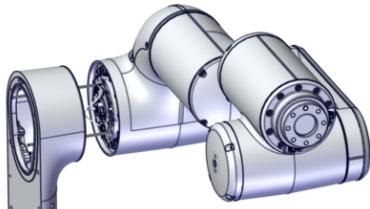
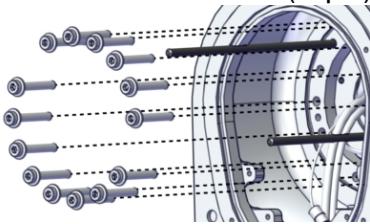
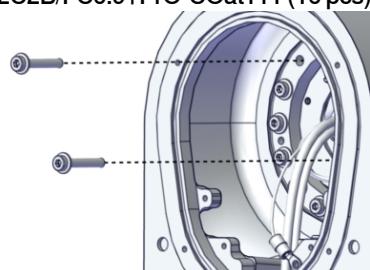
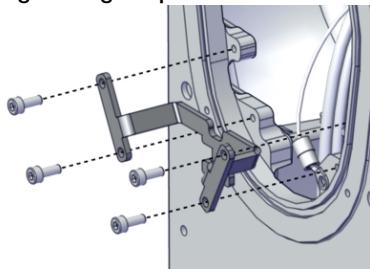
Action	Note
1 Fit two guide pins to the axis-3 joint.	 <p>xx2000001971</p>
2 Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000001973</p>

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5 Repair

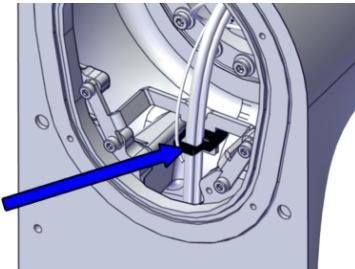
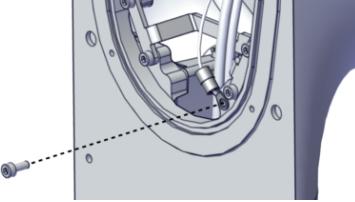
5.6.3 Replacing the axis-3 joint unit

Continued

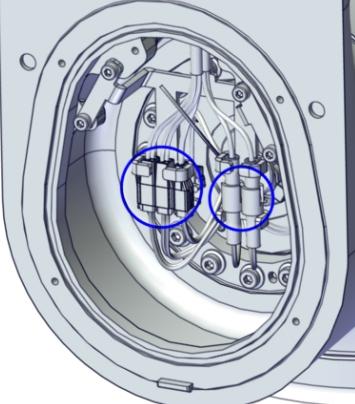
	Action	Note
3	Lift the upper arm into mounting position while inserting the cabling into the lower arm.	 xx2000001970
4	Slide the upper arm into place on the guide pins.	
5	Secure the upper arm to the lower arm with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001969
6	Remove the guide pins and fasten the remaining two screws.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001967
7	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm.
8	Refit the cable bracket with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm  xx2000001966

Continues on next page

Fastening the cabling between the lower and upper arm

	Action	Note
1	Secure the cabling with the cable tie.	<p>Cable ties</p>  <p>xx2000001965</p>
2	Connect the functional earth cable with the screw.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm</p>  <p>xx2000001964</p>

Connecting the upper arm cabling

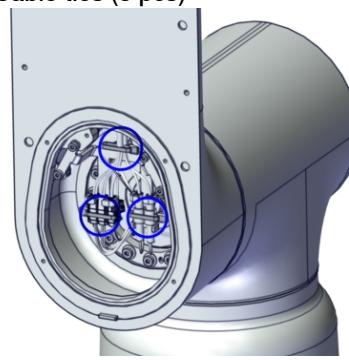
	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 <p>xx2000001938</p>

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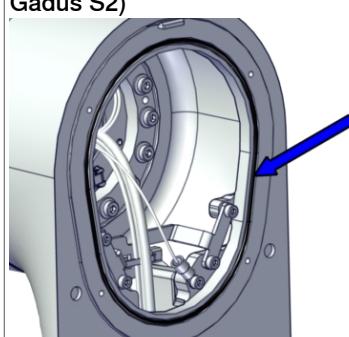
5 Repair

5.6.3 Replacing the axis-3 joint unit

Continued

Action	Note
2 Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937

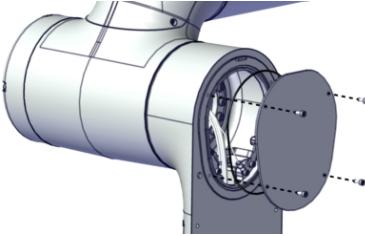
Refitting the lower arm covers

Action	Note
1 Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001955  xx2000001954

Continues on next page

5.6.3 Replacing the axis-3 joint unit

Continued

Action	Note
2 Refit the inner covers with four screws each.	<p>Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.4 Nm.</p>  <p>xx2000001947</p>
3 Snap the lower arm cover into place.	<p>Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.</p>
4 Secure the cover with four screws.	 <p>xx2000001929</p>

Concluding procedure

Action	Note
1 Calibrate the joint unit torque sensor.	See Calibration on page 719
2  DANGER Make sure all safety requirements are met when performing the first test run.	

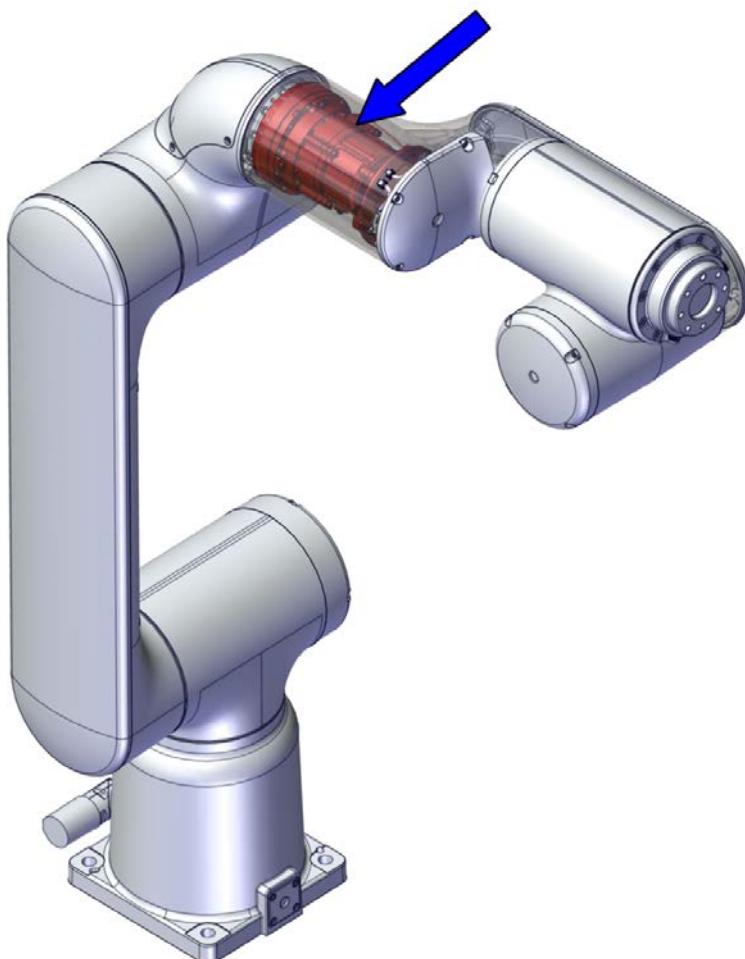
5 Repair

5.6.4 Replacing the axis-4 joint unit

5.6.4 Replacing the axis-4 joint unit

Location of the axis-4 joint unit

The joint unit is located as shown in the figure.



xx2000002119

Summary of the replacement procedure

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

- 1 Separate the cabling between the housing and the tubular (at the axis-3 joint unit).
- 2 Remove the tubular and place on a workbench.
- 3 Remove the axis-4 cover.
- 4 Replace the joint unit. Move the cabling from old to new joint unit.

Continues on next page

Required spare parts**Note**

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Joint unit	3HAC079143-001	New attachment screws and cable tie 3HAC075545-001 are included in the delivery.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077789-001	For joint units on axes 4, 5 and 6. Attachment screws M3x12 (4 pcs) are enclosed.
Guide pin, M3x110	3HAC077787-001	Always use guide pins in pairs. For joint units on axes 4, 5 and 6.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Tweezers	-	Used to handle drive board connectors.
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Cable ties	-	
O-ring	3HAC061327-043	Tubular cover Replace if damaged.
Flange socket head screw with glue	3HAB3413-312	M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included.
O-ring	3HAC061327-051	Axis-4 cover Replace if damaged.

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5 Repair

5.6.4 Replacing the axis-4 joint unit

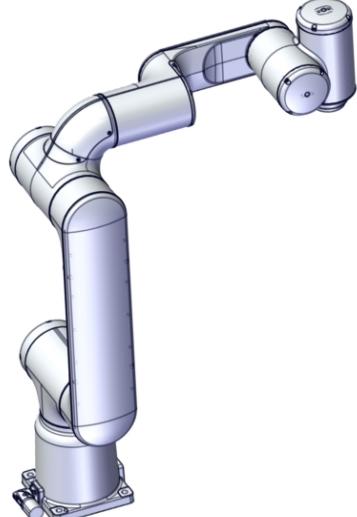
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Consumable	Article number	Note
Gasket	3HAC075056-001	Cover inside housing Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3 Replace if damaged.

Removing the joint unit

Use these procedures to remove the joint unit.

Preparations before removing the joint unit

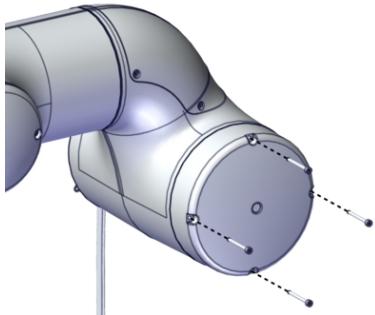
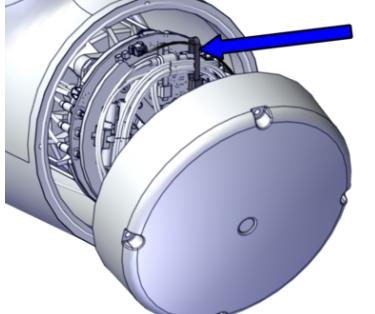
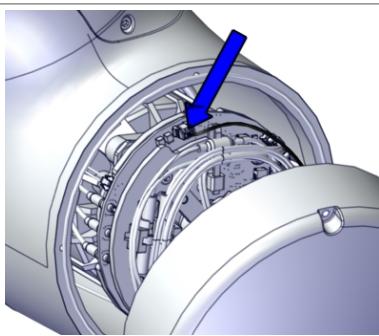
	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none">• Axis 1: No significance.• Axis 2: 0°• Axis 3: 0°• Axis 4: 0° (home position)• Axis 5: +90°• Axis 6: No significance. <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	 xx2100000005
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

Removing the housing cover

	Action	Note
1	<p>! CAUTION</p> <p>Make sure that all supplies for electrical power are turned off.</p>	

Continues on next page

5.6.4 Replacing the axis-4 joint unit
Continued

	Action	Note
2	Remove the cover screws.	 xx2000002021
3	CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002022
5	Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002023

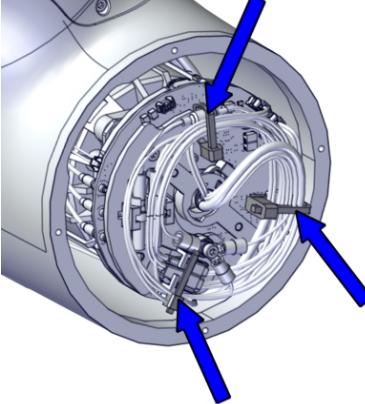
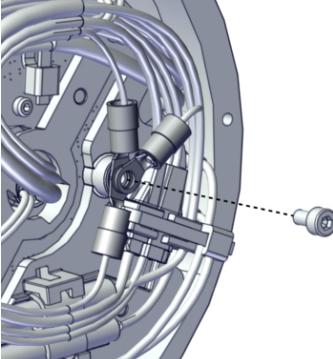
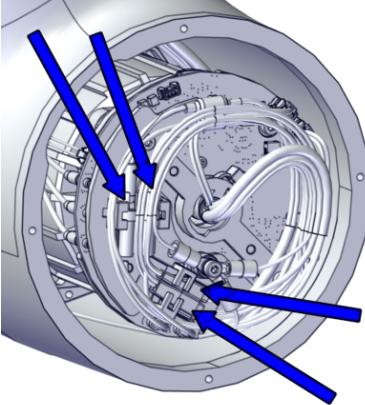
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5 Repair

5.6.4 Replacing the axis-4 joint unit

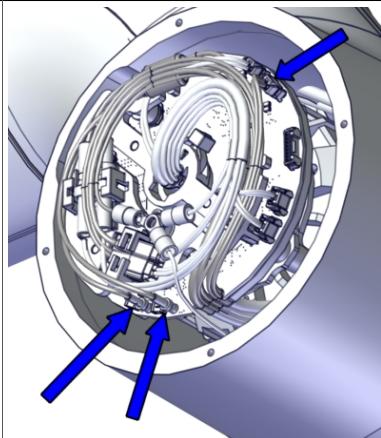
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Separating the cabling between the housing and the tubular

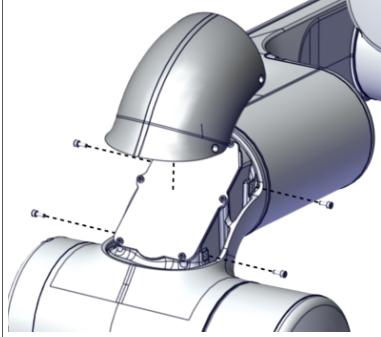
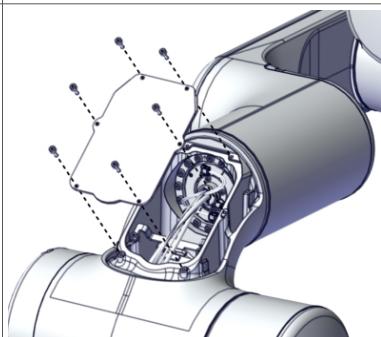
	Action	Note
1	Cut the cable ties.	 xx2000002066
2	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
3	Snap loose and disconnect the connectors: <ul style="list-style-type: none">• J4/5.DC+• J4/5.DC-• J4/5.CS• J4/5.CP	 xx2000002067

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5.6.4 Replacing the axis-4 joint unit
Continued

Action	Note
4 Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D3/4.X2 • D3/4.DC+ • D3/4.DC- 	 xx2000002120

Opening the housing top cover

Action	Note
1 Remove the cover by removing the four screws.	 xx2000002075
2 Remove the inner plate by removing the screws.	 xx2000002076

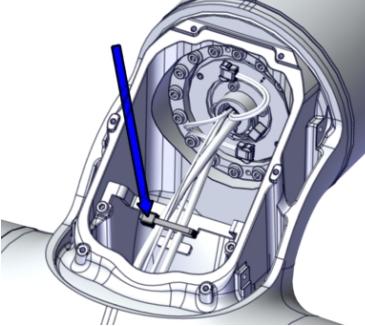
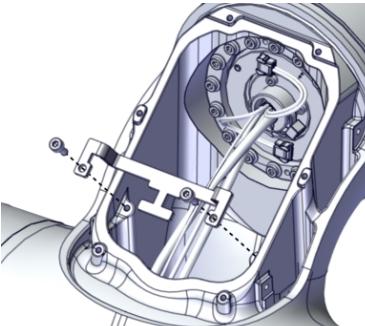
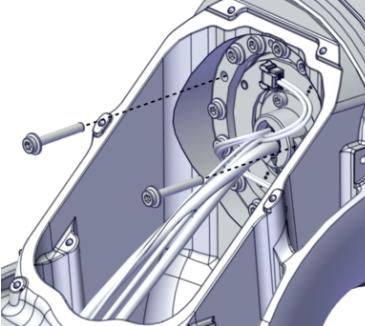
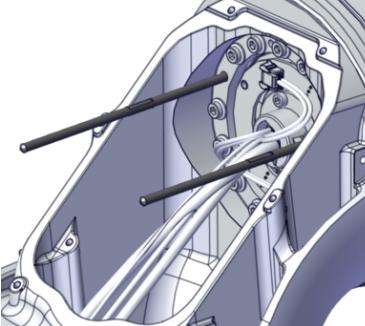
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5 Repair

5.6.4 Replacing the axis-4 joint unit

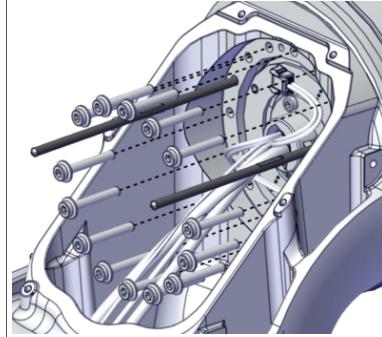
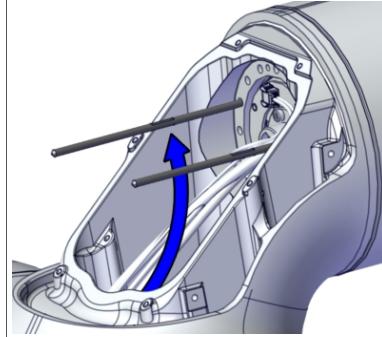
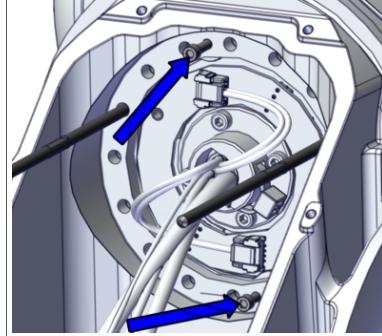
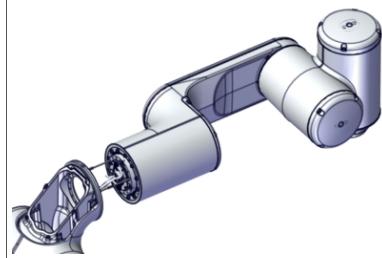
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Removing the tubular

	Action	Note
1	Cut the cable tie.	 xx2000002077
2	Remove the cable bracket by removing the two screws.	 xx2000002078
3	Remove two attachment screws and fit two guide pins to the axis-4 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002079  xx2000002080

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5.6.4 Replacing the axis-4 joint unit
Continued

Action	Note
4 Remove the remaining attachment screws.	 xx2000002081
5 Pull out the cabling carefully from the housing.	 xx2000002127
6 Use two fully threaded attachment screws as removal tools to press the housing out of position.	 xx2100000006
7 Remove the tubular from the housing. Assist the cabling to be removed from the housing while lifting away the complete tubular. Place the tubular on a workbench.	 xx2000002082

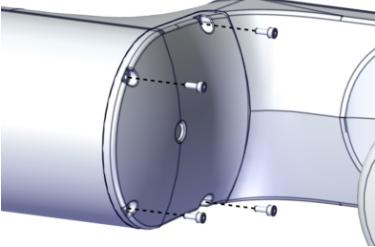
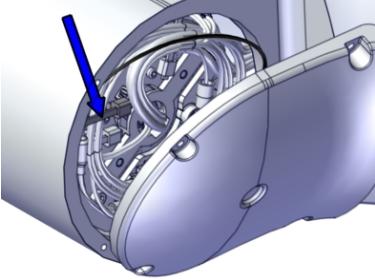
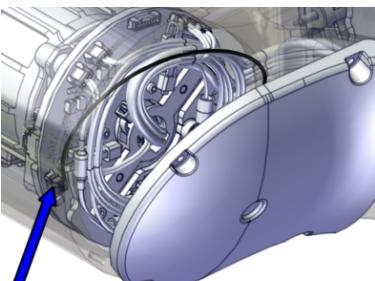
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5 Repair

5.6.4 Replacing the axis-4 joint unit

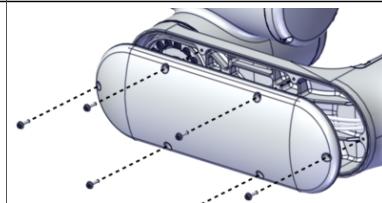
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Removing the axis-4 cover

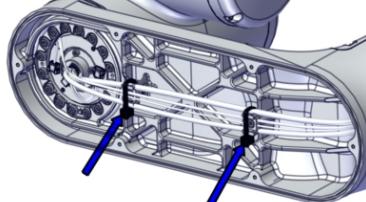
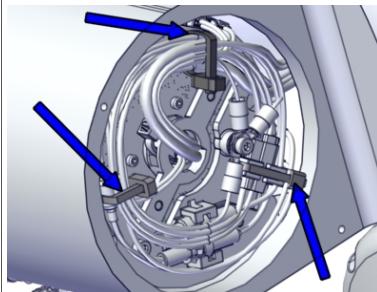
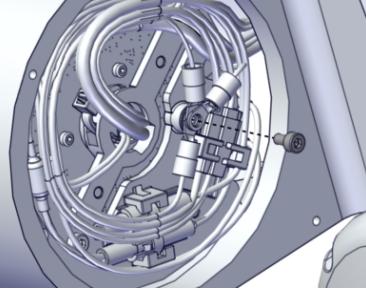
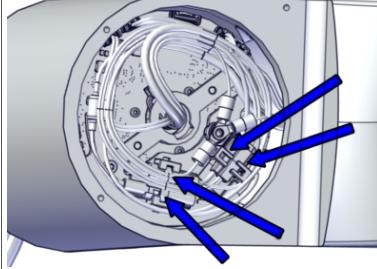
	Action	Note
1	Remove the cover screws.	 xx2000002083
2	! CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
3	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002084
4	Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	Tweezers  xx2000002085

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Removing the tubular cover

	Action	Note
1	Remove the cover by removing the six screws. Dispose the screws. New screws must be used when refitting the cover. New screws are included in the spare part delivery of the joint unit.	 xx2000002123

