ROBOTICS

Product manual

CRB 15000



Trace back information:
Workspace 25A version a9
Checked in 2025-02-25
Skribenta version 5.6.018

Product manual

CRB 15000

OmniCore

Document ID: 3HAC077389-001

Revision: S

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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 shall 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.

Note

Significant potential hazards for robot systems are listed in ISO 10218-2. ISO 12100 provides examples of the hazards associated with machines.

Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

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Prerequisites

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

- 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.

References

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

Document name	Document ID
Product manual, spare parts - CRB 15000	*3HAC079469-001*
Product specification - CRB 15000	*3HAC077390-001*
Product manual - OmniCore C30	*3HAC060860-001*
Circuit diagram - CRB 15000	*3HAC081041-003*
Operating manual - Integrator's guide OmniCore	*3HAC065037-001*
Technical reference manual - System parameters	*3HAC065041-001*
Application manual - Functional safety and SafeMove	*3HAC066559-001*
Application manual - PROFINET Controller/Device	*3HAC066558-001*
Application manual - Scalable I/O	*3HAC070208-001*
Application manual - Force control Standard for GoFa	*3HAC083267-001*
Technical reference manual - Event logs for RobotWare 7	*3HAC066553-001*
Application manual - Collaborative Speed Control add-in	*3HAC091309-001*

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: • 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 107*. • Added information about how to calibrate the robot, see *Calibration on page 1047*. • Updated spare part number for axis-3 joint unit.

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Revision	Description
C	Published in release 21C. The following updates are made in this revision: • 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 *Cyclic Brake Check* 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 98*.
D	Published in release 21D. The following updates are made in this revision: • Added information about laser scanner. • Added tip in section *Calibration methods on page 1047*. • Updated working range for axis 6, see *Working range on page 52*.
E	Published in release 22A. The following updates are made in this revision: • Updated information about ASI buttons. • Added tips about the calibration features, see *Features in the service routine on page 1050*. • Updated information for the SafeMove function **Human Contact Supervision**. • Updated information for lead-through, see *Lead-through on page 114*. • 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 45*. • Updated information about Gleitmo treated screws, see *Screw joints on page 1081*. • 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 SafeMove configurator app on FlexPendant on page 117*. • Added more information for laser scanners.
F	Published in release 22B. The following updates are made in this revision: • Corrected wire rating for customer cabling. • Added diagnostic data for drive board LEDs. • Updated operating conditions regarding ambient humidity. • Updated information regarding the torque sensor calibration routine. • Added connector designations to drive board images in replacement procedures. • Added information about changing laser scanner type.
G	Published in release 22C. The following updates are made in this revision: • Added pin specification for the customer connectors at the tool flange. • Added usable detergents to the cleaning section. • Added protection class for clean room suitability. • Changed tool designation and article number for cable tie gun. • Minor corrections. • Updated the connection figures and configuration procedure of the safetyIO-based laser scanners. • Removed the troubleshooting for issue of RED flashing status on Scalable I/O device and failure to move the robot.