Separating the cabling between the tubular and the tilt

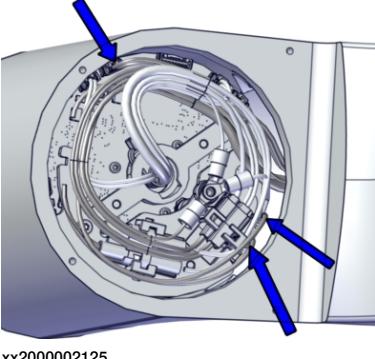
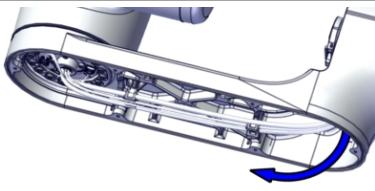
	Action	Note
1	Cut the cable ties, if needed.	 xx2000002124  xx2000002086
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002087
3	Snap loose and disconnect the connectors: • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP	 xx2000002089

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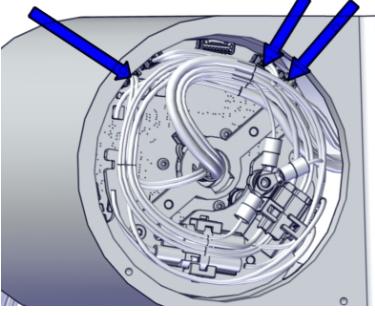
5 Repair

5.6.4 Replacing the axis-4 joint unit

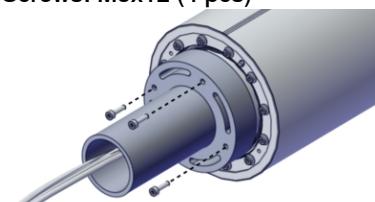
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Action	Note
<p>4 Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board:</p> <ul style="list-style-type: none"> • D3/4.X2 • D3/4.DC- • D3/4.DC+ <p>Use tweezers, if needed.</p>	<p>Tweezers</p>  <p>xx2000002125</p>
5 Pull out the cabling carefully from the tubular.	 <p>xx2000002126</p>

Disconnecting the axis-4 joint unit cabling

Action	Note
<p>1 Disconnect the connectors from the drive board.</p> <p>! CAUTION</p> <p>Use tweezers to unlock connectors and pull them off.</p> <ul style="list-style-type: none"> • D4/5.X1 • D4/5.X4 • D4/5.X5 	<p>Tweezers</p>  <p>xx2000002088</p>

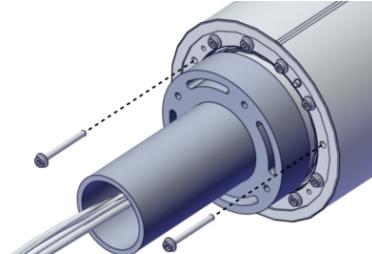
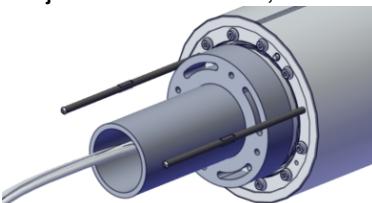
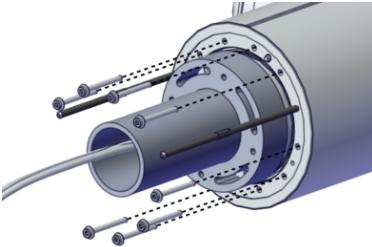
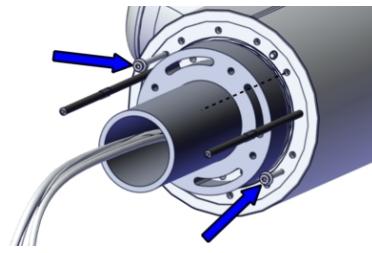
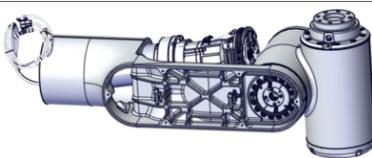
Removing the axis-4 joint unit

Action	Note
<p>1 Fit the lifting aid to the joint unit, on the torque sensor side.</p> <p>! CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)</p>  <p>xx2000002090</p>

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5.6.4 Replacing the axis-4 joint unit

Continued

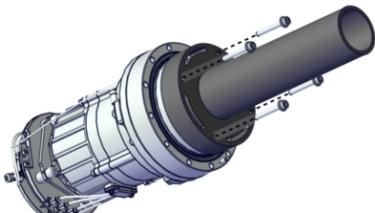
	Action	Note
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002091
3	<p>Fit two guide pins to the axis-4 joint unit.</p>	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  xx2000002578
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000326
5	<p>Press the joint unit out of position using two of the previous attachment screws as removal tools.</p>	 xx2100000327
6	<p>Remove the joint unit from the tubular.</p> <p>CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002116

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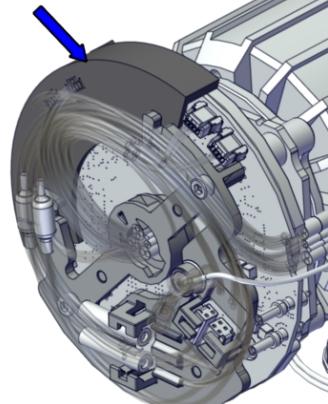
5 Repair

5.6.4 Replacing the axis-4 joint unit

Continued

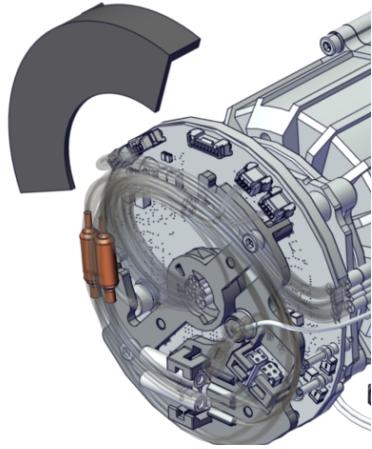
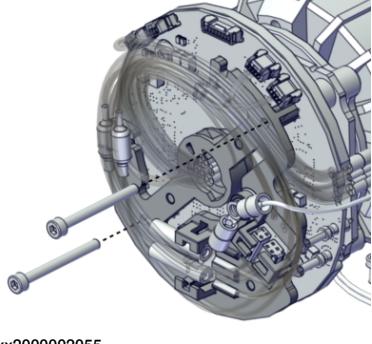
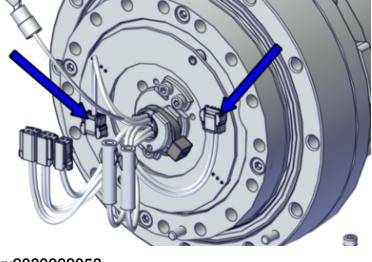
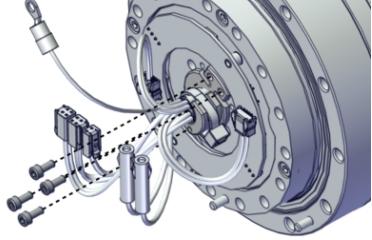
Action	Note
7 Remove the lifting aid and guide pins.	 xx2000001957

Removing the joint cable

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 44 .	
2 Fit the protection plate to the drive board unit.  Tip Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001  xx2000002057
3 Cut the cable tie at the drive board.	 xx2000002058

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5.6.4 Replacing the axis-4 joint unit
Continued

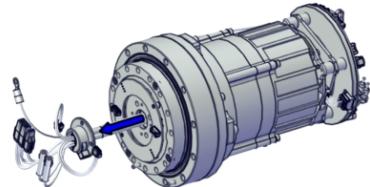
	Action	Note
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. <ul style="list-style-type: none"> • TQ.A • TQ.B 	 xx2000002053
7	Remove the cable plate by removing the attachment screws.	 xx2000002049

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5 Repair

5.6.4 Replacing the axis-4 joint unit

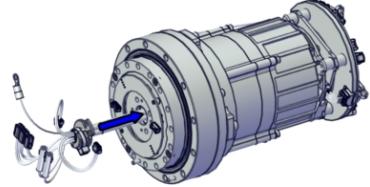
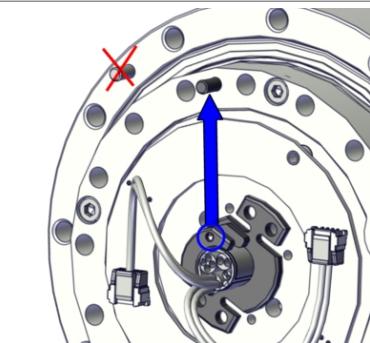
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	Action	Note
8	<p>Remove the joint cable from the hollow shaft from the torque sensor side.</p> <p>! CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002060

Refitting the joint unit

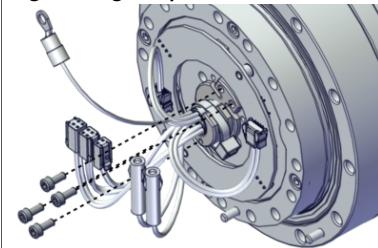
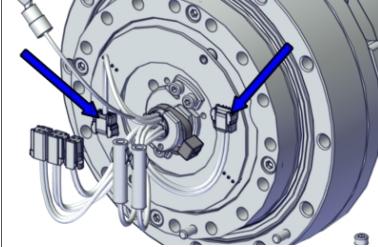
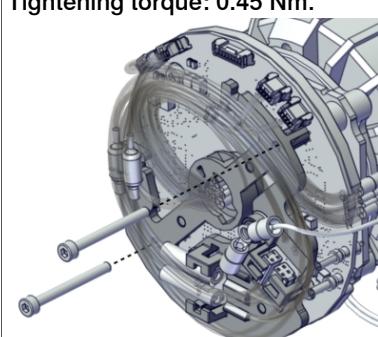
Use these procedures to refit the joint unit.

Refitting the joint cable

	Action	Note
1	<p>! ELECTROSTATIC DISCHARGE (ESD)</p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44.</p>	
2	<p>Place the joint cable through the hollow shaft from the torque sensor side.</p> <p>! CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002048
3	Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.	 xx2000002051

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5.6.4 Replacing the axis-4 joint unit
Continued

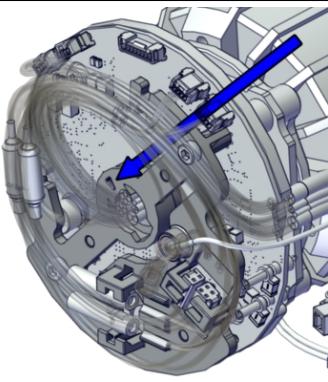
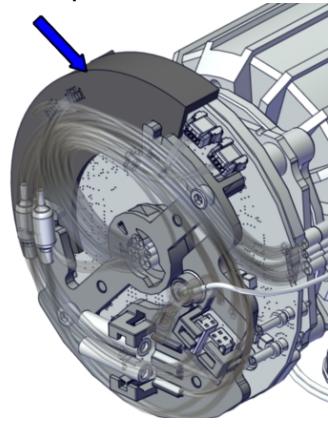
	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.
		 xx2000002049
5	Connect the two connectors to the torque sensor board. <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 xx2000002053
6	Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 xx2000002056
		Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.
		 xx2000002055

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5 Repair

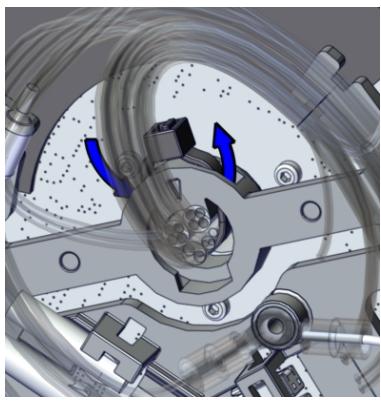
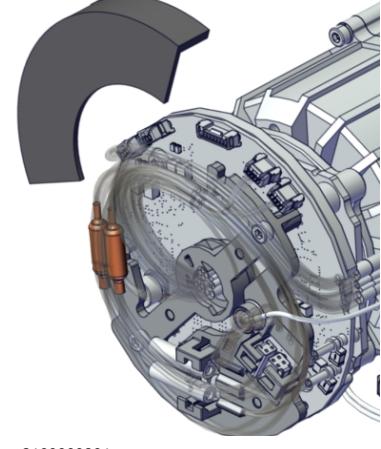
5.6.4 Replacing the axis-4 joint unit

Continued

	Action	Note
7	Keep the cabling loose, making sure not to twist or strain it. Use the cable tie to pre-fix the cable by hand.	 xx2100000507
8	Fit the protection plate to the drive board unit.	Protection plate: 3HAC077790-001  xx2000002057

Continues on next page

5.6.4 Replacing the axis-4 joint unit
Continued

	Action	Note
9	<p>Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.</p>	<p>Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO7 Setting for cable tie gun: 6.75.</p>  <p>xx2000002058</p>  <p>xx2000002059</p>
10	Remove the protection plate.	 <p>xx2100000301</p>

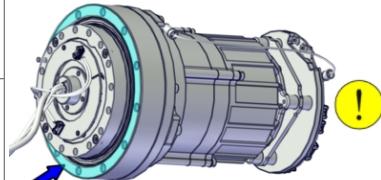
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5 Repair

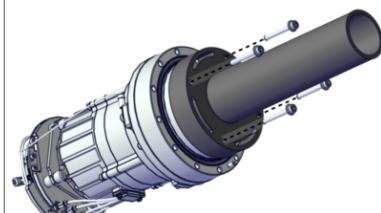
5.6.4 Replacing the axis-4 joint unit

Continued

Preparations before fitting the joint unit

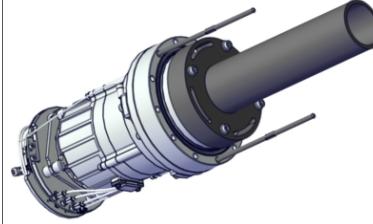
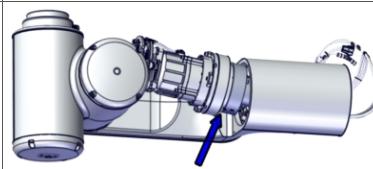
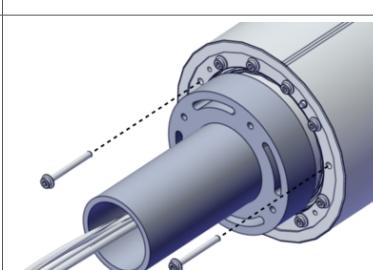
Action	Note
 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3 Apply a thin layer of flange sealant to the mounting surface. Do not contaminate the radial sealing with sealant.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	

Refitting the axis-4 joint unit

Action	Note
1 Fit the lifting aid to the joint unit.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079143-001 Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957

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5.6.4 Replacing the axis-4 joint unit
Continued

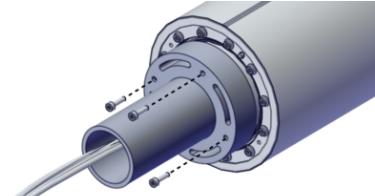
	Action	Note
2	Fit two guide pins to the joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  <p>xx2000002438</p>
3	<p>Fit the joint unit to the tubular, aligning the pin with the pin hole.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000002117</p>
4	Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2100000326</p>
5	Remove the guide pins and secure the remaining two attachment screws.	 <p>xx2000002091</p>
6	Pre-tighten the screws crosswise.	
7	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm.

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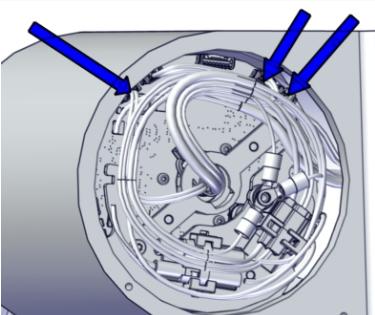
5 Repair

5.6.4 Replacing the axis-4 joint unit

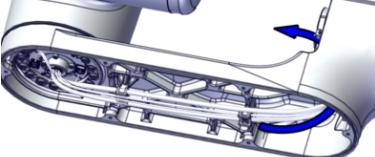
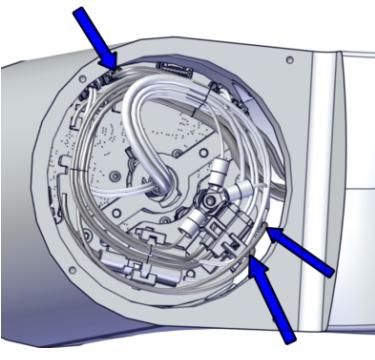
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Action	Note
8 Remove the lifting aid by removing the screws.	 xx2000002090
9 Clean pushed-out flange sealant, if any.	

Connecting the axis-4 joint unit cabling

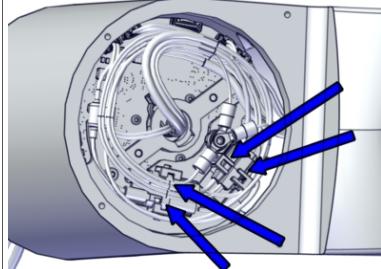
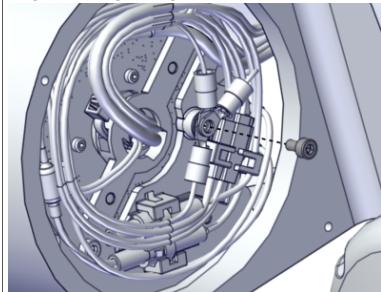
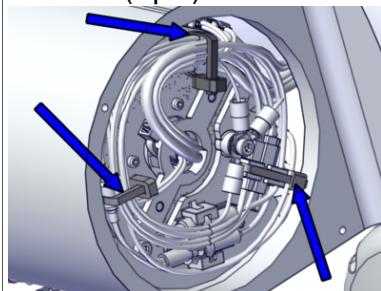
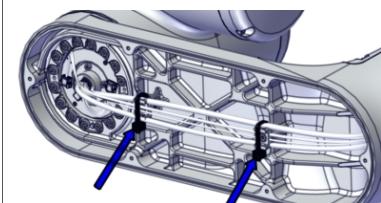
Action	Note
1 Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D4/5.X1 to X1 • D4/5.X4 to X4 • D4/5.X5 to X5 	 xx2000002088

Connecting the tilt cabling

Action	Note
1 Insert the cabling into the tubular.	 xx2000002148
2 Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D3/4.X2 to X2 • D3/4.DC- to Ground • D3/4.DC+ to +DC 	 xx2000002125

Continues on next page

5.6.4 Replacing the axis-4 joint unit
Continued

Action	Note
3 Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J4/5.DC+ to J5/6.DC+ • J4/5.DC- to J5/6.DC- • J4/5.CS to J5/6.CS • J4/5.CP to J5/6.CP 	 xx2000002089
4 Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002087
5 Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002086  xx2000002124

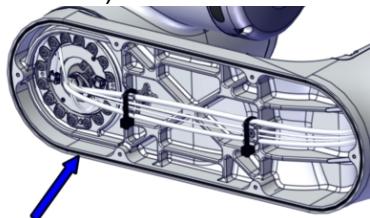
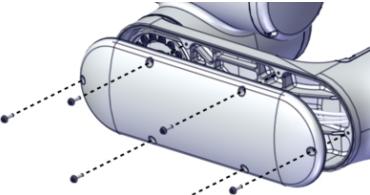
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5 Repair

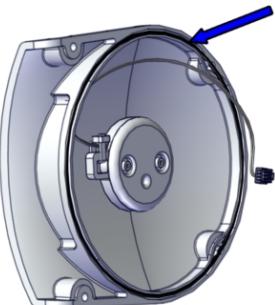
5.6.4 Replacing the axis-4 joint unit

Continued

Refitting the tubular cover

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-043 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002149
2	Refit the cover with new attachment screws.	Flange socket head screw with glue: 3HAB3413-312 M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included. Tightening torque: 1.6 Nm.  xx2000002123

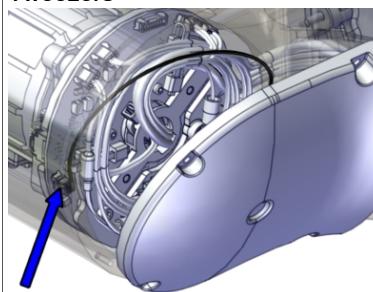
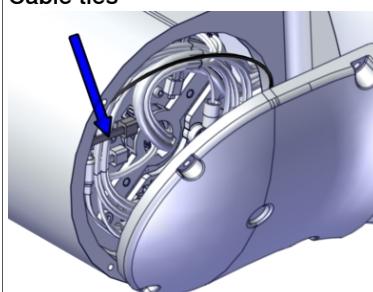
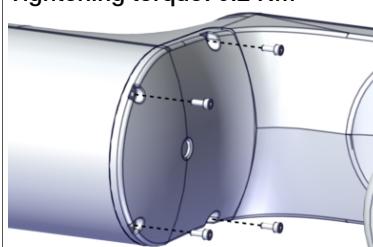
Refitting the axis-4 cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002092

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5.6.4 Replacing the axis-4 joint unit

Continued

	Action	Note
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	Tweezers  xx2000002085
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000002084
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.2 Nm  xx2000002083

Refitting the tubular

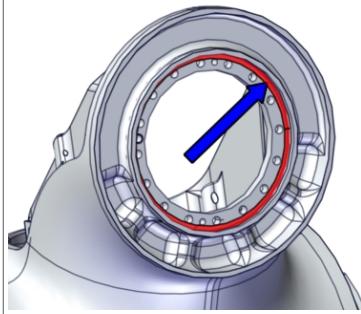
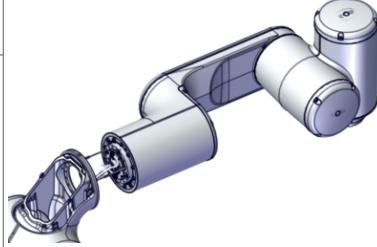
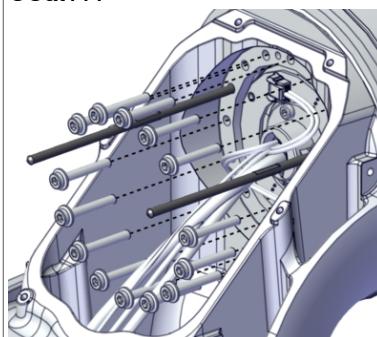
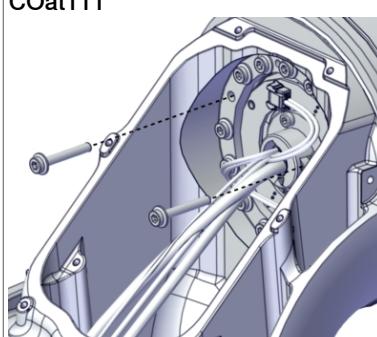
	Action	Note
1	Fit two guide pins to the axis-4 joint.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002093

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5 Repair

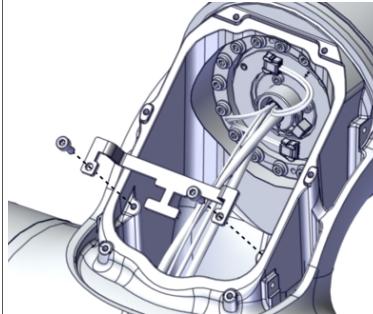
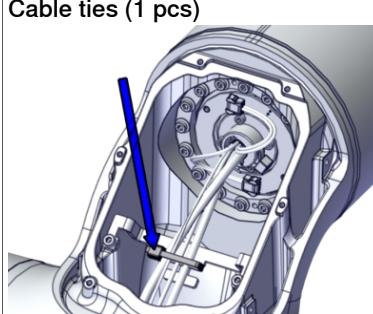
5.6.4 Replacing the axis-4 joint unit

Continued

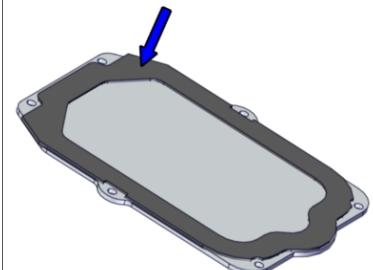
	Action	Note
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the housing mounting surface, as pointed out in the figure.	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000002094</p>
3	Lift the tubular into mounting position while inserting the cabling into the housing.	 <p>xx2000002082</p>
4	Slide the tubular into place on the guide pins.	
5	Secure the tubular to the housing with all attachment screws but two. Pre-tighten the screws crosswise firstly.	<p>Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111</p>  <p>xx2000002081</p>
6	Remove the guide pins and fasten the remaining two screws.	<p>Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111</p>  <p>xx2000002079</p>

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5.6.4 Replacing the axis-4 joint unit
Continued

	Action	Note
7	Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.
8	Refit the cable bracket with the two screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm
		 xx2000002078
9	Secure the cabling with a cable tie.	Cable ties (1 pcs)
		 xx2000002077

Closing the housing top cover

	Action	Note
1	Check the inner plate gasket. Replace if damaged.	Gasket: 3HAC075056-001  xx2000002095

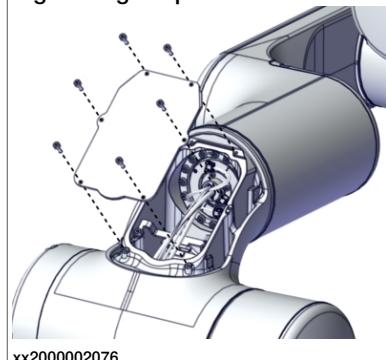
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5 Repair

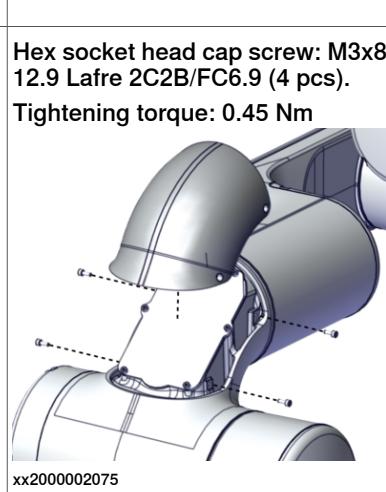
5.6.4 Replacing the axis-4 joint unit

Continued

Action	Note
2	Refit the inner plate with the screws.
3	Refit the cover with the four screws.



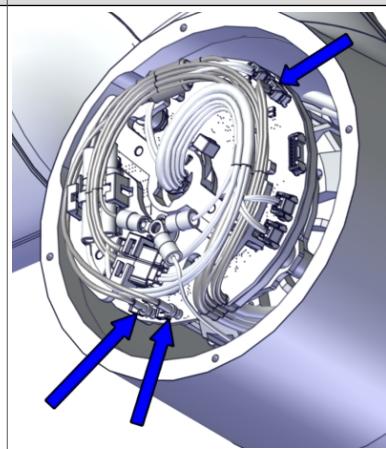
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xx2000002075

Connecting the tubular cabling

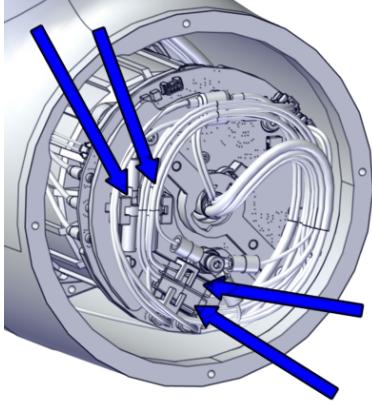
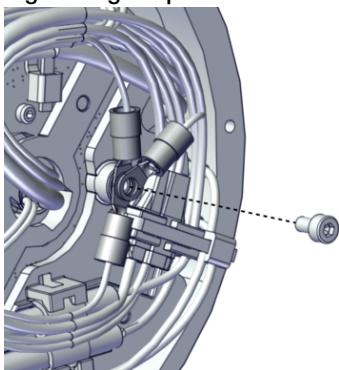
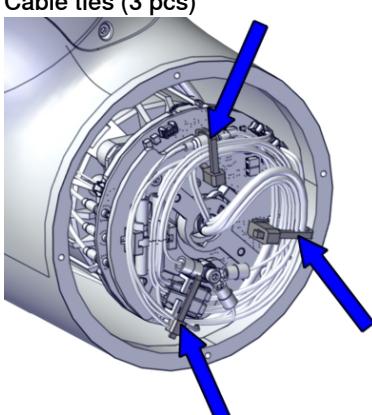
Action	Note
1	Reconnect the connectors to the drive board. • D3/4.DC+ to DC+ • D3/4.DC- to Ground • D3/4.X2 to X2



xx2000002120

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5.6.4 Replacing the axis-4 joint unit
Continued

	Action	Note
2	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J3.DC+ to J3.DC+ • J3.DC- to J3.DC- • J3.CS to J3.CS • J3.CP to J3.CP 	 xx2000002067
3	<p>Secure the cables for functional earth and protective earth with a screw.</p>	<p>Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.</p>  xx2000001945
4	<p>Secure the cabling with cable ties.</p>	<p>Cable ties (3 pcs)</p>  xx2000002066

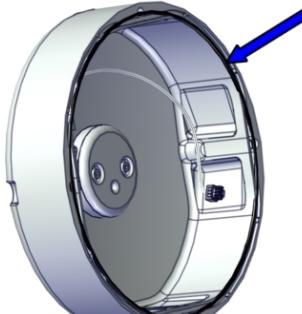
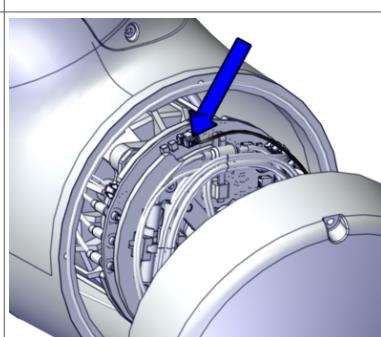
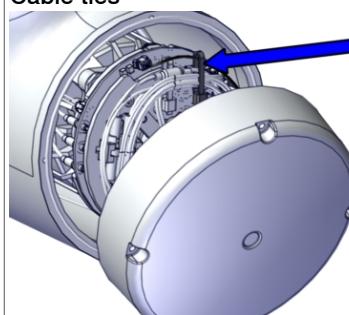
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5 Repair

5.6.4 Replacing the axis-4 joint unit

Continued

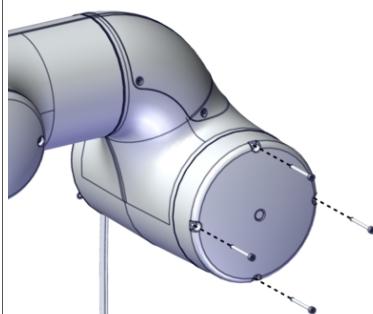
Refitting the housing cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000002023
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000002022

Continues on next page

5.6.4 Replacing the axis-4 joint unit

Continued

Action	Note
4 Refit the cover with the four screws.	<p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm</p>  <p>xx2000002021</p>

Concluding procedure

Action	Note
1 Calibrate the joint unit torque sensor.	See Calibration on page 719
2  DANGER Make sure all safety requirements are met when performing the first test run.	

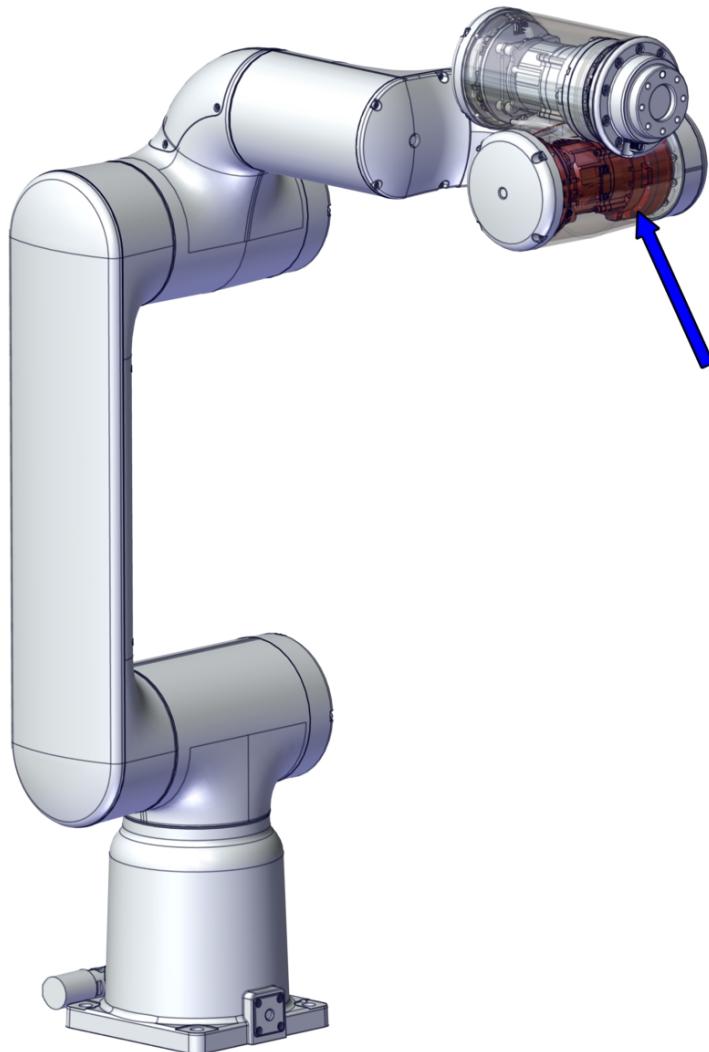
5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Location of the axis-5 joint unit

The joint unit is located as shown in the figure.

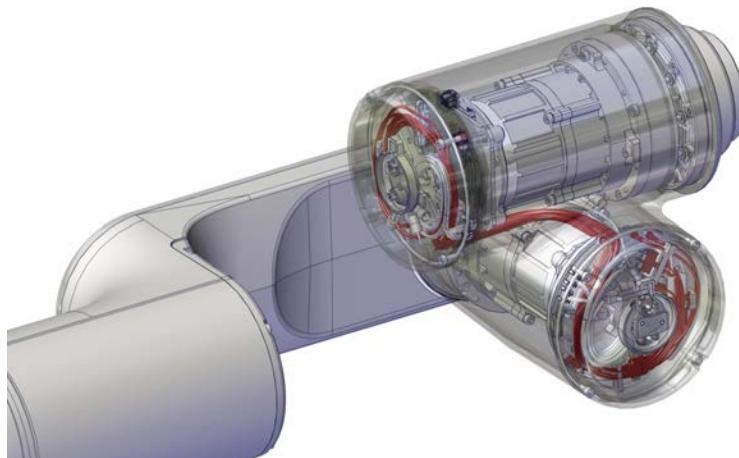


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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

*Continued***Location of the axis-5 to axis-6 transition cabling**

The cable harness is located as shown in the figure.



xx210000091

Summary of the replacement procedure

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

- 1 Remove the tubular cover.
- 2 Separate the cabling between the tubular and the tilt (at the axis-4 joint unit).
- 3 Remove the tilt and place on a workbench.
- 4 Remove the axis-6 joint unit.
- 5 Remove the axis-5 cover.
- 6 Replace the joint unit. Move the cabling from old to new joint unit.
- 7 Replace the axis-5 to axis-6 transition cabling.

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 CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Joint unit	3HAC079143-001	New attachment screws and cable tie 3HAC075545-001 are included in the delivery.
Cable harness, transition joint-5 and joint-6	3HAC073209-001	

Continues on next page

5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077789-001	For joint units on axes 4, 5 and 6. Attachment screws M3x12 (4 pcs) are enclosed.
Guide pin, M3x110	3HAC077787-001	Always use guide pins in pairs. For joint units on axes 4, 5 and 6.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Tweezers	-	Used to handle drive board connectors.
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Grease	3HAC042536-001	Shell Gadus S2
Cable ties	-	
O-ring	3HAC061327-051	Axis-5 cover Replace if damaged.
O-ring	3HAC061327-051	Arm-side interface Replace if damaged.
Flange socket head screw with glue	3HAB3413-312	M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included.
O-ring	3HAC061327-043	Tubular cover Replace if damaged.
O-ring	3HAC061327-051	Axis-4 cover Replace if damaged.

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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

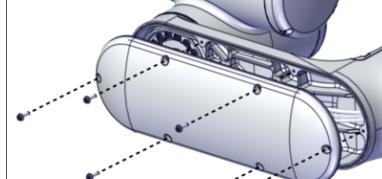
Removing the joint unit and transition cabling

Use these procedures to remove the joint unit and transition cabling.

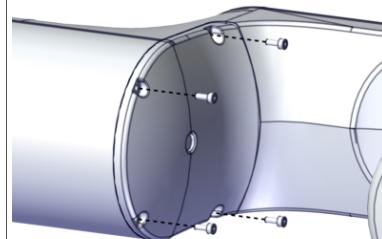
Preparations before removing the joint unit and transition cabling

	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none"> • Axis 1: No significance. • Axis 2: No significance. • Axis 3: No significance. • Axis 4: No significance. • Axis 5: 0° (home position) • Axis 6: No significance. <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	
2	<p>! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

Removing the tubular cover

	Action	Note
1	<p>Remove the cover by removing the six screws. Dispose the screws. New screws must be used when refitting the cover.</p> <p>New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002123

Removing the axis-4 cover

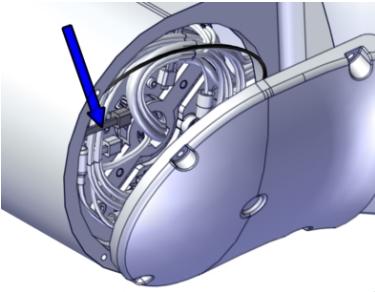
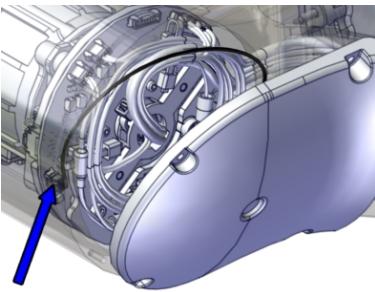
	Action	Note
1	Remove the cover screws.	 xx2000002083

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5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

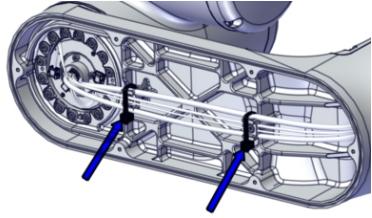
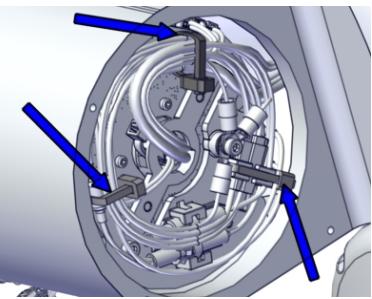
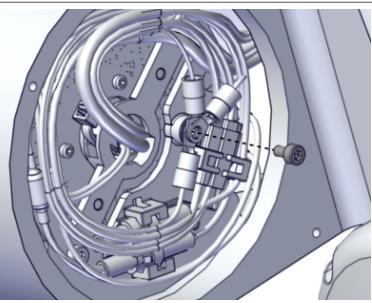
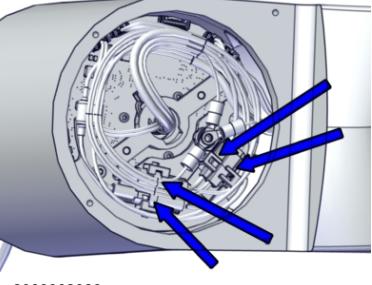
Continued

	Action	Note
2	<p>! CAUTION</p> <p>There is cabling connected between the cover and the joint unit drive board.</p> <p>Open the cover with care to avoid damage to the cabling or the connector(s).</p> <p>Do not leave the cover in location without being secured with the attachment screws.</p>	
3	Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002084
4	Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	Tweezers  xx2000002085

Continues on next page

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Separating the cabling between the tubular and the tilt

	Action	Note
1	Cut the cable ties, if needed.	 xx2000002124  xx2000002086
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002087
3	Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP 	 xx2000002089

Continues on next page

5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

Action	Note
<p>4 Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board:</p> <ul style="list-style-type: none"> • D3/4.X2 • D3/4.DC- • D3/4.DC+ <p>Use tweezers, if needed.</p>	<p>Tweezers</p> <p>xx2000002125</p>
5 Pull out the cabling carefully from the tubular.	<p>xx2000002126</p>

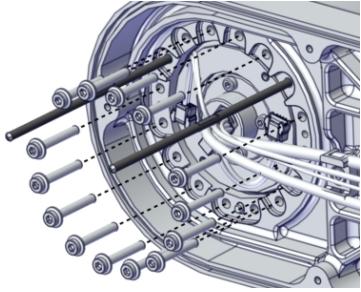
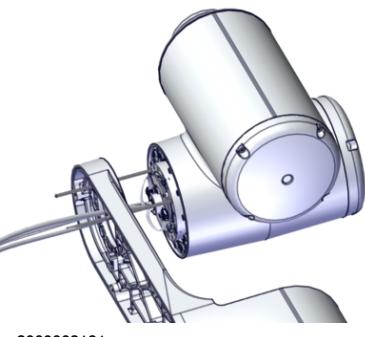
Removing the tilt

Action	Note
1 Remove two attachment screws and fit two guide pins to the axis-5 joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.</p> <p>xx2000002128</p> <p>xx2000002129</p>

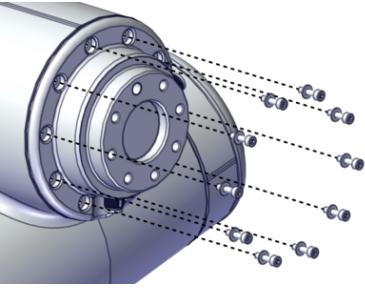
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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

Action	Note
2 Remove the remaining attachment screws.	 xx2000002130
3 Press the tilt out of position using two of the previous attachment screws as removal tools.	
4 Remove the tilt from the tubular. Assist the cabling to be removed while lifting away the complete tilt. Place the tilt on a workbench.	 xx2000002131

Removing the tool flange

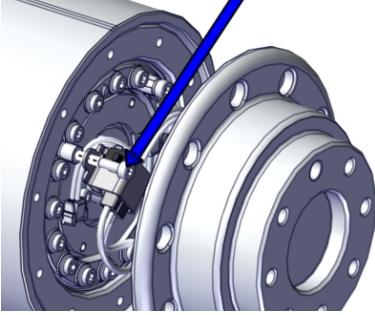
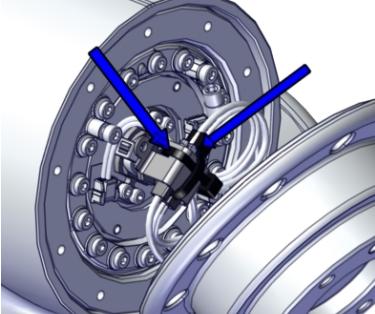
Action	Note
1 Remove the tool flange screws and washers.	 xx2000002155
2  CAUTION There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	

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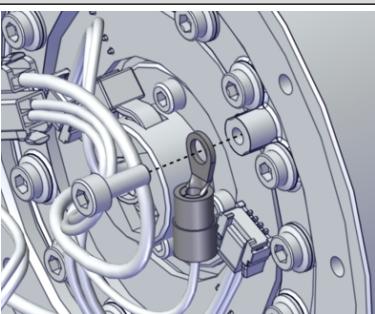
5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

Action	Note
3 Loosen the tool flange and remove the cable bracket by removing the screw.	 xx2000002156
4 Cut the cable ties.	 xx2000002157
5 Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

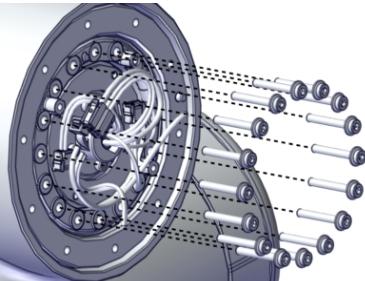
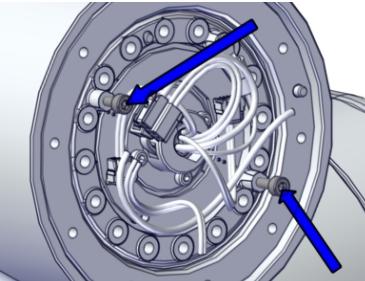
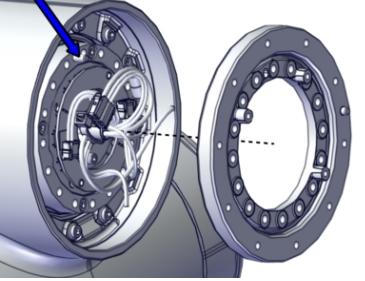
Disconnecting the tool flange functional earth cable

Action	Note
1 Remove the functional earth cable by removing the screw.	 xx2000002159

Continues on next page

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Removing the tool flange adapter

	Action	Note
1	Remove the tool flange adapter screws.	 xx2000002165
2	Press the adapter out of position by using two of the attachment screws as removal tools.	 xx2000002166
3	Remove the tool flange adapter.	 xx2000002167

Removing the arm-side interface

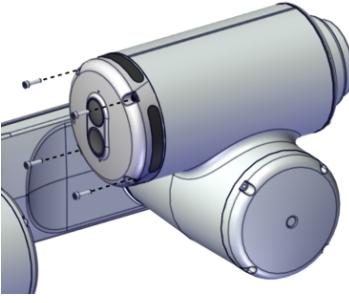
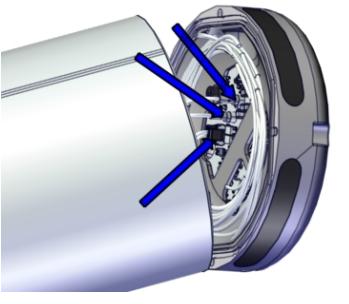
	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	 CAUTION There is cabling connected between the arm-side interface and the joint unit drive board. Open the arm-side interface with care to avoid damage to the cabling or the connector(s). Do not leave the arm-side interface in location without being secured with the attachment screws.	