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Continued

Revision	Description
H	Published in release 22D. The following updates are made in this revision: • Added support for wrist optimization.
J	Published in release 23A. The following updates are made in this revision: • Added information for new brake release functionality using the FlexPendant. • Added support for the option *Absolute Accuracy*. • Added information about releasing the brakes by using the FlexPendant.
K	Published in release 23A. The following updates are made in this revision: • Updated requirement and procedure descriptions for manually releasing the brakes.
L	Published in release 23B. The following updates are made in this revision: • Added new variants CRB 15000-10/1.52 and CRB 15000-12/1.27. • Added pin assignment on XG1 connector of SafetyIO-based laser scanner. • Updated the logical expressions for SafeMove configuration using Visual SafeMove.
M	Published in release 23D. The following updates are made in this revision: • Editorial corrections. • Renamed spare part "axis-6 inner flange" to "tool flange adapter" for consistency. • Updated replacement procedure of wrist housing. • Updated the installation procedure for the Collaborative Speed Control add-in. • Added troubleshooting for issue that program execution stops because no safety configuration template loaded.
N	Published in release 24A. The following updates are made in this revision: • Rating spec in each wire of Customer Power (CP) changed from 1.5A to 3A. • Updated usable cleaning detergents and cleaning information. • Added hybrid floor cable 3 m and drag chain cable 15 m.
P	Published in release 24B. The following updates are made in this revision: • Updated the information about the guide pins used to refit the axis-1 and -2 joint units for CRB 15000-10/1.52 and CRB 15000-12/1.27. • Added a step to inspect the protective earth of floor cables. • Moved contents about laser scanner configuration and Collaborative Speed Control add-in to a separate manual *Application manual - Collaborative Speed Control add-in*.
Q	Published in release 24C. The following updates are made in this revision: • Editorial corrections. • Updated description of diagnostic code "flash 4 times then pause" for functional error LED (red). See *Diagnostic LEDs on joint unit drive board on page 1070*. • Updated the description for running the torque sensor calibration, see *Running the service routine TorqueSensorCal on page 1050*. • Updates images of working range and turning radius for CRB 15000-5/0.95. • Added information about robot lifetime. • Updated the flange reach for CRB 15000-10/1.52 and CRB 15000-12/1.27.
R	Published in release 24D. The following updates are made in this revision: • Added bending radius for hybrid floor cables and drag chain cable. • Added support for the option *Ultra Accuracy*.

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Revision	Description
S	Published in release 25A. The following updates are made in this revision: • Added information about robot lifetime working in L/H/P applications. • Updated usable cleaning detergents and cleaning instructions. • Added information that *Wrist Optimization* requires an update of the safety controller.

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Product documentation

Categories for user documentation from ABB Robotics

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



Tip

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

Product manuals

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

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

Technical reference manuals

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

Application manuals

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

An application manual generally contains information about:

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

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- Examples of how to use the application.

Operating manuals

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

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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 17*.

Illustrations

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

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

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1 Safety

1.1 Safety information

1.1.1 Limitation of liability

Limitation of liability

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

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

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

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

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 15000-5/0.95 can only be used with the ABB OmniCore C30 controller with Drive system 7, and the CRB 15000-10/1.52 and CRB 15000-12/1.27 can only be used with the ABB OmniCore C30 controller with Drive system 10.

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1.1.1 Limitation of liability
Continued

Note

The type of drive system installed in the controller can be found on the drive label on the controller cabinet. Always verify the drive label before connecting the controller to the manipulator.

Controllers delivered in RobotWare versions earlier than 7.10 may not have a Drive label attached. Then the integrator must clearly mark an observed symbol on the controller to avoid incorrect connections.

For more information see:

- *Product manual - OmniCore C30*

Spare parts and equipment

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

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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.

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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.

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

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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 22*.

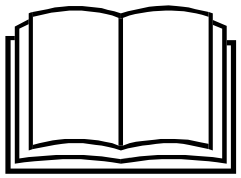
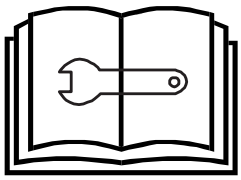
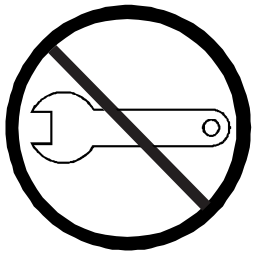
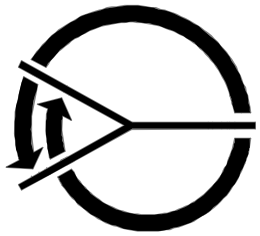
The information labels can contain information in text.