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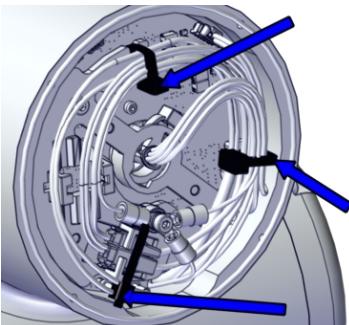
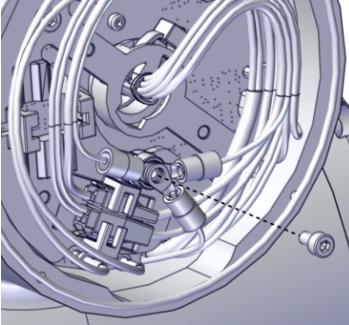
5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

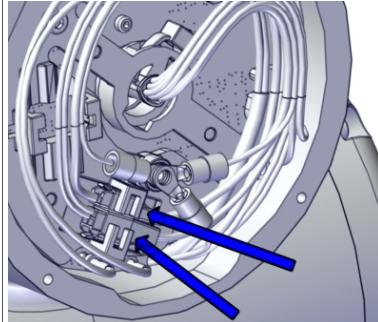
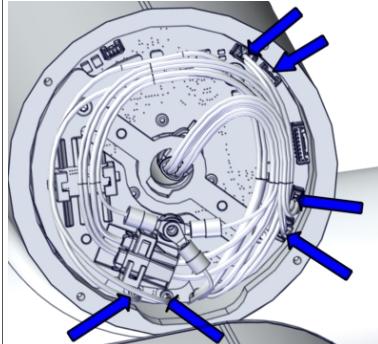
Action	Note
3 Remove the attachment screws.	 xx2000002550
4 Loosen the arm-side interface carefully and disconnect the connectors from it. <ul style="list-style-type: none"> • ASI.DC+ • ASI.DC- • ASI.X1 	 xx2100000335

Disconnecting the axis-6 joint unit cabling

Action	Note
1 Cut the cable ties.	 xx2000002161
2 Remove the functional and protective earth cables by removing the screw.	 xx2000002162

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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Action	Note
3 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J7.CS • J7.CP 	 xx2000002163
4 Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D6.X1 • D6.DC+ • D6.DC- • D6.X4 • D6.X2 • D6.X5 <p>! CAUTION Use tweezers to unlock connectors and pull them off.</p>	Tweezers  xx2000002164

Removing the axis-6 joint unit

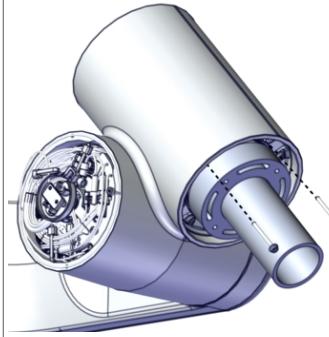
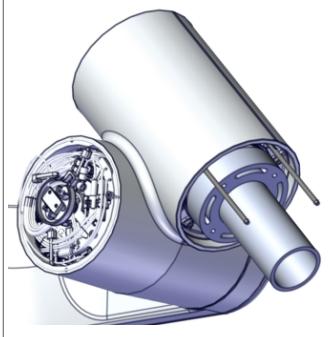
Action	Note
1 Fit the lifting aid to the joint unit, on the torque sensor side. ! CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002168 Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.

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5 Repair

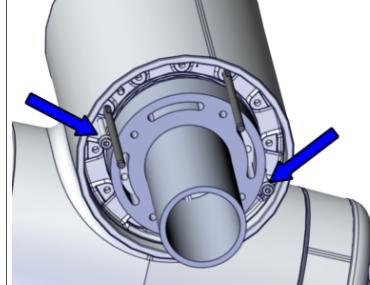
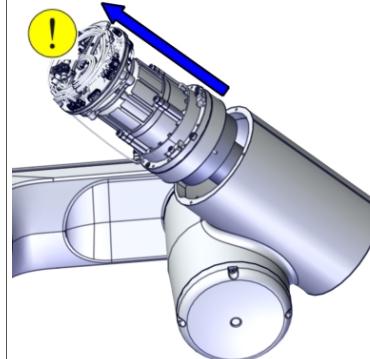
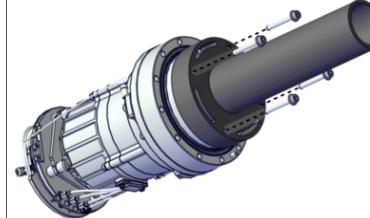
5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

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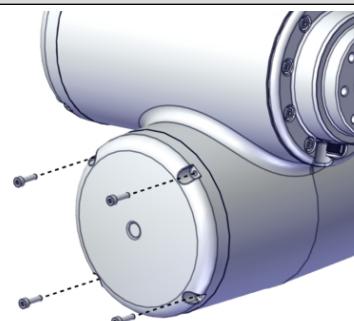
	Action	Note
2	<p>Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002170 Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.
3	<p>Fit two guide pins to the axis-6 joint unit.</p>	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2100000328
4	<p>Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000329

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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Action	Note
5 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2100000330
6 Remove the joint unit from the tubular. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002169 Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.
7 Remove the lifting aid and guide pins.	 xx2000001957

Removing the axis-5 cover

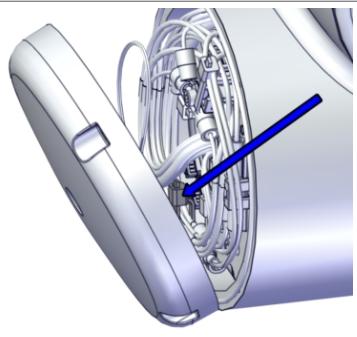
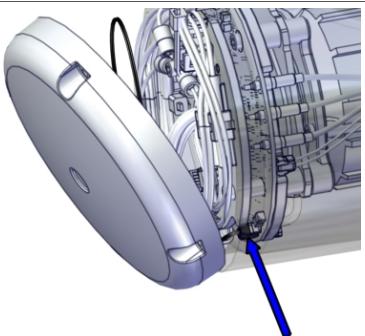
Action	Note
1 Remove the cover by removing the four screws.	 xx2000002132

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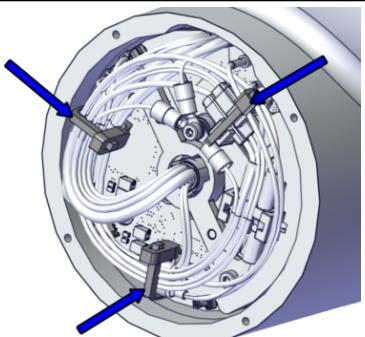
5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

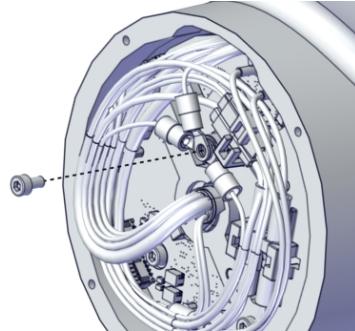
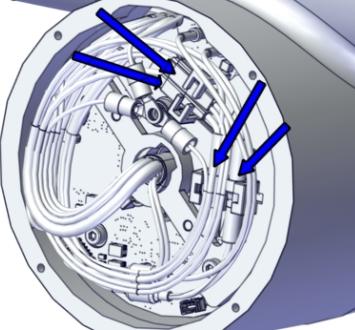
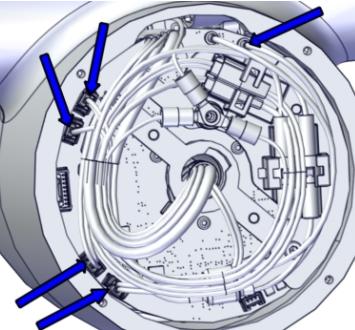
Action	Note
<p>2</p> <p>CAUTION</p> <p>There is cabling connected between the cover and the joint unit drive board.</p> <p>Open the cover with care to avoid damage to the cabling or the connector(s).</p> <p>Do not leave the cover in location without being secured with the attachment screws.</p>	
<p>3</p> <p>Open the cover and cut the cable tie that holds the brake release cable.</p>	 xx2000002133
<p>4</p> <p>Disconnect the brake release connector DR.X8 from the drive board.</p> <p>Remove the cover.</p>	 xx2000002134

Disconnecting the axis-5 joint unit cabling

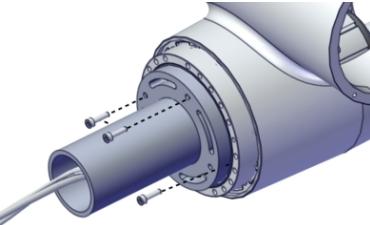
Action	Note
<p>1</p> <p>Cut the cable ties.</p>	 xx2000002135

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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Action	Note
2 Remove the functional and protective earth cables by removing the screw.	 xx2000002136
3 Snap loose and disconnect the connectors: <ul style="list-style-type: none"> • J5/6.DC+ • J5/6.DC- • J5/6.CS • J5/6.CP 	 xx2000002137
4 Disconnect the connectors from the drive board. <ul style="list-style-type: none"> • D4/5.X1 • D5.DC+ • D5.DC- • D4/5.X4 • D5.X2 • D4/5.X5 <p>! CAUTION Use tweezers to unlock connectors and pull them off.</p>	Tweezers  xx2000002138

Removing the axis-5 joint unit

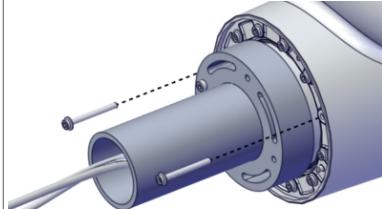
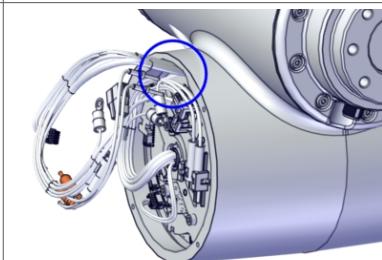
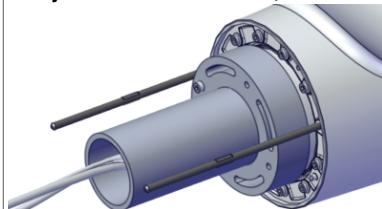
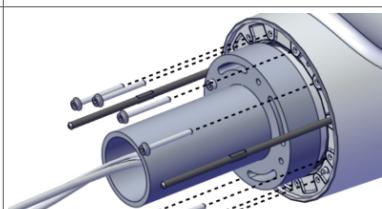
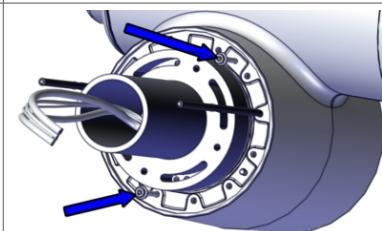
Action	Note
1 Fit the lifting aid to the joint unit, on the torque sensor side. ! CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002139

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5 Repair

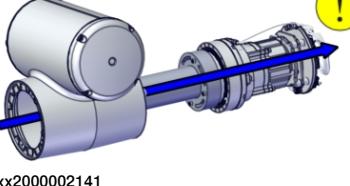
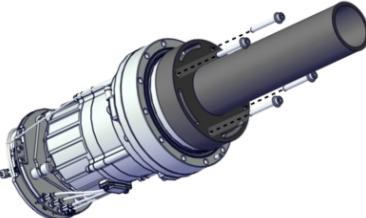
5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

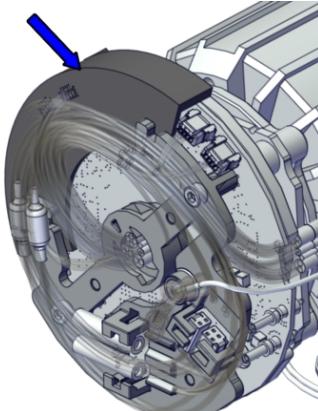
Action	Note
<p>2 Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2000002140
<p>3 Put the cabling at the slot in order not to squeeze it during removal of joint unit.</p>	 xx2100000284
<p>4 Fit two guide pins to the axis-5 joint unit.</p>	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2100000332
<p>5 Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.</p>	 xx2100000333
<p>6 Press the joint unit out of position using two of the previous attachment screws as removal tools.</p>	 xx2100000334

Continues on next page

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Action	Note
7 Remove the joint unit from the tubular. ! CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002141
8 Remove the lifting aid and guide pins.	 xx2000001957

Removing the joint cable

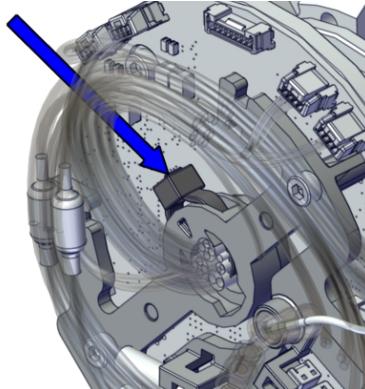
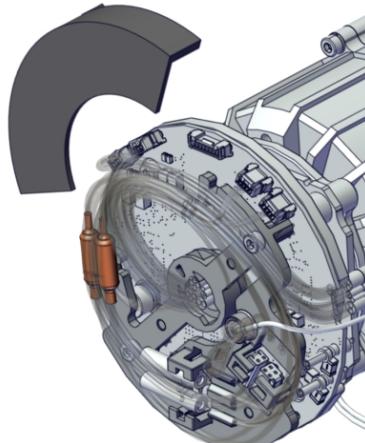
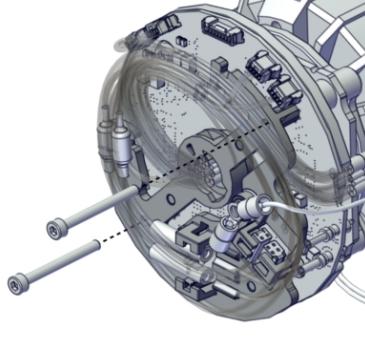
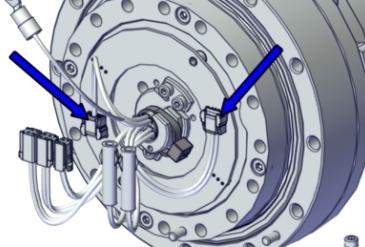
Action	Note
1 ! ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2 Fit the protection plate to the drive board unit. ! Tip Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001  xx2000002057

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5 Repair

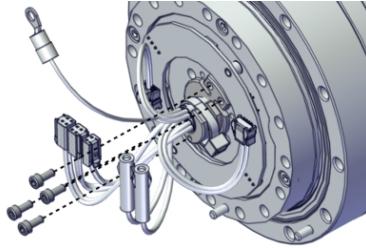
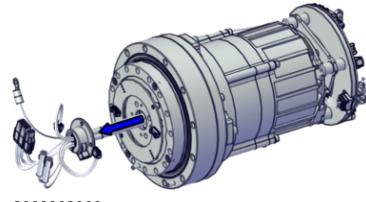
5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

	Action	Note
3	Cut the cable tie at the drive board.	 xx2000002058
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. • TQ.A • TQ.B	 xx2000002053

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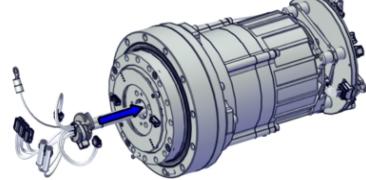
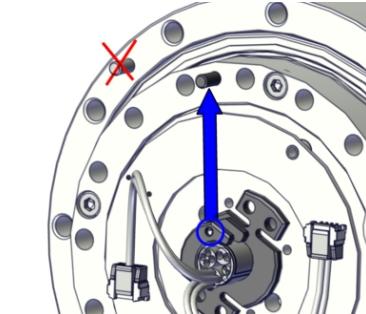
5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Action	Note
7 Remove the cable plate by removing the attachment screws.	
8 Remove the joint cable from the hollow shaft from the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	

Refitting the joint unit and transition cabling

Use these procedures to refit the joint unit and transition cabling.

Refitting the axis-5 joint unit cable

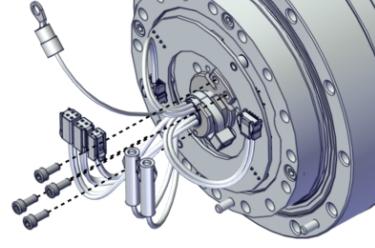
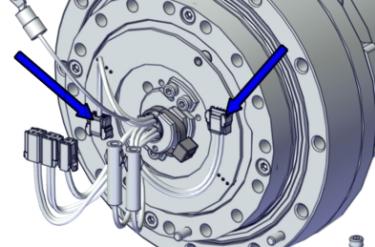
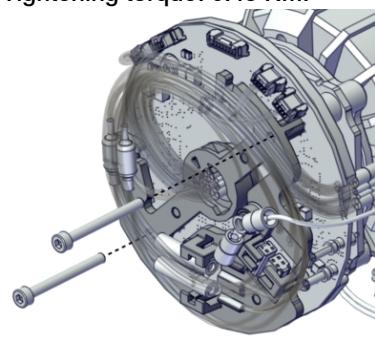
Action	Note
1  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	
2 Place the joint cable through the hollow shaft from the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	
3 Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.	

Continues on next page

5 Repair

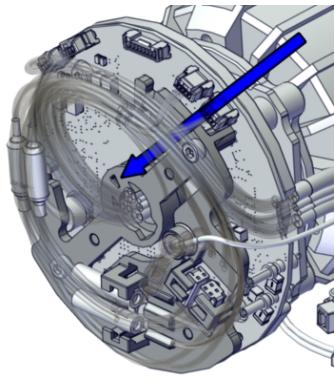
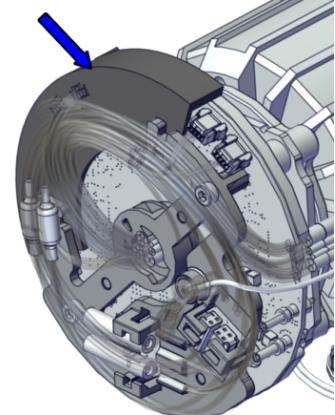
5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	<p>Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002049</p>
5	<p>Connect the two connectors to the torque sensor board.</p> <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 <p>xx2000002053</p>
6	Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 <p>xx2000002056</p> <p>Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.</p>  <p>xx2000002055</p>

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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

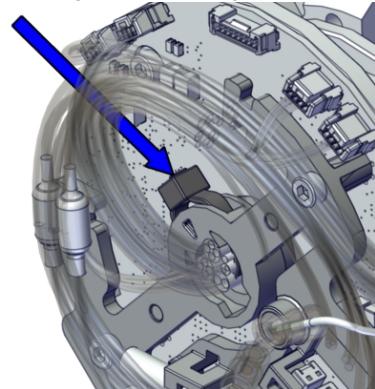
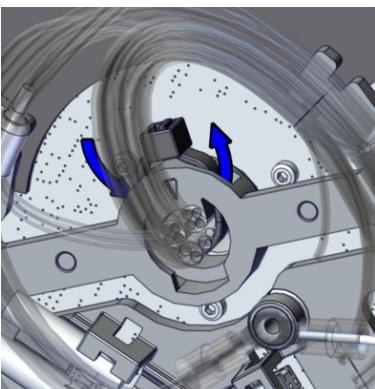
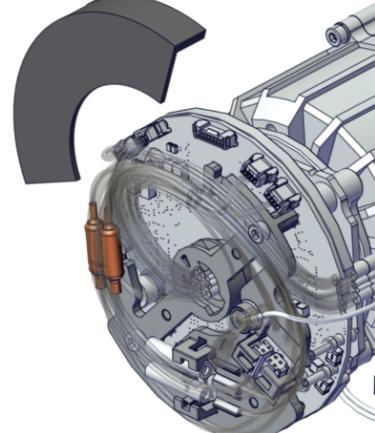
	Action	Note
7	<p>Keep the cabling loose, making sure not to twist or strain it.</p> <p>Use the cable tie to pre-fix the cable by hand.</p>	 xx2100000507
8	Fit the protection plate to the drive board unit.	<p>Protection plate: 3HAC077790-001</p>  xx2000002057

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5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

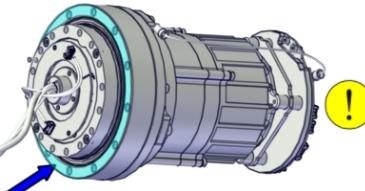
Continued

	Action	Note
9	<p>Secure the cables to the cable support with a cable tie, using a cable tie gun.</p> <p>Assembly direction for the cable tie is shown in the figure.</p>	<p>Cable tie: 3HAC075545-001. For securing joint unit cable.</p> <p>Cable tie gun EVO7</p> <p>Setting for cable tie gun: 6.75.</p>  <p>xx2000002058</p>  <p>xx2000002059</p>
10	Remove the protection plate.	 <p>xx2100000301</p>

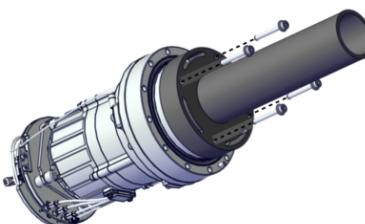
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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Preparations before fitting the joint unit

	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i> .	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>The unit is sensitive to ESD on page 44</i> .	