Symbols on safety labels

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

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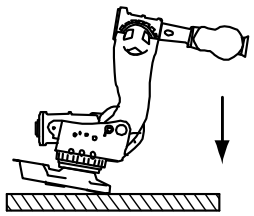
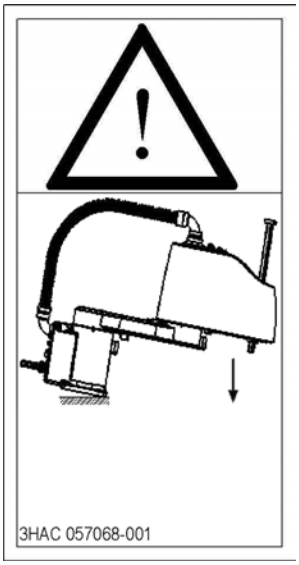
Symbol	Description
 xx0900000813	**See user documentation** Read user documentation for details. Which manual to read is defined by the symbol: • No text: *Product manual*.
 xx0900000816	**Before disassembly, see product manual**
 xx0900000815	**Do not disassemble** Disassembling this part can cause injury.
 xx0900000814	**Extended rotation** This axis has extended rotation (working area) compared to standard.
 xx0900000808	**Brake release** Using the brake release tool will release the brakes. This means that the robot arm can fall down.

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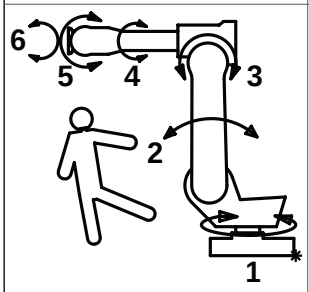
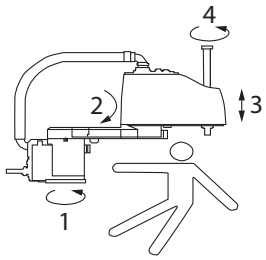
1.2.2 Safety symbols on manipulator labels

Continued

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

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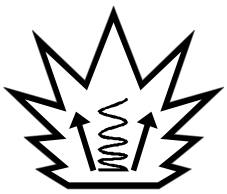
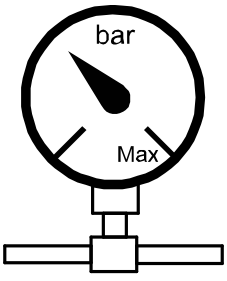
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Symbol	Description
 xx0900000818  xx1300001087	**Heat** Risk of heat that can cause burns. (Both signs are used)
 xx2400000736  xx1500002616	**Moving robot** The robot can move unexpectedly.
 xx0900000821	**Lifting bolt**
 xx1000001242	**Adjustable chain sling with shortener**

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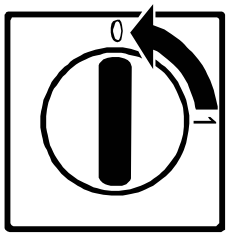
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1.2.2 Safety symbols on manipulator labels
Continued

Symbol	Description
 xx0900000822	**Lifting of robot**
	Swivel eye bolt The exclamation mark indicates required usage of swivel eye bolts at the lifting points.
 xx0900000823	**Oil** Can be used in combination with prohibition if oil is not allowed.
 xx0900000824	**Mechanical stop**
 xx1000001144	**No mechanical stop**
 xx0900000825	**Stored energy** Warns that this part contains stored energy. Used in combination with *Do not disassemble* symbol.
 xx0900000826	**Pressure** Warns that this part is pressurized. Usually contains additional text with the pressure level.

Continues on next page

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Symbol	Description
 xx0900000827	**Shut off with handle** Use the power switch on the controller.
 xx1400002648	**Do not step** Warns that stepping on these parts can cause damage to the parts.

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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 stop category 1 is defined. Exceptions are only allowed:

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

Stop category 1 is 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 stop category 1 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 stop category 1 for CRB 15000 *Safety Functions* in the application risk assessment.

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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 1074* 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.

Using lifting accessories and other external equipment

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

Electrical safety

Incoming mains must be installed to fulfill national regulations.

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

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

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

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

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

Safety devices

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

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

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

Other hazards

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 107*, and *The SafeMove configurator app on FlexPendant on page 117*, as well as *Guidelines for transient and quasi-static contact, CRB 15000 on page 129* 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.