Refitting the axis-5 joint unit and transition cabling

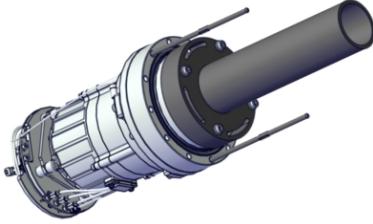
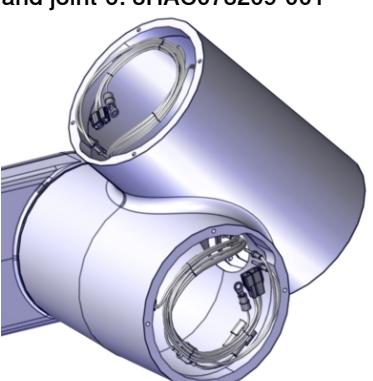
	Action	Note
1	 CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079143-001 Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957

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5 Repair

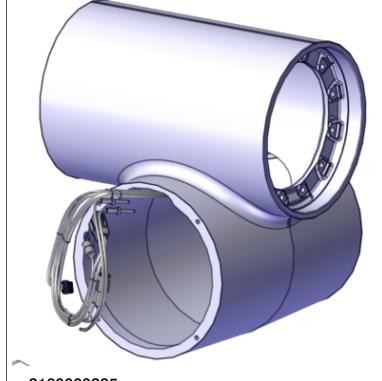
5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

	Action	Note
2	Fit two guide pins to the joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  <p>xx2000002438</p>
3	Fit the transition cable between axis-5 and axis-6 joint units into the tilt.	<p>Cable harness, transition joint-5 and joint-6: 3HAC073209-001</p>  <p>xx2100000040</p>

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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

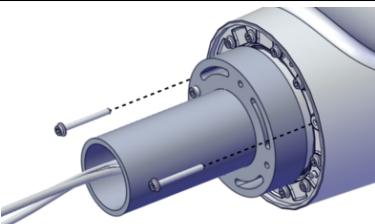
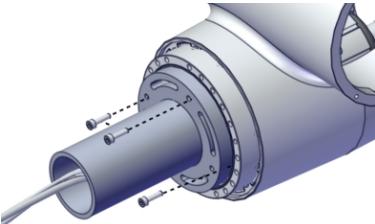
Action	Note
4 Place the cabling at the slot before refitting the joint unit.	 xx210000041
5 Fit the joint unit to the tilt, aligning the pin with the pin hole.	 xx2100000285
6 Secure the joint unit with new attachment screws.	CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.

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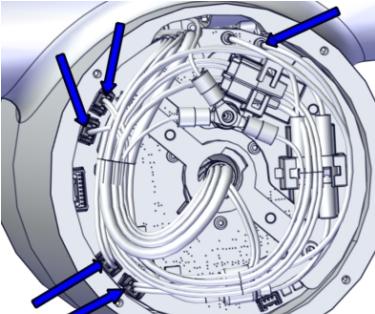
5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

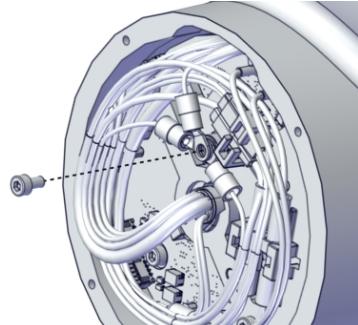
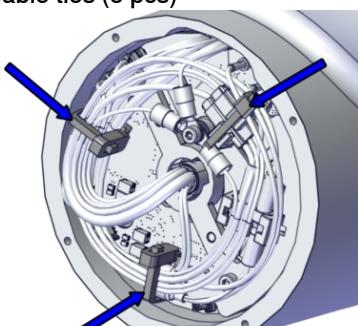
Action	Note
7 Remove the guide pins and secure the remaining two attachment screws.	 xx2000002140
8 Pre-tighten the screws crosswise.	
9 Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm.
10 Remove the lifting aid by removing the screws.	 xx2000002139
11 Clean pushed-out flange sealant, if any.	

Connecting the axis-5 joint unit cabling

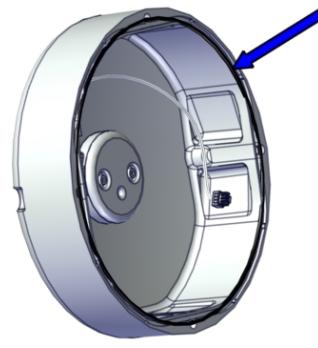
Action	Note
1 Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D4/5.X1 to X1 • D5.DC+ to +DC • D5.DC- to Ground • D4/5.X4 to X4 • D5/4.X2 to X2 • D4/5.X5 to X5 	 xx2000002138
2 Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J5/6.DC+ to J6.DC+ • J5/6.DC- to J6.DC- • J5/6.CS to J6.CS • J5/6.CP to J6.CP 	 xx2000002137

Continues on next page

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Action	Note
3 Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002136
4 Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002135

Refitting the axis-5 cover

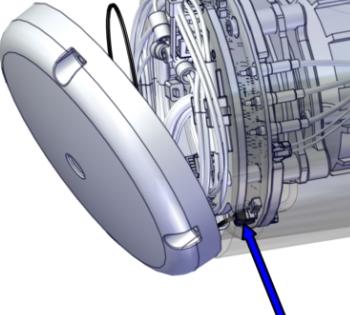
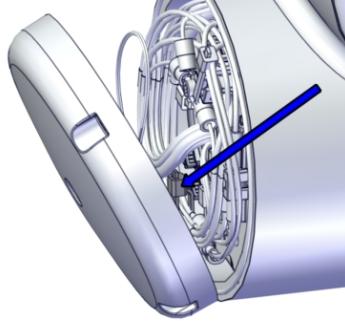
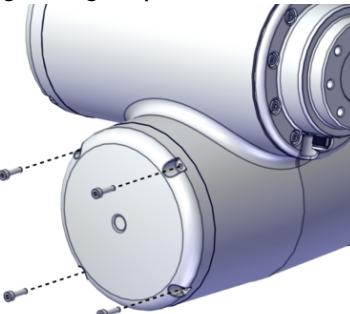
Action	Note
1 Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000001962

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5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

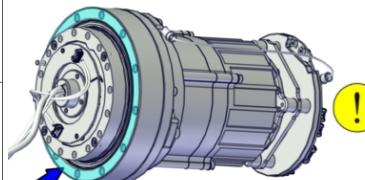
	Action	Note
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	 xx2000002134
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000002133
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.2 Nm  xx2000002132

Preparations before fitting the joint unit

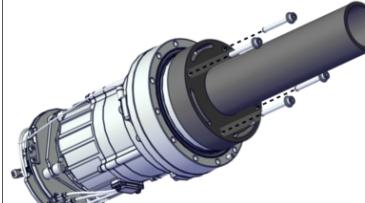
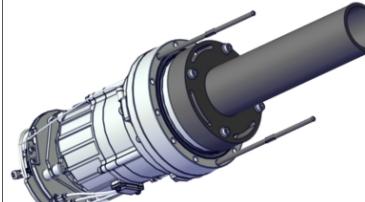
	Action	Note
1	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section The unit is sensitive to ESD on page 44 .	

Continues on next page

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Action	Note
2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000001860
3 Apply a thin layer of flange sealant to the mounting surface. Do not contaminate the radial sealing with sealant.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	

Refitting the axis-6 joint unit

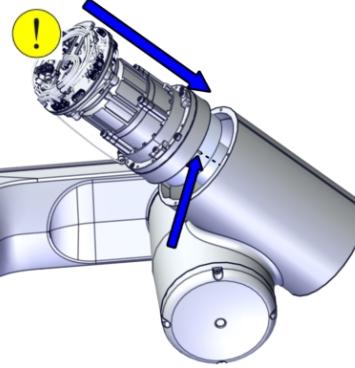
Action	Note
1 Fit the lifting aid to the joint unit.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079143-001 Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
2 Fit two guide pins to the joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2000002438

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5 Repair

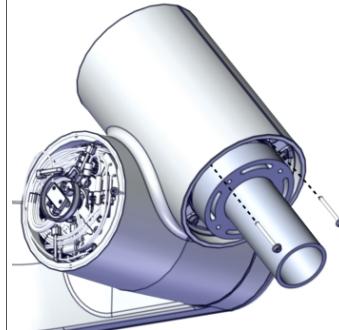
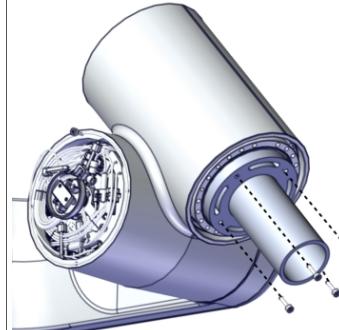
5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

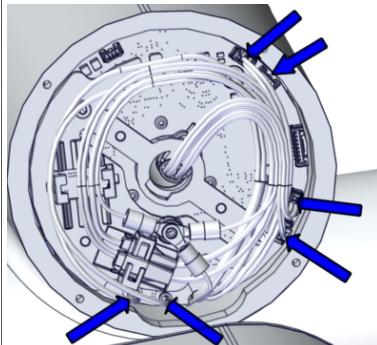
Action	Note
3 Place the cabling at the slot before refitting the joint unit.	 xx2100000041
4 Fit the joint unit to the tilt, aligning the pin with the pin hole. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002195
5 Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000329

Continues on next page

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

	Action	Note
6	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002170
7	Pre-tighten the screws crosswise.	
8	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm.
9	Remove the lifting aid by removing the screws.	 xx2000002168
10	Clean pushed-out flange sealant, if any.	

Connecting the axis-6 joint unit cabling

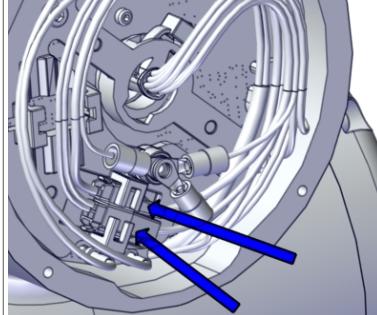
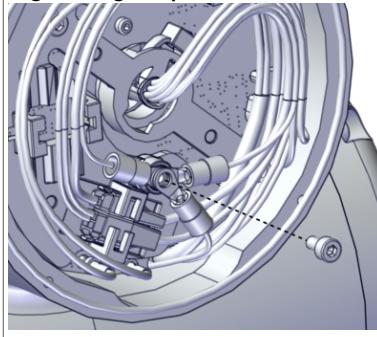
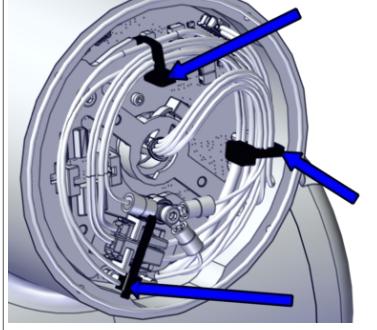
	Action	Note
1	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D6.X1 to X1 • D6.DC+ to +DC • D6.DC- to Ground • D6.X4 to X4 • D6.X2 to X2 • D6.X5 to X5 	 xx2000002164

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5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

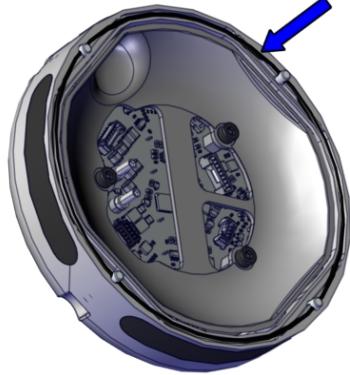
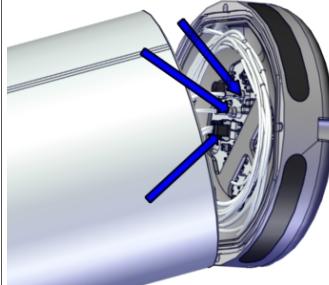
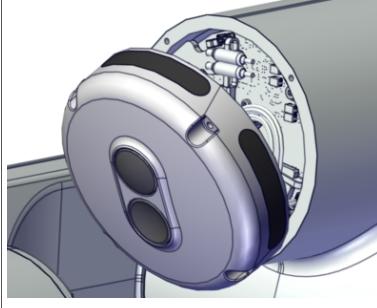
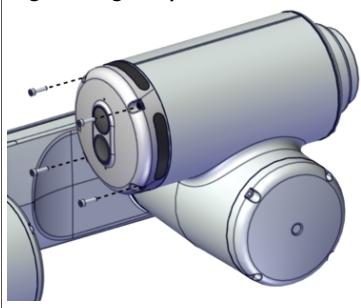
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	Action	Note
2	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J7.CS to J7.CS • J7.CP to J7.CP 	 xx2000002163
3	<p>Secure the cables for functional earth and protective earth with a screw.</p>	<p>Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.</p>  xx2000002162
4	<p>Secure the cabling with cable ties.</p>	<p>Cable ties (3 pcs)</p>  xx2000002161

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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Refitting the arm-side interface

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002551
2	Place the arm-side interface at mounting position and reconnect the connectors. <ul style="list-style-type: none"> • ASI.DC+ • ASI.DC- • ASI.X1 <p>The correct orientation of the arm-side interface is with the convex button in upper position.</p> <p> Note</p> <p>Do not leave the arm-side interface in location without being secured with the attachment screws.</p>	 xx2100000335  xx2100000336
3	Refit the arm-side interface with four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002550

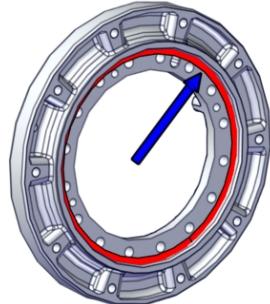
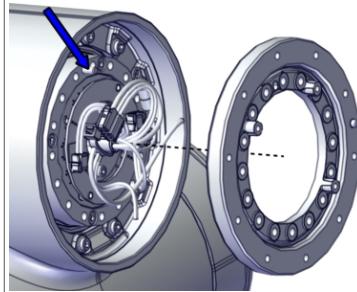
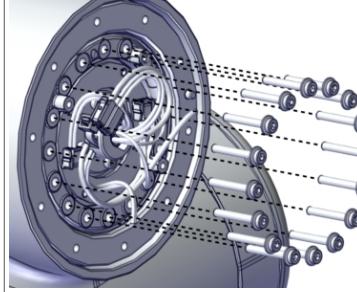
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5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

Refitting the tool flange adapter

	Action	Note
1	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the adapter mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574  xx2000002196
2	Refit the tool flange adapter, aligning the pin with the pin hole.	Axis-6 inner flange: 3HAC073952-001  xx2000002167
3	Secure with screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) Tightening torque: 1.8 Nm.  xx2000002165

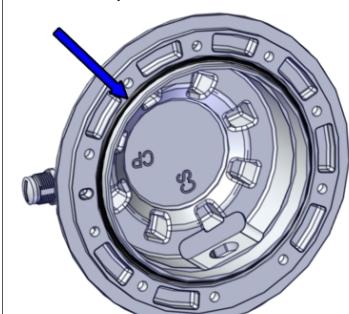
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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Connecting the tool flange functional earth cable

	Action	Note
1	Secure the cable for functional earth to the tool flange adapter with a screw.	 xx2000002159

Refitting the tool flange

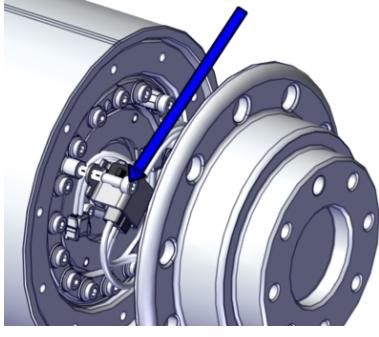
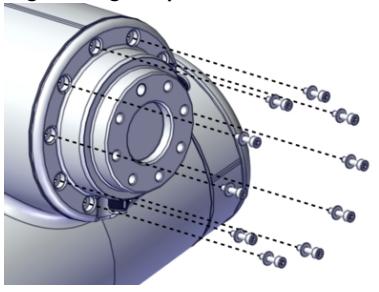
	Action	Note
1	Check the o-ring on the tool flange and lubricate with grease. Replace if damaged.	Axis-6 flange: 3HAC073953-001 O-ring: 3HAB3772-182 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002197
2	Place the tool flange at mounting position and reconnect the CP/CS connectors.	 xx2000002158

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5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

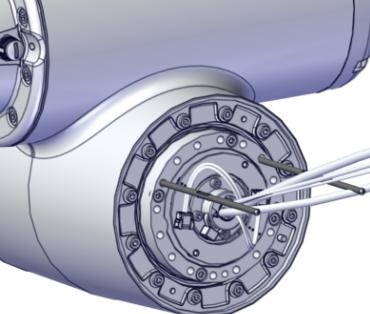
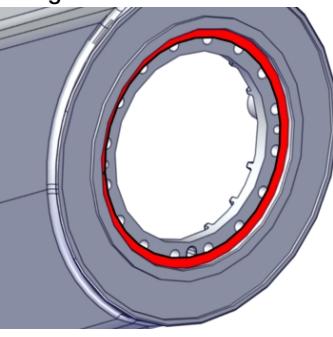
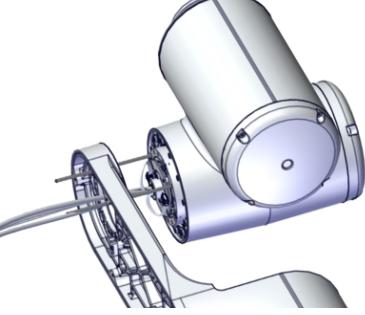
Continued

Action	Note
3 Fit the connectors to the cable bracket and secure the connectors with two cable ties.	<p>Cable ties (2 pcs)</p>  <p>xx2000002157</p>
4 Refit the cable bracket with the screw.	<p>Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (1 pcs) Tightening torque: 0.8 Nm.</p>  <p>xx2000002156</p>
5 Refit and secure the tool flange with screws and washers.	<p>Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (10 pcs) Spring washer: 7x3.2x0.6 Steel (10 pcs) Tightening torque: 1.8 Nm.</p>  <p>xx2000002155</p>

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5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Refitting the tilt

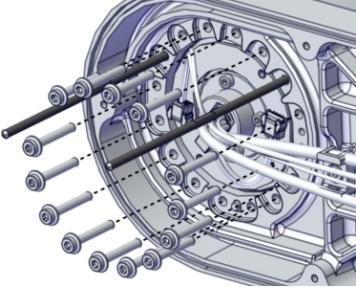
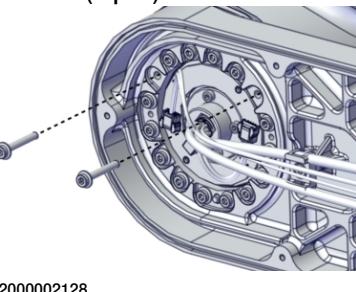
	Action	Note
1	Fit two guide pins to the axis-5 joint.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.</p>  <p>xx2000002146</p>
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the tubular mounting surface, as pointed out in the figure.	<p>Cleaning agent: Isopropanol Flange sealant: Loctite 574</p>  <p>xx2000002147</p>
3	Lift the tilt into mounting position while inserting the cabling into the tubular.	
4	Slide the tilt into place on the guide pins.	 <p>xx2000002131</p>

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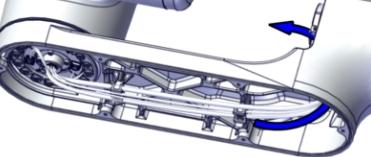
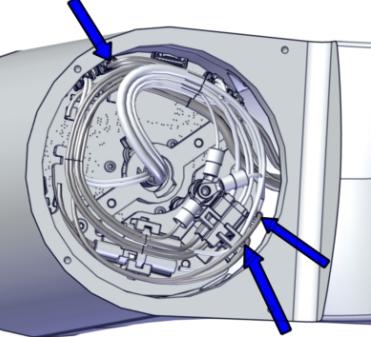
5 Repair

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

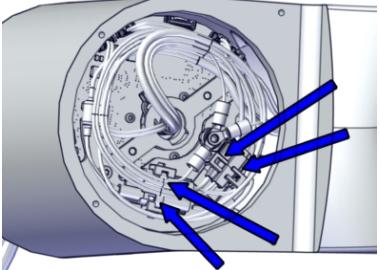
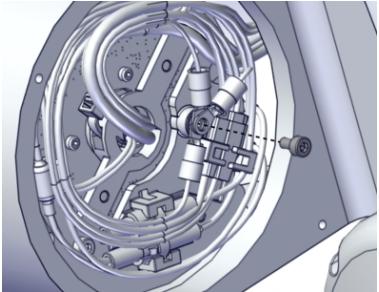
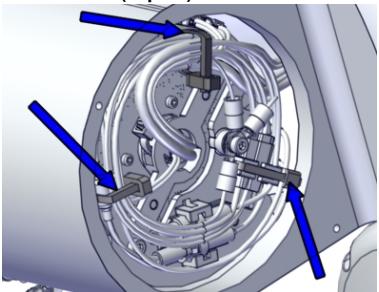
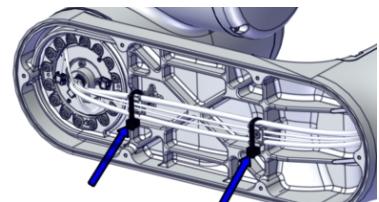
Action	Note
5 Secure the tilt to the tubular with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (14 pcs)  xx2000002130
6 Remove the guide pins and fasten the remaining two screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (2 pcs)  xx2000002128
7 Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.