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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

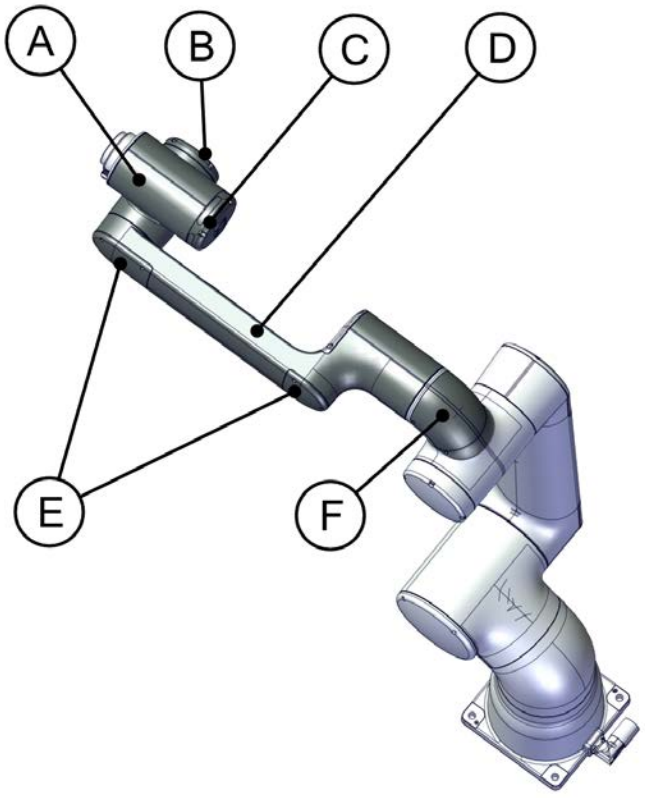
WARNING

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

Hot surfaces

Touch surface temperatures shall be verified when running demanding motion cycles at high ambient temperatures. If necessary, to prevent burns, allow touch surfaces to cool down before working closely with the robot.

The following figure takes the CRB 15000-12/1.27 as an example to show the locations of touch surfaces. All the other surfaces are considered as non-touch surfaces.



xx2300000975

A	Wrist housing
B	Axis-5 cover

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C	Arm side interface
D	Tubular
E	Tubular covers
F	Housing cover

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1.6 Safety during maintenance and repair

1.6.1 Safety during maintenance and repair

General

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

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

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

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

Hot surfaces

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

Allergic reaction

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

Gearbox lubricants (oil or grease)

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

Note

Take special care when handling hot lubricants.

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 137*.

Related information

See also the safety information related to installation and operation.

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1.6.2 Emergency release of the robot axes

Description

How to release the brakes is described in the section:

- *Manually releasing the brakes on page 69*.

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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*.

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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.

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1.8 Safety during decommissioning

General

See section *Decommissioning on page 1073*.

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

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2 Manipulator description

2.1 About CRB 15000

Introduction

The CRB 15000 robot is a flexible, agile 6-axis articulated robot, available in three variants spanning various options for payload from 5 kg to 12 kg, wrist reach from 0.95 m to 1.52 m (flange reach from 1.05 m to 1.63 m), and 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 15000-5/0.95 can only be used with the ABB OmniCore C30 controller with Drive system 7, and the CRB 15000-10/1.52 and CRB 15000-12/1.27 can only be used with the ABB OmniCore C30 controller with Drive system 10.

The type of drive system installed in the controller can be found on the Drive label on the controller cabinet. Always verify the Drive label before connecting the controller to the manipulator.

Controllers delivered in RobotWare versions earlier than 7.10 may not have a Drive label attached. Then the integrator must clearly mark an observed symbol on the controller to avoid incorrect connections.

For more information see:

- *Product manual - OmniCore C30*

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2.2 Technical data

Weight, robot

The table shows the weight of the robot.

Robot model	Nominal weight
CRB 15000-5/0.95	28 kg
CRB 15000-10/1.52	51 kg
CRB 15000-12/1.27	48 kg

Note

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

Mounting positions

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

Mounting position	Installation angle
Floor mounted	0°
Wall mounted	Any angle
Suspended	180°

Note

The actual mounting angle must always be configured in the system parameters, otherwise the performance and lifetime is affected. See *Setting the system parameters for an inverted or a tilted robot on page 77*.

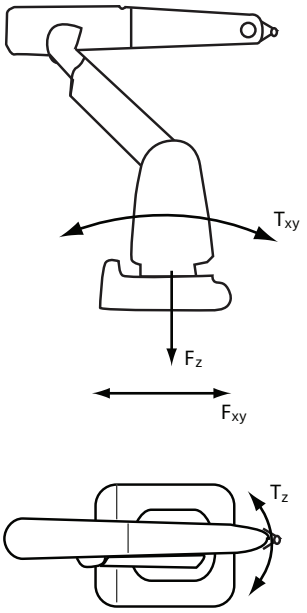
Loads on foundation, robot

The illustration shows the directions of the robots stress forces.

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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

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	±303 N[i] / ±470 N[ii] / ±470 N[iii]	±1113 N[i] / ±1460 N[ii] / ±1450 N[iii]
Force z	+280 ±147 N[i] / +500 ±410 N[ii] / +480 ±420 N[iii]	+280 ±857 N[i] / +500 ±650 N[ii] / +480 ±690 N[iii]
Torque xy	±246 Nm[i] / ±570 Nm[ii] / ±580 Nm[iii]	±711 Nm[i] / ±1,280 Nm[ii] / ±1,180 Nm[iii]
Torque z	±145 Nm[i] / ±200 Nm[ii] / ±210 Nm[iii]	±334 Nm[i] / ±720 Nm[ii] / ±690 Nm[iii]

i Valid for CRB 15000-5/0.95.

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2.2 Technical data
Continued

ii Valid for CRB 15000-10/1.52.
iii Valid for CRB 15000-12/1.27.

Wall mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	+280 ±130 N[i] / +510 ±490 N[ii] / +480 ±450 N[iii]	+280 ±1000 N[i] / +510 ±1220 N[ii] / +480 ±1260 N[iii]
Force z	±289 N[i] / ±390 N[ii] / ±360 N[iii]	±944 N[i] / ±900 N[ii] / ±1150 N[iii]
Torque xy	±275 Nm[i] / ±700 Nm[ii] / ±677 Nm[iii]	±768 Nm[i] / ±2,000 Nm[ii] / ±1,970 Nm[iii]
Torque z	±162 Nm[i] / ±400 Nm[ii] / ±370 Nm[iii]	±338 Nm[i] / ±780 Nm[ii] / ±790 Nm[iii]

i Valid for CRB 15000-5/0.95.
ii Valid for CRB 15000-10/1.52.
iii Valid for CRB 15000-12/1.27.

Suspended

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	±303 N[i] / ±470 N[ii] / ±470 N[iii]	±1113 N[i] / ±1460 N[ii] / ±1450 N[iii]
Force z	-280 ±147 N[i] / +500 ±410 N[ii] / +480 ±420 N[iii]	-280 ±857 N[i] / +500 ±650 N[ii] / +480 ±690 N[iii]
Torque xy	±246 Nm[i] / ±570 Nm[ii] / ±580 Nm[iii]	±711 Nm[i] / ±1,280 Nm[ii] / ±1,180 Nm[iii]
Torque z	±145 Nm[i] / ±200 Nm[ii] / ±210 Nm[iii]	±334 Nm[i] / ±720 Nm[ii] / ±690 Nm[iii]

i Valid for CRB 15000-5/0.95.
ii Valid for CRB 15000-10/1.52.
iii Valid for CRB 15000-12/1.27.

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. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy / ultra accuracy.
Minimum resonance frequency	22Hz **Note** It may affect the manipulator lifetime to have a lower resonance frequency than recommended.	The value is recommended for optimal performance. Due to foundation stiffness, consider robot mass including equipment.[i] For information about compensating for foundation flexibility, see the description of *Motion Process Mode* in the manual that describes the controller software option, see *References on page 10*.

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Requirement	Value	Note
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 [ii] / 45°C [iii]
Maximum ambient humidity	<75% relative humidity For limited period of time (<1 month): <95% relative humidity [iv]
Maximum ambient altitude	0-2,000 m (100-84 kPa)

i At low environmental temperature < 10ºC 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.

ii Valid for CRB 15000-5/0.95.

iii Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27.

iv Depending on climate and robot running conditions, condensation may occur on the inside of plastic covers. The condensation will disappear over time by itself, alternatively the user can open the covers and run a program for 12 hours to accelerate the process.