Connecting the tilt cabling

Action	Note
1 Insert the cabling into the tubular.	 xx2000002148
2 Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D3/4.X2 to X2 • D3/4.DC- to Ground • D3/4.DC+ to +DC 	 xx2000002125

Continues on next page

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

	Action	Note
3	<p>Connect the connectors to each other and snap them to the cable holders.</p> <ul style="list-style-type: none"> • J4/5.DC+ to J5/6.DC+ • J4/5.DC- to J5/6.DC- • J4/5.CS to J5/6.CS • J4/5.CP to J5/6.CP 	 xx2000002089
4	<p>Secure the cables for functional earth and protective earth with a screw.</p>	<p>Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.</p>  xx2000002087
5	<p>Secure the cabling with cable ties.</p>	<p>Cable ties (3 pcs)</p>  xx2000002086  xx2000002124

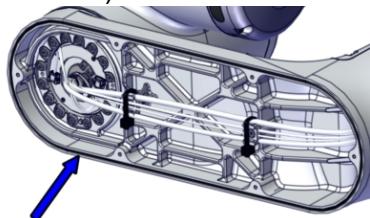
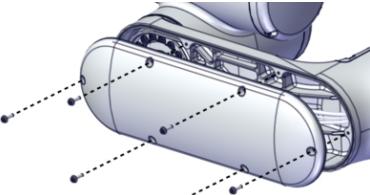
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5 Repair

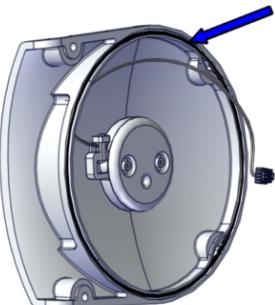
5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

Refitting the tubular cover

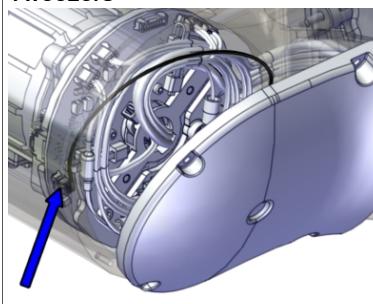
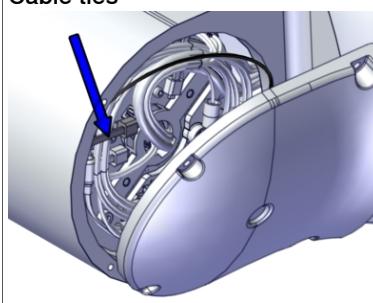
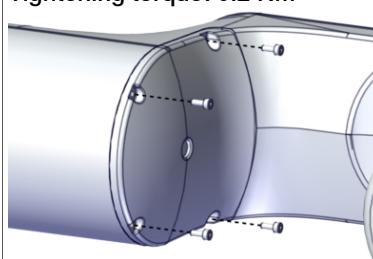
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-043 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002149
2	Refit the cover with new attachment screws.	Flange socket head screw with glue: 3HAB3413-312 M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included. Tightening torque: 1.6 Nm.  xx2000002123

Refitting the axis-4 cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002092

Continues on next page

5.6.5 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

	Action	Note
2	Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	Tweezers  xx2000002085
3	Secure the brake release cable with a cable tie.	Cable ties  xx2000002084
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.2 Nm  xx2000002083

Concluding procedure

	Action	Note
1	Calibrate the joint unit torque sensor.	See Calibration on page 719
2	 DANGER Make sure all safety requirements are met when performing the first test run.	

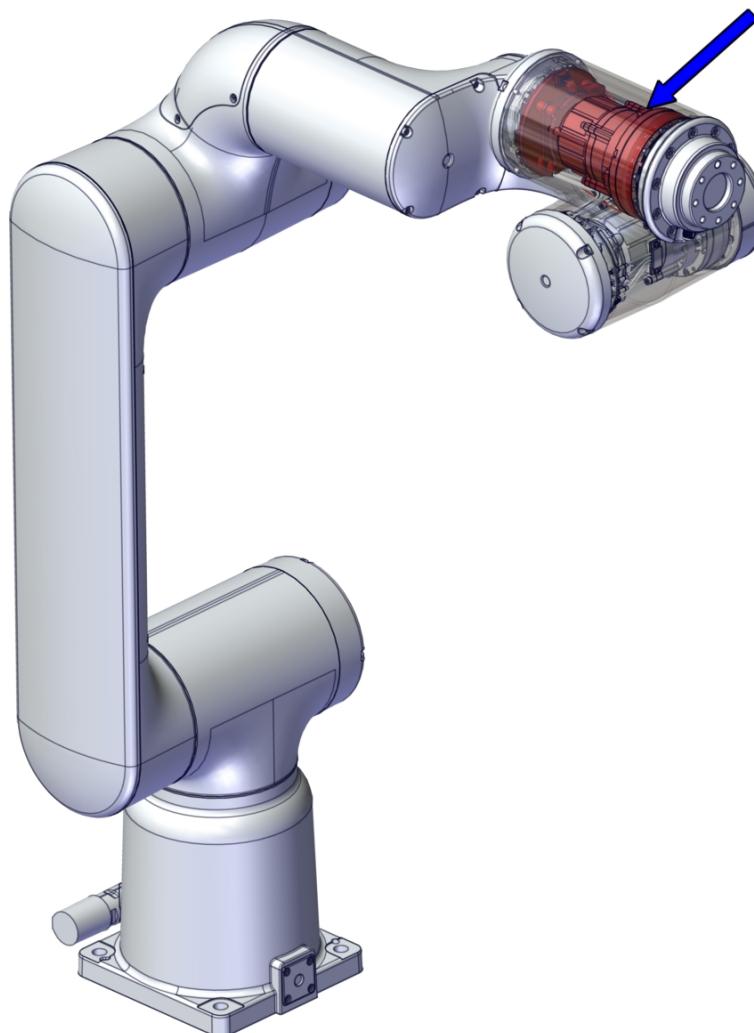
5 Repair

5.6.6 Replacing the axis-6 joint unit

5.6.6 Replacing the axis-6 joint unit

Location of the axis-6 joint unit

The joint unit is located as shown in the figure.



xx2000002122

Summary of the replacement procedure

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

- 1 Remove the tool flange.
- 2 Remove the tool flange adapter.
- 3 Remove the axis-6 cover.
- 4 Replace the joint unit. Move the cabling from old to new joint unit.

Continues on next page

Required spare parts**Note**

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Joint unit	3HAC079143-001	New attachment screws and cable tie 3HAC075545-001 are included in the delivery.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077789-001	For joint units on axes 4, 5 and 6. Attachment screws M3x12 (4 pcs) are enclosed.
Guide pin, M3x110	3HAC077787-001	Always use guide pins in pairs. For joint units on axes 4, 5 and 6.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint unit.
Cable tie gun EVO7	-	HellermannTyton 110-70084 or similar
Tweezers	-	Used to handle drive board connectors.
Standard toolkit	-	Content is defined in section Standard toolkit on page 749 .

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574
Grease	3HAC042536-001	Shell Gadus S2
O-ring	3HAB3772-182	Tool flange
O-ring	3HAC061327-051	Arm-side interface Replace if damaged.
Cable ties	-	

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5 Repair

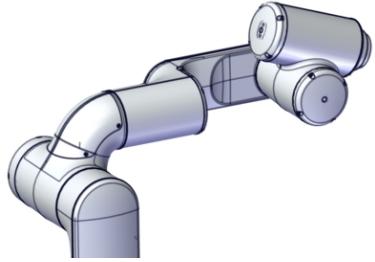
5.6.6 Replacing the axis-6 joint unit

Continued

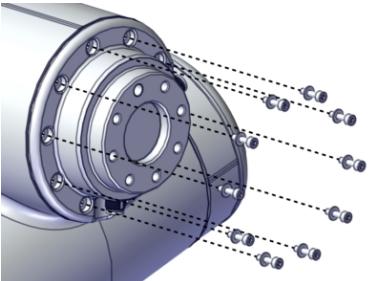
Removing the joint unit

Use these procedures to remove the joint unit.

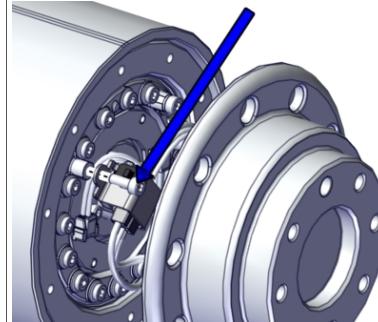
Preparations before removing the joint unit

Action	Note
<p>1 Jog the robot to the specified position:</p> <ul style="list-style-type: none">• Axis 1: No significance.• Axis 2: No significance.• Axis 3: No significance.• Axis 4: No significance.• Axis 5: approximately +20°• Axis 6: 0° (home position) <p>! CAUTION</p> <p>Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.</p>	 xx2100000043
<p>2 ! CAUTION</p> <p>Turn off all supplies for electrical power to the robot, before starting the repair work.</p>	

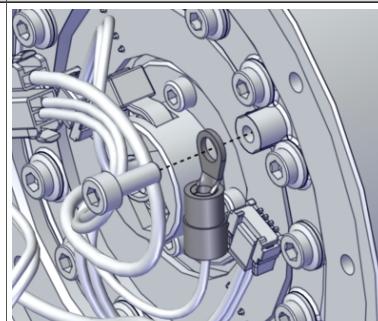
Removing the tool flange

Action	Note
<p>1 Remove the tool flange screws and washers.</p>	 xx2000002155
<p>2 ! CAUTION</p> <p>There is cabling connected between the cover and the joint unit drive board.</p> <p>Open the cover with care to avoid damage to the cabling or the connector(s).</p> <p>Do not leave the cover in location without being secured with the attachment screws.</p>	

Continues on next page

Action	Note
3 Loosen the tool flange and remove the cable bracket by removing the screw.	 xx2000002156
4 Cut the cable ties.	 xx2000002157
5 Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

Disconnecting the tool flange functional earth cable

Action	Note
1 Remove the functional earth cable by removing the screw.	 xx2000002159

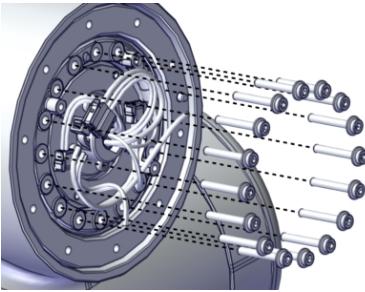
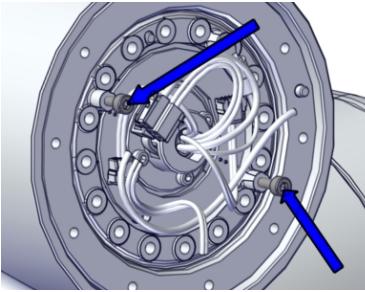
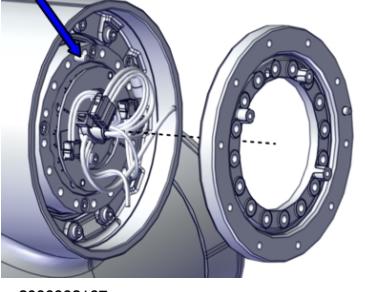
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5 Repair

5.6.6 Replacing the axis-6 joint unit

Continued

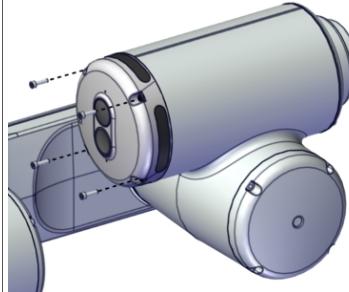
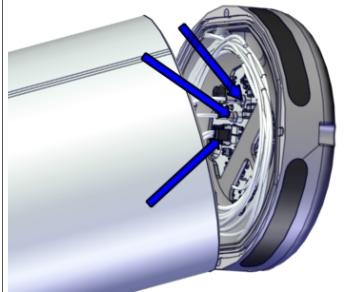
Removing the tool flange adapter

	Action	Note
1	Remove the tool flange adapter screws.	 xx2000002165
2	Press the adapter out of position by using two of the attachment screws as removal tools.	 xx2000002166
3	Remove the tool flange adapter.	 xx2000002167

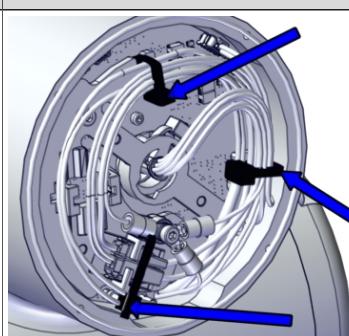
Removing the arm-side interface

	Action	Note
1	 CAUTION Make sure that all supplies for electrical power are turned off.	
2	 CAUTION There is cabling connected between the arm-side interface and the joint unit drive board. Open the arm-side interface with care to avoid damage to the cabling or the connector(s). Do not leave the arm-side interface in location without being secured with the attachment screws.	

Continues on next page

	Action	Note
3	Remove the attachment screws.	 xx2000002550
4	Loosen the arm-side interface carefully and disconnect the connectors from it. <ul style="list-style-type: none"> • ASI.DC+ • ASI.DC- • ASI.X1 	 xx2100000335

Disconnecting the axis-6 joint unit cabling

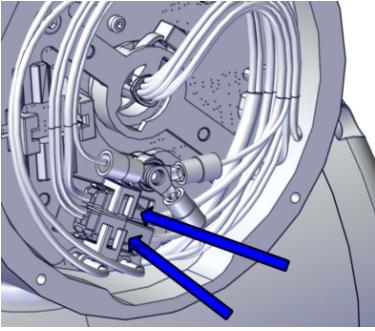
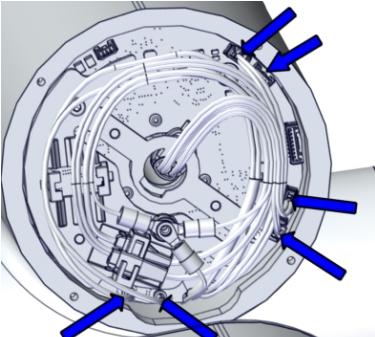
	Action	Note
1	Cut the cable ties.	 xx2000002161
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002162

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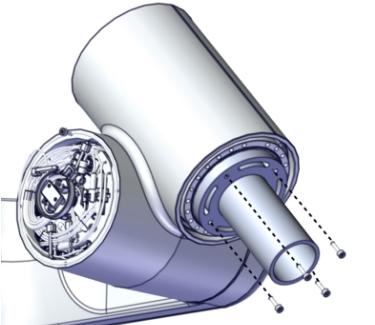
5 Repair

5.6.6 Replacing the axis-6 joint unit

Continued

Action	Note
3 Snap loose and disconnect the connectors: • J7.CS • J7.CP	 xx2000002163
4 Disconnect the connectors from the drive board. • D6.X1 • D6.DC+ • D6.DC- • D6.X4 • D6.X2 • D6.X5	Tweezers  xx2000002164

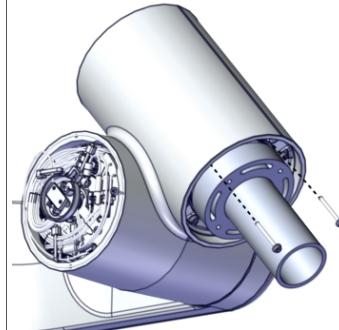
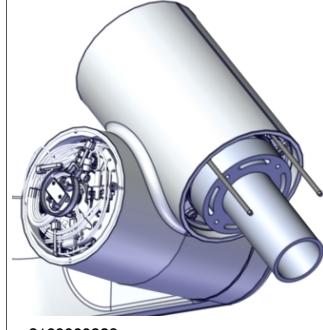
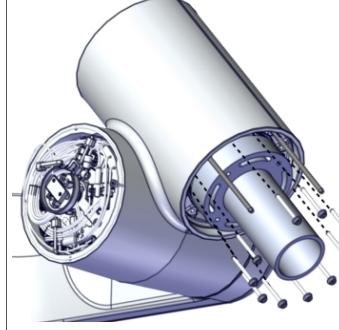
Removing the axis-6 joint unit

Action	Note
1 Fit the lifting aid to the joint unit, on the torque sensor side.  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002168 Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.

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5.6.6 Replacing the axis-6 joint unit

Continued

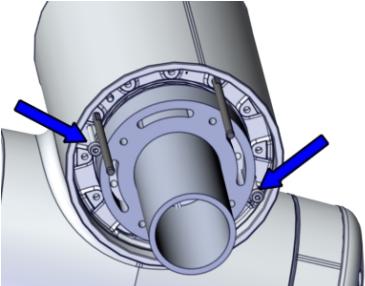
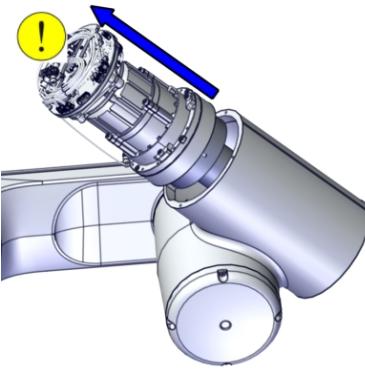
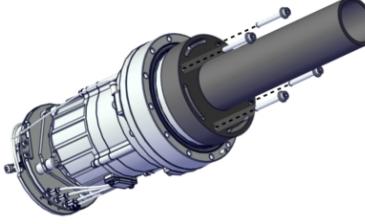
Action	Note
2 Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2000002170 Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.
3 Fit two guide pins to the axis-6 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2100000328
4 Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000329

Continues on next page

5 Repair

5.6.6 Replacing the axis-6 joint unit

Continued

Action	Note
5 Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2100000330
6 Remove the joint unit from the tubular. CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002169 <p>Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.</p>
7 Remove the lifting aid and guide pins.	 xx2000001957

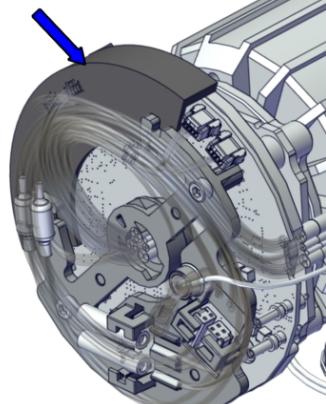
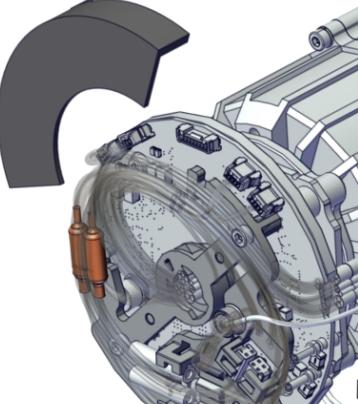
Removing the joint cable

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 44 .	

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5.6.6 Replacing the axis-6 joint unit

Continued

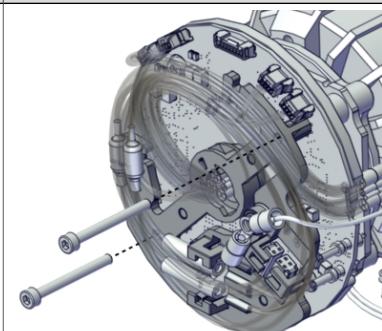
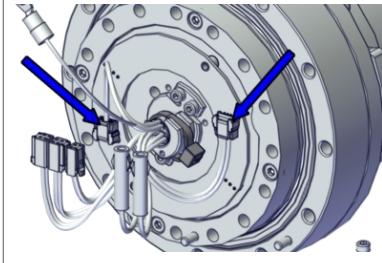
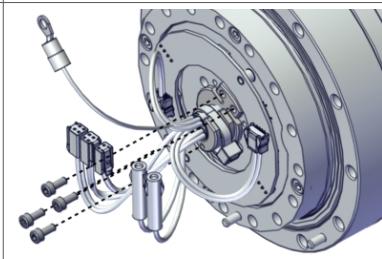
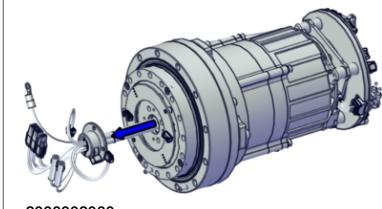
	Action	Note
2	<p>Fit the protection plate to the drive board unit.</p> <p> Tip</p> <p>Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.</p>	<p>Protection plate: 3HAC077790-001</p>  <p>xx2000002057</p>
3	Cut the cable tie at the drive board.	 <p>xx2000002058</p>
4	Remove the protection plate.	 <p>xx2100000301</p>

Continues on next page

5 Repair

5.6.6 Replacing the axis-6 joint unit

Continued

Action	Note
5 Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6 Disconnect the two connectors from the torque sensor board. <ul style="list-style-type: none"> • TQ.A • TQ.B 	 xx2000002053
7 Remove the cable plate by removing the attachment screws.	 xx2000002049
8 Remove the joint cable from the hollow shaft from the torque sensor side.	 xx2000002060

Refitting the joint unit

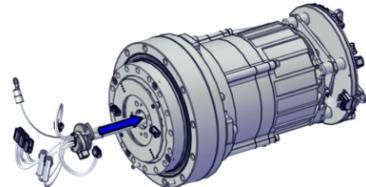
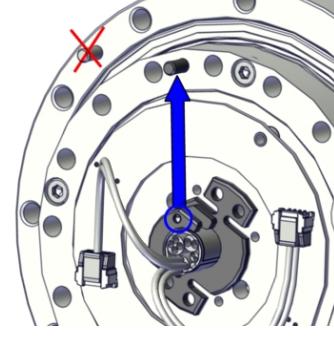
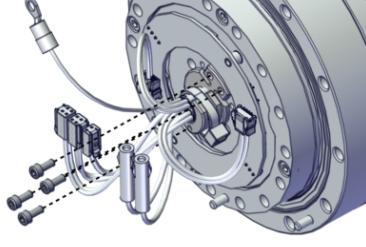
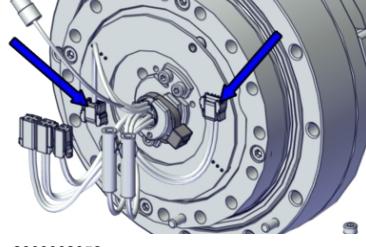
Use these procedures to refit the joint unit.

Refitting the joint cable

Action	Note
 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 44 .	

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5.6.6 Replacing the axis-6 joint unit
Continued

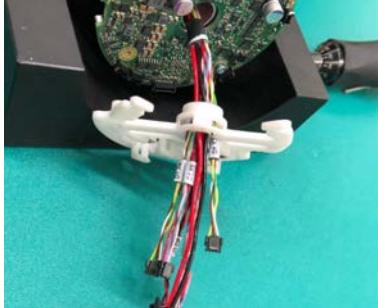
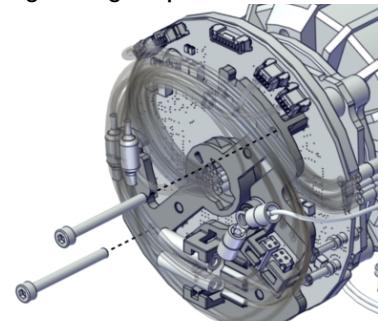
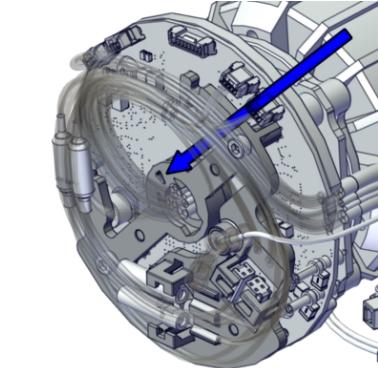
	Action	Note
2	<p>Place the joint cable through the hollow shaft from the torque sensor side.</p> <p>CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 xx2000002048
3	<p>Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.</p>	 xx2000002051
4	<p>Secure the cable plate to the joint unit with the attachment screws.</p>	<p>Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs)</p> <p>Tightening torque: 0.45 Nm.</p>  xx2000002049
5	<p>Connect the two connectors to the torque sensor board.</p> <ul style="list-style-type: none"> • TQ.A to CH1/A • TQ.B to CH2/B 	 xx2000002053

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5 Repair

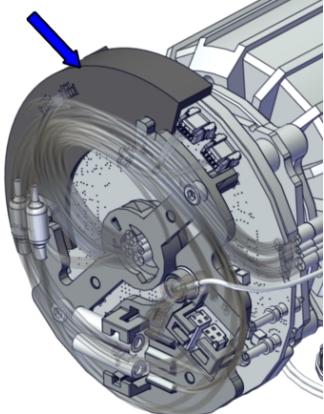
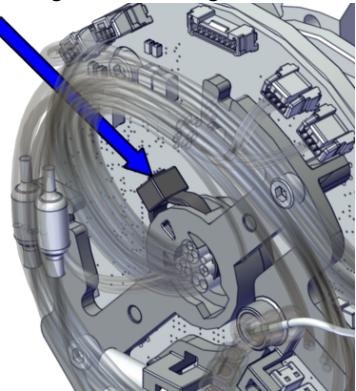
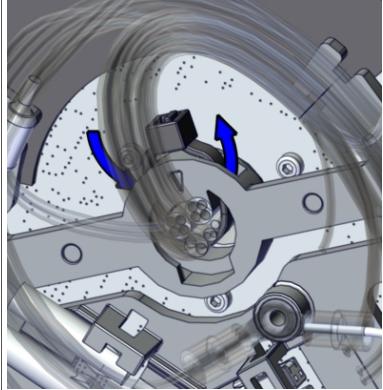
5.6.6 Replacing the axis-6 joint unit

Continued

	Action	Note
6	Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 xx2000002056 Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.  xx2000002055
7	Keep the cabling loose, making sure not to twist or strain it. Use the cable tie to pre-fix the cable by hand.	 xx2100000507

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5.6.6 Replacing the axis-6 joint unit
Continued

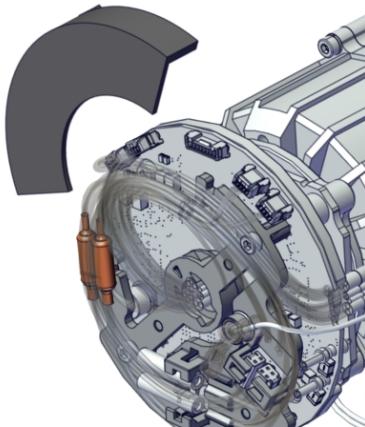
	Action	Note
8	Fit the protection plate to the drive board unit.	<p>Protection plate: 3HAC077790-001</p>  <p>xx2000002057</p>
9	<p>Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.</p>	<p>Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO7 Setting for cable tie gun: 6.75.</p>  <p>xx2000002058</p>  <p>xx2000002059</p>

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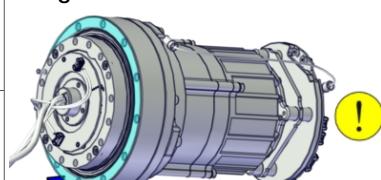
5 Repair

5.6.6 Replacing the axis-6 joint unit

Continued

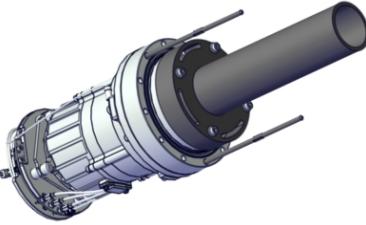
Action	Note
10 Remove the protection plate.	 xx2100000301

Preparations before fitting the joint 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 44 .	
2 Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574
3  CAUTION The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  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 44 .	 xx2000001860

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Refitting the axis-6 joint unit

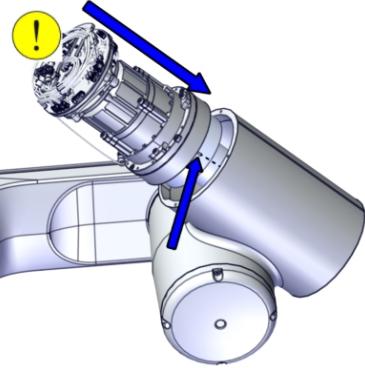
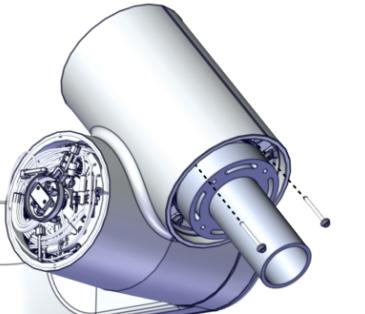
	Action	Note
1	<p>Fit the lifting aid to the joint unit.</p> <p> CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	<p>Joint unit: 3HAC079143-001 Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)</p>  <p>xx2000001957</p>
2	Fit two guide pins to the joint unit.	<p>Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.</p>  <p>xx2000002438</p>
3	Place the cabling at the slot before refitting the joint unit.	 <p>xx2100000041</p>

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5 Repair

5.6.6 Replacing the axis-6 joint unit

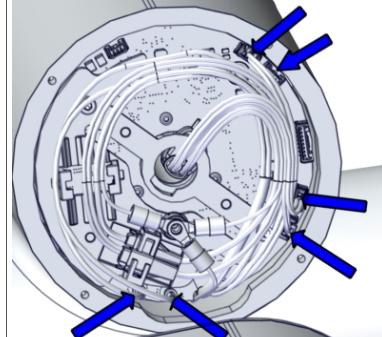
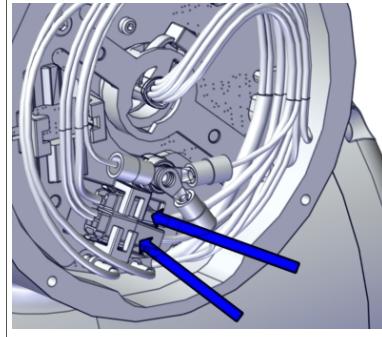
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	Action	Note
4	<p>Fit the joint unit to the tilt, aligning the pin with the pin hole.</p> <p> CAUTION</p> <p>The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.</p>	 <p>xx2000002195</p>
5	Secure the joint unit with new attachment screws.	<p>Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs</p> <p>Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.</p>  <p>xx2100000329</p>
6	Remove the guide pins and secure the remaining two attachment screws.	 <p>xx2000002170</p>
7	Pre-tighten the screws crosswise.	
8	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm.

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	Action	Note
9	Remove the lifting aid by removing the screws.	 xx2000002168
10	Clean pushed-out flange sealant, if any.	

Connecting the axis-6 joint unit cabling

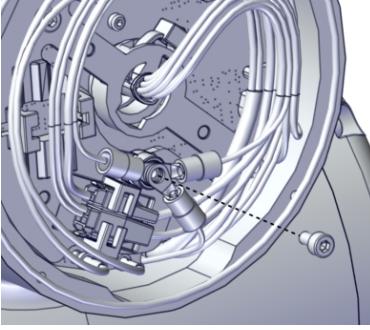
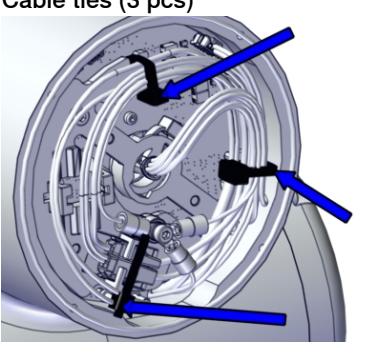
	Action	Note
1	Reconnect the connectors to the drive board. <ul style="list-style-type: none"> • D6.X1 to X1 • D6.DC+ to +DC • D6.DC- to Ground • D6.X4 to X4 • D6.X2 to X2 • D6.X5 to X5 	 xx2000002164
2	Connect the connectors to each other and snap them to the cable holders. <ul style="list-style-type: none"> • J7.CS to J7.CS • J7.CP to J7.CP 	 xx2000002163

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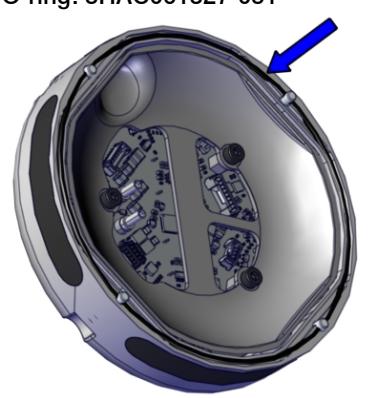
5 Repair

5.6.6 Replacing the axis-6 joint unit

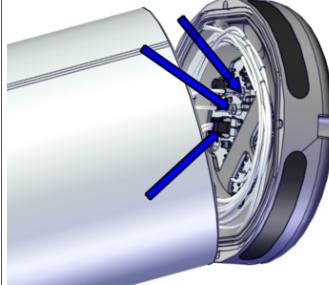
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Action	Note
3 Secure the cables for functional earth and protective earth with a screw.	<p>Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.</p>  <p>xx2000002162</p>
4 Secure the cabling with cable ties.	<p>Cable ties (3 pcs)</p>  <p>xx2000002161</p>

Refitting the arm-side interface

Action	Note
1 Fit the o-ring to its groove. Replace if damaged.	<p>O-ring: 3HAC061327-051</p>  <p>xx2000002551</p>

Continues on next page

	Action	Note
2	<p>Place the arm-side interface at mounting position and reconnect the connectors.</p> <ul style="list-style-type: none"> • ASI.DC+ • ASI.DC- • ASI.X1 <p>The correct orientation of the arm-side interface is with the convex button in upper position.</p> <p> Note</p> <p>Do not leave the arm-side interface in location without being secured with the attachment screws.</p>	 xx2100000335
3	Refit the arm-side interface with four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm

Refitting the tool flange adapter

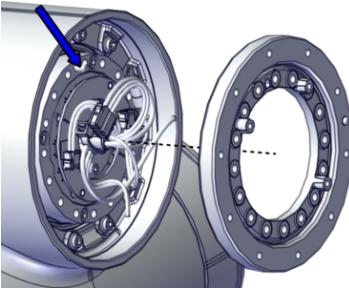
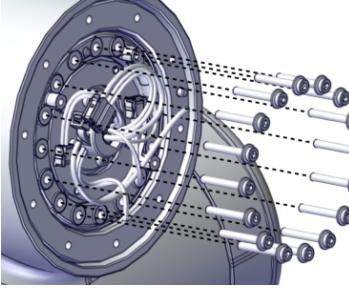
	Action	Note
1	<p>Clean the mounting surface with isopropanol.</p> <p>Apply flange sealant to the corner of the adapter mounting surface, as pointed out in the figure.</p>	Cleaning agent: Isopropanol Flange sealant: Loctite 574

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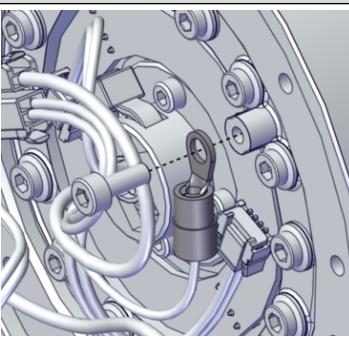
5 Repair

5.6.6 Replacing the axis-6 joint unit

Continued

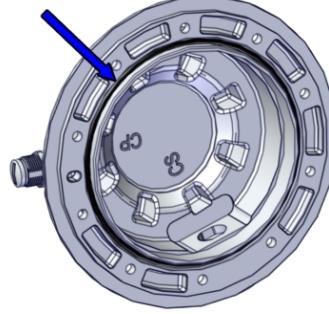
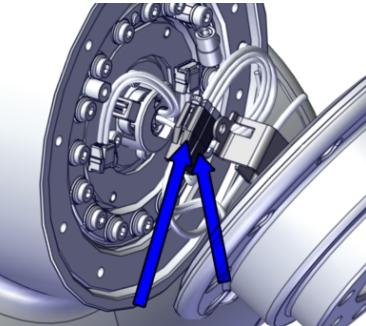
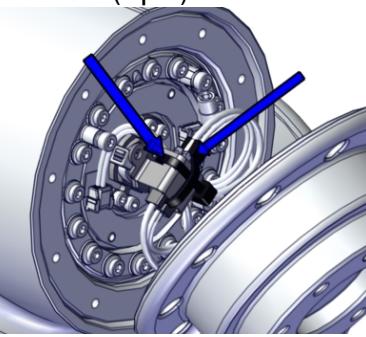
Action	Note
2 Refit the tool flange adapter, aligning the pin with the pin hole.	Axis-6 inner flange: 3HAC073952-001  xx2000002167
3 Secure with screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) Tightening torque: 1.8 Nm.  xx2000002165

Connecting the tool flange functional earth cable

Action	Note
1 Secure the cable for functional earth to the tool flange adapter with a screw.	 xx2000002159

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Refitting the tool flange

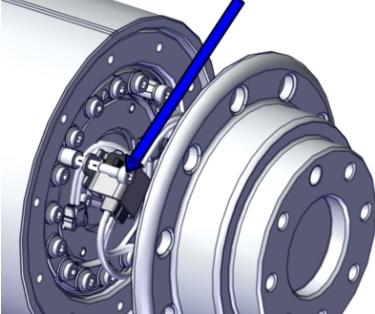
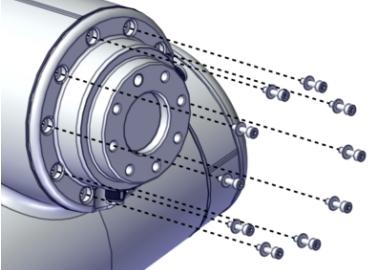
	Action	Note
1	Check the o-ring on the tool flange and lubricate with grease. Replace if damaged.	Axis-6 flange: 3HAC073953-001 O-ring: 3HAB3772-182 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002197
2	Place the tool flange at mounting position and reconnect the CP/CS connectors.	 xx2000002158
3	Fit the connectors to the cable bracket and secure the connectors with two cable ties.	Cable ties (2 pcs)  xx2000002157

Continues on next page

5 Repair

5.6.6 Replacing the axis-6 joint unit

Continued

Action	Note
4 Refit the cable bracket with the screw.	<p>Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (1 pcs) Tightening torque: 0.8 Nm.</p>  <p>xx2000002156</p>
5 Refit and secure the tool flange with screws and washers.	<p>Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (10 pcs) Spring washer: 7x3.2x0.6 Steel (10 pcs) Tightening torque: 1.8 Nm.</p>  <p>xx2000002155</p>

Concluding procedure

Action	Note
1 Calibrate the joint unit torque sensor.	See Calibration on page 719
2  DANGER Make sure all safety requirements are met when performing the first test run.	

6 Calibration

6.1 Calibration method and when to calibrate

Calibration method

The CRB 15000 torque sensors are calibrated with the routine **TorqueSensorCal** which is available in the **System Module TorqueSensorCalib**. No external calibration tools are required.

The calibration method for the robot consists of calibrating the motor torque sensors, which are installed to monitor and measure the motor torque.

When to calibrate

The torque sensor in an axis motor must be calibrated if any of the following situations occur:

- A drift in the sensor values has occurred.
This is shown on the FlexPendant as error code **90549 Torque sensor check failure** or **34334 Arm side torque sensor error**.
- A joint unit has been replaced.
- Repair work that involves removal and refitting of the joint units, has been performed.

No calibration is needed at site at robot installation.

The torque sensor routine only works on floor mounted robots.



Tip

When designing the robot cell, run the torque sensor routine in RobotStudio to verify that the path and pose are obtainable in the planned design.

6 Calibration

6.2 Calibrating the robot

6.2 Calibrating the robot

Torque sensor calibration routine

The CRB 15000 torque sensors are calibrated with the routine **TorqueSensorCal**, which is available in the **System Module TorqueSensorCalib**. No external calibration tools are required. The torque sensor calibration routine checks and calibrates the torque sensors of CRB 15000. This calibration routine must be run in manual operating mode.

The torque sensor calibration routine checks and calibrates the torque sensors for the CRB 15000.

The calibration routine must be run in manual operating mode.

Features in the routine

The routine for the torque sensor calibration includes three features:

- 1 Compare the current torque sensor offsets with measured offsets, **Torque Sensor Check**. This is useful for a quick test of the calibration.
- 2 Calibrate torque sensors when a sensor drift has occurred, **Torque Sensor Calib**.¹ This is useful, for example, if there are event log messages about a sensor drift, or if there is a drift when using lead-through.
- 3 Calibrate torque sensors when a joint unit has been exchanged, **Joint Unit Replacement**.¹ This is useful also when a joint is removed as part of replacing another part.

This feature includes the above features, that is, runs all of them.

¹ This feature is only available when user authorization (UAS) is set with user grant Safety Services.

Preparations before calibration

Remove any tools mounted on the robot, to get accurate torque offsets measurements.

Running routine **TorqueSensorCal**

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.

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



Note

If feature **Joint Unit Replacement** is to be run, put the controller in state Motors OFF and then start the calibration from the FlexPendant.

After the initial steps, a controller restart is performed and then the routine needs to be restarted again. After restart, go to Motors ON state and continue.

Continues on next page



Note

The calibration procedure must be called using **PP to Routine**, and not by using **Call Routine**.

- 1 Choose which feature to run.

The features are described in [Features in the routine on page 720](#).

Only the feature **Torque Sensor Check** is shown for users without user grant Safety Services.

The other features require a password. The default password is 14775 (can be changed by the integrator).

- 2 Choose which axis/axes to calibrate.

- 3 The robot moves to a position or positions where measurements are performed.

- 4 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not.

If the calibration data is saved, the new sensor offsets are saved in a file called `TSENS_LOG.TXT` in the `HOME` directory.

- 5 If new calibration data is saved you will be asked to do a test with the lead-through functionality active to verify that the sensors work correctly.

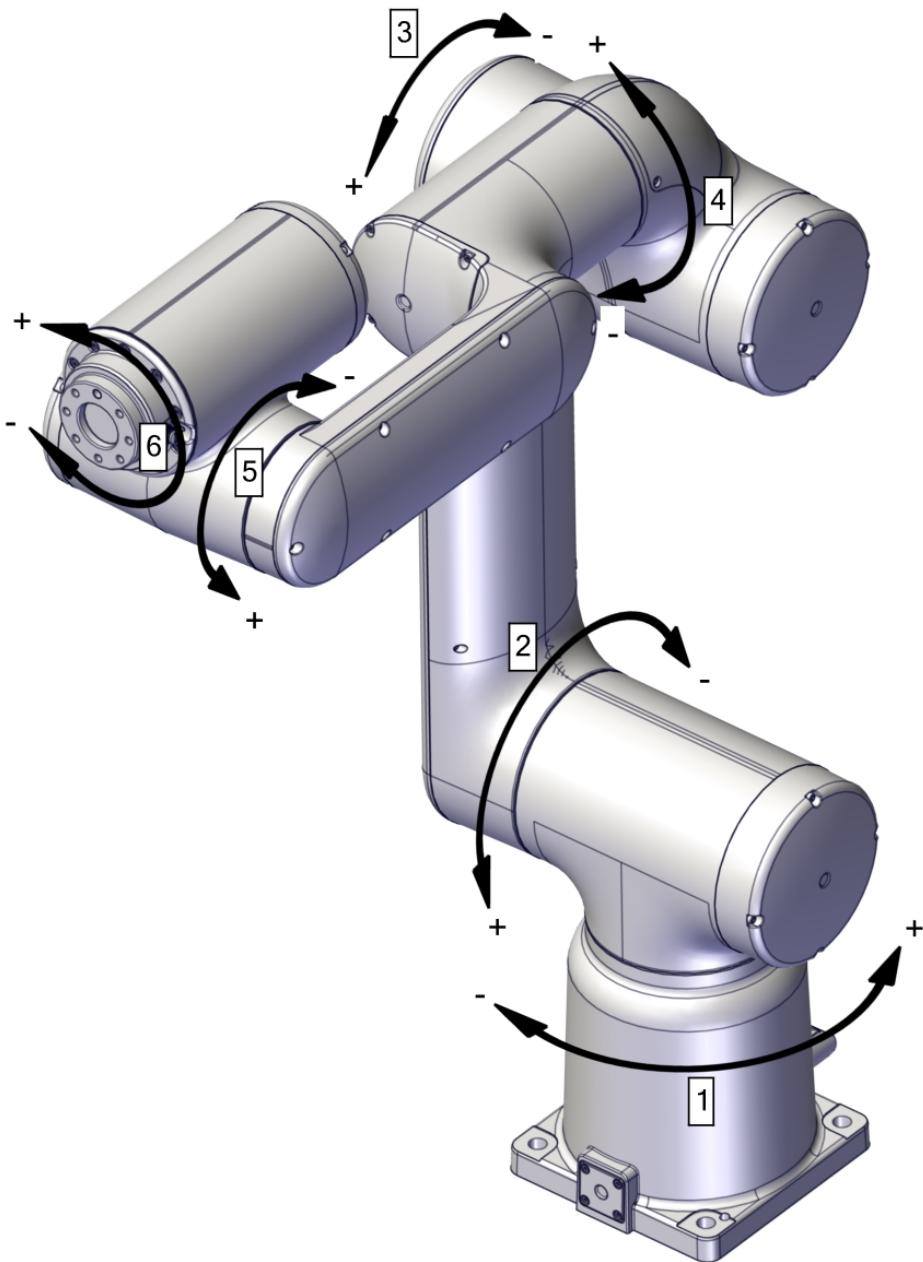
- 6 Finally the robot is moved back to the original position.

6.3 Jogging directions

6.3 Jogging directions

Illustration of axis jogging directions

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



xx2000002400

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: <ul style="list-style-type: none">• the configuration files• connectors• options and their configuration• changes in the robot working space/movements.
---------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Continues on next page

7 Troubleshooting

7.1 Introduction to troubleshooting

Continued

The robot has recently been repaired	Check: <ul style="list-style-type: none">• 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: <ul style="list-style-type: none">• 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: <ul style="list-style-type: none">• connections• software versions

7.2 Mechanical noise or dissonance

Description

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

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

Consequences

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

Possible causes

The symptom can be caused by:

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

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

- Overheating.

Recommended actions

The following actions are recommended:

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

Continues on next page

7 Troubleshooting

7.2 Mechanical noise or dissonance

Continued

	Action	Information
8	Too hot gearbox oil may be caused by: <ul style="list-style-type: none">• 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.

7.3 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. Check for any recorded fault status.

7 Troubleshooting

7.4 Brake release tool does not work

7.4 Brake release tool does not work

Description

The holding brake of a motor is not released using the brake release tool.

Consequences

The robot axis can not be manually moved.

Possible causes

The symptom can be caused by:

- Damaged magnet on the brake release tool.
- Faulty power supply to the brake.
- Incorrect usage of the brake release tool:
 - There has been an attempt to use the brake release mechanism while the robot is in mode MOTORS ON.
 - There has been an attempt to use the brake release mechanism in automatic operating mode.
 - There has been an attempt to use the brake release mechanism during the startup phase of the controller, that is, before the controller is fully operational.
 - There has been an attempt to use the brake release mechanism while the manipulator is moving.
 - There has been a very brief application of the magnet to the brake release points, for example, by accident.
- Faulty joint electronic hardware.

Recommended actions

The following actions are recommended:

	Action	Information
1	Look for damage to the magnet. Replace the tool if damaged.	Brake release tool: 3HAC079146-001
2	Verify that the brake release tool is used correctly.	See Manually releasing the brakes on page 52 .
3	Check the brake power supply to the motor during the Motors OFF state.	See the circuit diagram. Check for any recorded fault status.

Continues on next page

	Action	Information
4	<p>Reset the brake release software as follows:</p> <ol style="list-style-type: none">1 Turn off electrical power supply to the robot.2 Turn on electrical power supply to the robot, without enabling the motors, and perform following step within 30 minutes.3 Wait for the controller to be fully operational, for example, verify that the FlexPendant is restarted. Place the brake release tool against the brake release point on the joint and hold for 2-10 seconds. Remove the brake release tool and wait for at least 2 seconds. <p>Software is reset. Any error code is removed from the FlexPendant.</p> <ol style="list-style-type: none">4 Test the brake release function using the brake release tool against the brake release point on the joint. <p>If the brake still does not release, repeat the reset cycle steps 3 and 4.</p> <p>Five (5) attempts are allowed in total to reset the brake release. If desired, the process can be repeated from step 1. If the brake still does not release, contact the local ABB customer service.</p>	

7 Troubleshooting

7.5 Communication failure between PROFINET-based laser scanner, PLC, and controller

Description

The ProfiNet LED on the laser scanner is not lit up, indicating that the ProfiNet communication between the laser scanner, PLC, and OmniCore controller fails to be set up. However, the cable connection is properly connected and necessary parameters are correctly set during the laser scanner configuration.

This issue may occur when PROFINET-based laser scanner(s) is connected.

Consequences

Communication fails to be set up between the laser scanner, PLC, and OmniCore. The safety separation function with the laser scanner cannot be applied.

Possible causes

The firewall for the ProfiNet network is disabled.

Recommended actions

- 1 Open RobotStudio.
- 2 In the **Controller** tab page, choose **Communication** from the **Configuration** group.
- 3 Select **Firewall Manager** in the **Type** pane.
- 4 Set **Enable on Public Network** to **Yes** for the network service **ProfiNet**.

7.6 Communication failure between PLC and controller

Description

The OmniCore controller and PLC are configured with all parameters correctly set. However, the communication between the OmniCore controller and PLC still fails. This issue may occur when the PROFINET-based laser scanner(s) is connected.

Consequence

The safety configurations do not take effect.

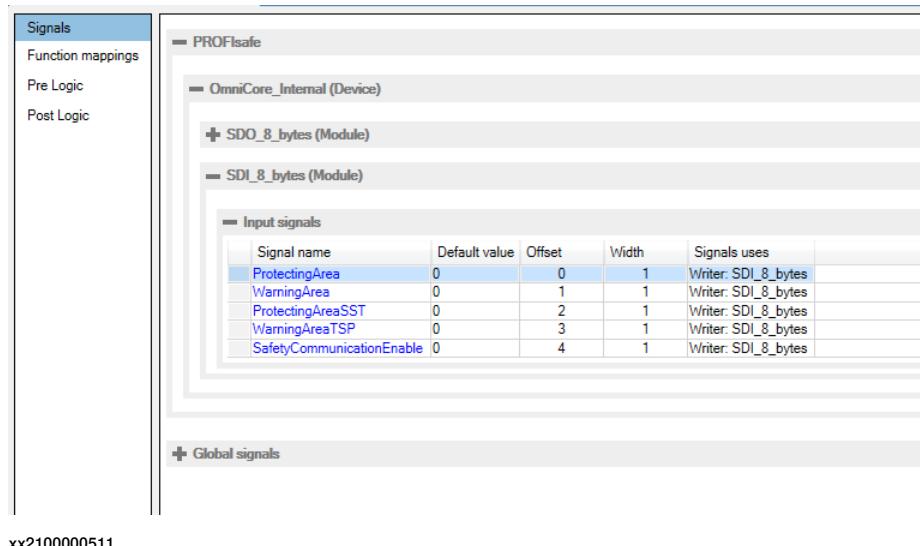
Possible causes

During configuration of communication between the OmniCore controller and PLC, the PROFIsafe device information must be configured on the OmniCore controller's side first. Otherwise, the configured signals will not be saved in the safety module in the OmniCore controller.

Recommended actions

- 1 Open the RobotStudio.
- 2 In the Controller tab page, choose **Visual SafeMove** from Safety in the Configuration group.
- 3 Check the Safe I/O configurations.

For robots running RobotWare 7.5 or earlier, the following signals can be observed.



xx2100000511

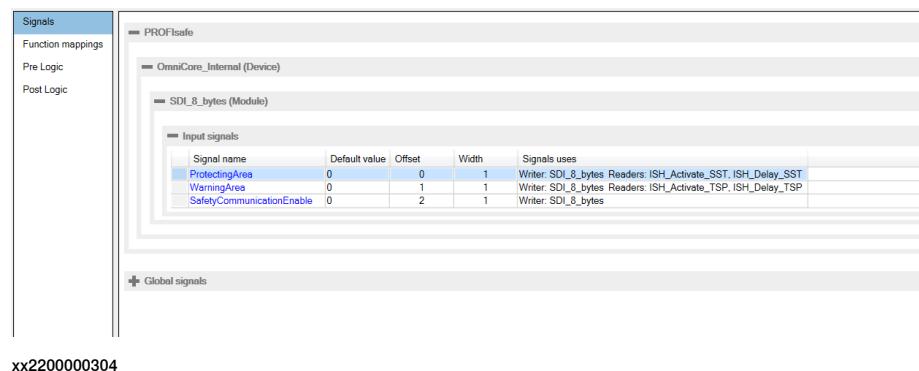
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7 Troubleshooting

7.6 Communication failure between PLC and controller

Continued

For robots running RobotWare 7.6 or later, the following signals can be observed.



The screenshot shows the I/O Engineering Tool interface. On the left, there's a sidebar with tabs for 'Signals', 'Function mappings', 'Pre Logic', and 'Post Logic'. The main area is titled 'PROFIsafe' and contains a tree view with 'OmniCore_Internal (Device)' and 'SDI_8_bytes (Module)'. Under 'SDI_8_bytes (Module)', there's a section for 'Input signals' which lists three signals: 'ProtectingArea', 'WarningArea', and 'SafetyCommunicationEnable'. Each signal has columns for 'Signal name', 'Default value', 'Offset', 'Width', and 'Signals uses'. The 'ProtectingArea' row is selected, showing values 0, 0, 1, and 'Writer: SDI_8_bytes Readers: ISH_Activate_SST, ISH_Delay_SST'. The 'WarningArea' row shows values 0, 1, 1, and 'Writer: SDI_8_bytes Readers: ISH_Activate_TSP, ISH_Delay_TSP'. The 'SafetyCommunicationEnable' row shows values 0, 2, 1, and 'Writer: SDI_8_bytes'. At the bottom of the main window, there's a footer with the text 'xx2200000304'.

Signal name	Default value	Offset	Width	Signals uses
ProtectingArea	0	0	1	Writer: SDI_8_bytes Readers: ISH_Activate_SST, ISH_Delay_SST
WarningArea	0	1	1	Writer: SDI_8_bytes Readers: ISH_Activate_TSP, ISH_Delay_TSP
SafetyCommunicationEnable	0	2	1	Writer: SDI_8_bytes

- 4 If the signals cannot be observed, choose **I/O Engineering Tool** from **Configuration** in the **Configuration** group.
- 5 Go back to the **Visual SafeMove** window and write the SafeMove configurations to the controller again.
You will observe the signals and the communication is correctly set up.

7.7 Communication failure between scalable I/O device and controller

Description

The OmniCore controller and scalable I/O device DSQC1042 are configured with all parameters correctly set. However, the communication between the OmniCore controller and scalable I/O device still fails.

This issue may occur when the SafetyIO-based laser scanner(s) is connected.

Consequence

The safety configurations do not take effect.

Possible causes

During configuration of communication between the OmniCore controller and scalable I/O device, the scalable I/O device information must be configured on the OmniCore controller's side first. Otherwise, the configured signals will not be saved in the OmniCore controller.

Recommended actions

- 1 Open the RobotStudio.
- 2 In the Controller tab page, choose **Visual SafeMove** from **Safety** in the **Configuration** group.
- 3 Check the Safe I/O configurations.

The following signals can be observed.

Signal name	Default value	Offset	Width	Commission Mode	Signals uses
ABB_Scalable_IO_0_D1	0	0	1	None	Writer: ABB_Scalable_IO Readers: ISH_Protect
ABB_Scalable_IO_0_D2	0	1	1	None	Writer: ABB_Scalable_IO Readers: ISH_Protect
ABB_Scalable_IO_0_D3	0	2	1	None	Writer: ABB_Scalable_IO Readers: ISH_Warnin
ABB_Scalable_IO_0_D4	0	3	1	None	Writer: ABB_Scalable_IO Readers: ISH_Warnin
ABB_Scalable_IO_0_D5	0	4	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_D6	0	5	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_D7	0	6	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_D8	0	7	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_D9	0	8	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_D10	0	9	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_D11	0	10	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_D12	0	11	1	None	Writer: ABB_Scalable_IO

xx2200000305

- 4 If the signals cannot be observed, choose **I/O Engineering Tool** from **Configuration** in the **Configuration** group.
- 5 Go back to the **Visual SafeMove** window and write the SafeMove configurations to the controller again.

You will observe the signals and the communication is correctly set up.

7 Troubleshooting

7.8 Movement in Safe area not in full speed or at zero speed

Description

The speed in the Safe area is not at the full speed specified in the motion instruction or even at zero speed after the SST/TSP violation is triggered.

This issue may occur when robot is running RobotWare 7.5 or an earlier version.

Consequences

Robot cannot move in the specified speed, that is, in slow speed, or even stops movement in the Safe area.

Possible causes

Before the SST/TSP is triggered, the system triggers Protecting or Warning area speed control first. In this case, the speed control module uses the value of SpeedRefresh to control the robot movement speed. At the time that the SST/TSP triggers the robot stopping, the speed control has already changed by the SpeedRefresh value which is 0 in Protecting area and 20 in Warning area.

When users are back to the Safe area and restart or step the program after the SST/TSP violation, the SpeedRefresh value that refresh the speed to 100 does not take effect. That is, the speed is still controlled by the SpeedRefresh value 0 or 20. Although the speed shown in the FlexPendant is 100%, the actual speed is still controlled by the combination of the SpeedRefresh value and the speed set in motion instruction, which will result in the movement stopping or moving in slow speed in the Safe area.

Furthermore, when the STT violation is triggered, the manipulator triggers Cat0 or Cat1 emergency stop. If the user tries to start program in the Protecting area but is not in the STT area, the robot will start moving a short path to regain the previous point and then stop. In this case, the speed is restricted to 0.

For more details, see [Strategies \(RobotWare 7.5\) on page 123](#).

Recommended actions

Users could perform either of the following solutions:

- Reset the program pointer and start the program in the Safe area again.
- Enter the Warning area but not trigger the TSP supervision violation and then back to the Safe area again.

7.9 Unable to remove or change installed options in Collaborative Speed Control add-in

7.9 Unable to remove or change installed options in Collaborative Speed Control add-in

Description

The installed lead-through or laser scanner options fail to be removed or changed in the Collaborative Speed Control add-in using Installation Manager 7.

Consequence

The options cannot be removed or changed.

Possible causes

SpeedHandling modules remains in task T_ROB1 after option removal or change. Existing template SafeMove configuration file is not removed or synchronized with the new configuration of the new option.

Recommended actions

- 1 Reset the template SafeMove configuration file to factory settings and restart the controller.
- 2 De-select the checkboxes of the options that require to be removed or changed in the Collaborative Speed Control add-in and restart the controller.
- 3 Remove the remained SpeedHandling modules in T_ROB1 if existing and remove the folder HOME/CSpeedControl manually.
- 4 Reset the RAPID and parameters in RobotStudio and restart the controller.

7 Troubleshooting

7.10 RED flashing status on Scalable I/O device and unable to move the robot

Description

The LED on scalable I/O device is in RED flashing status and the robot cannot be moved in automatic mode after following necessary configurations have been done:

- The Collaborative Speed Control add-in installed with options 3051-2 I/O scanner or 3051-4 Dual I/O scanner selected.
- The template SafeMove configuration file uploaded.
- The scalable I/O device installed on and connected to the controller.

Consequence

Communication with scalable I/O device does not set up and laser scanner(s) cannot function. The robot cannot be moved in automatic mode.

Possible causes

The Collaborative Speed Control add-in is installed first and then the scalable I/O device is installed and connected. The system incorrectly recognizes the device as two and shows two ABB_Scalable_IO devices in the device list on FlexPendant and RobotStudio. The real scalable I/O device is listed with device name *ABB_Scalable_IO1* while the other nonexistent device is listed with the device name *ABB_Scalable_IO*.

During automatic configuration, the correct IP address 192.168.10.130 is assigned to the device with name *ABB_Scalable_IO*. In this situation, the IP address will be configured for the nonexistent device whose serial number is 0, while the real device is configured with an incorrect IP address 192.168.10.131 with its true serial number.

Recommended actions

- 1 Open the RobotStudio and click the **Controller** tab.
- 2 Connect the controller with an account with the *Admin* user grant.
- 3 Click **Request Write Access**.
- 4 In the left pane of the window, right-click the device with the device name *ABB_Scalable_IO1* in the **I/O System** group and choose **Configure Device**.
If the serial number of the device is not 0, it is the right device requiring to be configured.
- 5 In the **Configuration** area, choose **Update device** and select *ABB_Scalable_IO* from the drop-down list.
- 6 Click **OK**.

7.11 Unexpected robot movement when starting the program in Protecting Area

7.11 Unexpected robot movement when starting the program in Protecting Area

Description

The robot moves unexpectedly in a speed not larger than 250 mm/sec when the user starts the program in Protecting area, in which situation the robot should be stopped and stand still.

Consequence

The unexpected robot movement may cause damages or injuries to objects or persons within its movement range.

Possible causes

The robot moves in mentioned scenario only when all of the following conditions are met:

- The function ISH_b_FunctionlityIsUsed in RAPID program InternalSpeedHandling_User is set to TRUE.
- The template SafeMove configuration file provided with the Collaborative Speed Control add-in is not loaded, or is loaded but Global_SST configuration is removed or the ISH_UserMODE_bNot_ImmitCollab is set to 1.
- The system is in Auto mode or Manual Full Speed mode.
- The robot was stopped during running a program, and then manually moved to another position which is within the range of the robot return path.
- The user stands in Protecting area and restarts the program using FlexPendant.

Recommended actions

Reset the template SafeMove configuration file to factory setting and then load the configuration file provided with the Collaborative Speed Control add-in. See detailed procedures in [The SafeMove configurator app on FlexPendant on page 86](#).

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8 Decommissioning

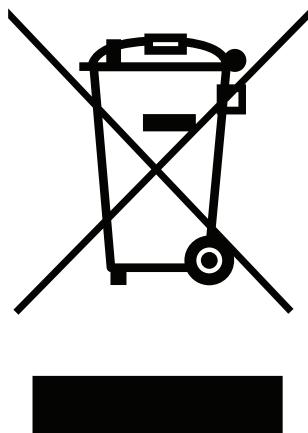
8.1 Environmental information

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).



Materials used in the product

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

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

Material	Example application
Aluminium	Base, lower arm, upper arm
Copper	Cables, motors, brakes
Electronics	PCBAs, sensors, brake release unit
Neodymium	Motors, brake release tool
Nickel	Tool flange, protection cap
Oil, grease	Gearboxes
Plastic/rubber	Cables, connectors, holder, covers, and so on
Steel	Gears, screws, sheet metals, brackets

Continues on next page

8 Decommissioning

8.1 Environmental information

Continued

China RoHS symbol

The following symbol shows the information to hazardous substances and the environmental protection use period of CRB 15000 according to "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products (SJ/T 11364-2014) ".



xx1900000803

Green symbol with "e" in it: The product does not contain any hazardous substances exceeding concentration limits and is a green environmentally friendly product which can be recycled.

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.

8.2 Scrapping of robot

Important when scrapping the robot



DANGER

When a robot is disassembled while being scrapped, it is very important to remember the following before disassembling starts, in order to prevent injuries:

- Always remove all oil/grease in gearboxes. If exposed to heat, for example from a blow torch, the oil/grease will catch fire.
- When motors are removed from the robot, the robot will collapse if it is not properly supported before the motor is removed.

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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 Reference information

9.2 Applicable standards

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	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
ISO/TS 15066	Robots and robotic devices - Collaborative robots This Technical Specification specifies safety requirements for collaborative industrial robot systems and the work environment, and supplements the requirements and guidance on collaborative industrial robot operation given in ISO 10218-1 and ISO 10218-2.

Region specific standards and regulations

Standard	Description
ANSI/RIA R15.06	Safety requirements for industrial robots and robot systems
ANSI/UL 1740	Safety standard for robots and robotic equipment
CAN/CSA Z 434-03	Industrial robots and robot Systems - General safety requirements
EN ISO 10218-1	Robots and robotic devices — Safety requirements for industrial robots — Part 1: Robots

Continues on next page

Deviations

Deviations from ISO 10218-1:2011 for CRB 15000

The CRB 15000 is by default always in collaborative operation.

9 Reference information

9.3 Unit conversion

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.

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)	<i>Gleitmo 603 + Geomet 500</i>	3-5 µm
M6-M20 (any length except M20x60)	<i>Gleitmo 603 + Geomet 720</i>	3-5 µm
M20x60	<i>Gleitmo 603 + Geomet 500</i>	8-12 µm
M20x60	<i>Gleitmo 603 + Geomet 720</i>	6-10 µm

Tightening torque

Before tightening any screw, note the following:

- **Special torques** are specified in the repair, maintenance or installation procedure descriptions. Any special torque specified overrides a 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%!

9 Reference information

9.5 Weight specifications

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	Note
1	Torque wrench, 0.2-4.6 Nm	
1	Hexagon bit socket head cap, size 1.5 mm	
1	Hexagon bit socket head cap, size 2 mm	
1	Hexagon bit socket head cap, size 2.5 mm	
1	Hexagon bit socket head cap, size 3 mm	
1	Tweezer	
1	Cable ties	

9 Reference information

9.7 Special tools

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 749*](#), and of special tools, listed directly in the instructions and also gathered in this section.

Special tools



Note

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

Continues on next page

Tools and equipment with spare part number: (These tools can be ordered from ABB)			Axis-1 cabling	Axis-2 cabling	Axis-3 cabling	Axis-4 cabling	Axis-5 cabling	Axis-6 cabling	Axis-5 to axis-6 transition cabling	Lower arm	Housing	Tubular	Wrist housing	Base	Swing	Axis-1 joint unit	Axis-2 joint unit	Axis-3 joint unit	Axis-4 joint unit	Axis-5 joint unit	Axis-6 joint unit
Lifting accessories																					
Lifting aid	3HAC077788-001	 xx2100000465	1							1			1	1	1	1	1	1	1	1	
Lifting aid	3HAC077789-001	 xx2100000464							1		1	1					1	1	1		
Guiding tools																					
Guide pin, M4x120	3HAC077786-001	 xx2100000463	2							2	2		2	2	2	2	2	2	2	2	
Guide pin, M3x110	3HAC077787-001	 xx2100000462							2		2	2					2	2	2	2	
Other tools																					
Cable tie gun EVO7	-		1	1	1	1	1	1	1				1	1		1	1	1	1	1	1
Protection plate	3HAC077790-001	 xx2100000461	1	1	1	1	1	1	1				1	1		1	1	1	1	1	1

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