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 (CRB 15000-5/0.95)	IP54 Type 12k [ii] NEMA 12k [iii]

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Protection type	Protection class [i]
Manipulator, protection type Standard (CRB 15000-10/1.52 and CRB 15000-12/1.27)	IP67

i According to IEC 60529.
ii According to UL50/UL50E, CSA C22.2 No 94.2-15.
iii According to NEMA 250.

Clean room suitability, robot

The table shows the suitability for clean room environment for the valid protection types of the robot.

Protection type	Protection class
Manipulator, suitability class (protection type Standard)	ISO Class 4 [i]

i According to ISO 14644-1 / ISO 14644-14.

Harsh environment

The manipulator complies with the following harsh environment.

Parameter	According to
Flowing, mixed gas corrosion test	ISA–71.04-2013 G3 Harsh Group A DIN EN 60068-2-60

Components and concentrations of the mixed corrosive gas:

- Hydrogen sulphide (H_2S): 50 ppb
- Nitrogen dioxide (NO_2): 1,250 ppb
- Chlorine (Cl_2): 10 ppb
- Sulphur dioxide (SO_2): 300 ppb

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

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[i] / 450 Nm[ii] / 390 Nm[iii]
2	175.44 Nm[i] / 400 Nm[ii] / 400 Nm[iii]
3	90.6 Nm[i] / 160 Nm[ii] / 160 Nm[iii]
4	18.72 Nm[i] / 60 Nm[ii] / 60 Nm[iii]
5	21.44 Nm[i] / 60 Nm[ii] / 60 Nm[iii]
6	9.2 Nm[i] / 60 Nm[ii] / 60 Nm[iii]

i Valid for CRB 15000-5/0.95.
ii Valid for CRB 15000-10/1.52.
iii Valid for CRB 15000-12/1.27.

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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		Equiv. PFH_D (incl. brake)[i] [1/hour]
1	Enabling function	3	$2.22x10^{-7}$	d		$3.70x10^{-7}$
2	Emergency stop	3	$2.31x10^{-7}$	d		$3.79x10^{-7}$
3a	Protective stop (discrete)	3	$2.40x10^{-7}$	d		$3.88x10^{-7}$
3b	Protective stop (safe bus)	3	$2.51x10^{-7}$	d		$3.99x10^{-7}$
4	Stop category 0	3	$2.51x10^{-7}$	d		$3.99x10^{-7}$
5	Monitored stop category 1	3	$2.66x10^{-7}$	d		$4.14x10^{-7}$
6	Axis Position Supervision	3	$2.66x10^{-7}$	d		$4.14x10^{-7}$
7	Axis Speed Supervision	3	$2.66x10^{-7}$	d		$4.14x10^{-7}$
8	Stand Still Supervision	3	$2.66x10^{-7}$	d		$4.14x10^{-7}$
9	Tool Position Supervision	3	$2.66x10^{-7}$	d		$4.14x10^{-7}$

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	SafeMove functions	Category (SRP/CS)	PFH_D (SRP/CS) [1/hour]	PL		Equiv. PFH_D (incl. brake) [i] [1/hour]
10	Tool Orientation Supervision	3	$2.66x10^{-7}$	d		$4.14x10^{-7}$
11	Tool Speed Supervision	3	$2.66x10^{-7}$	d		$4.14x10^{-7}$
12	TCP Force Supervision	3	$2.74x10^{-7}$	d		$4.22x10^{-7}$
13	Axis Torque Supervision	3	$2.74x10^{-7}$	d		$4.22x10^{-7}$
14	Safe Payload Supervision	3	$2.74x10^{-7}$	d		$4.22x10^{-7}$
15	Control Error Supervision	3	$2.66x10^{-7}$	d		$4.14x10^{-7}$
16	Contact Application Tolerance	3	$2.66x10^{-7}$	d		$4.14x10^{-7}$

i Calculated using $PFHd_{Brake}$ = 1/ ($MTTFd_{Brake}$ (years) x 8760 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 155*.

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 157*). 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

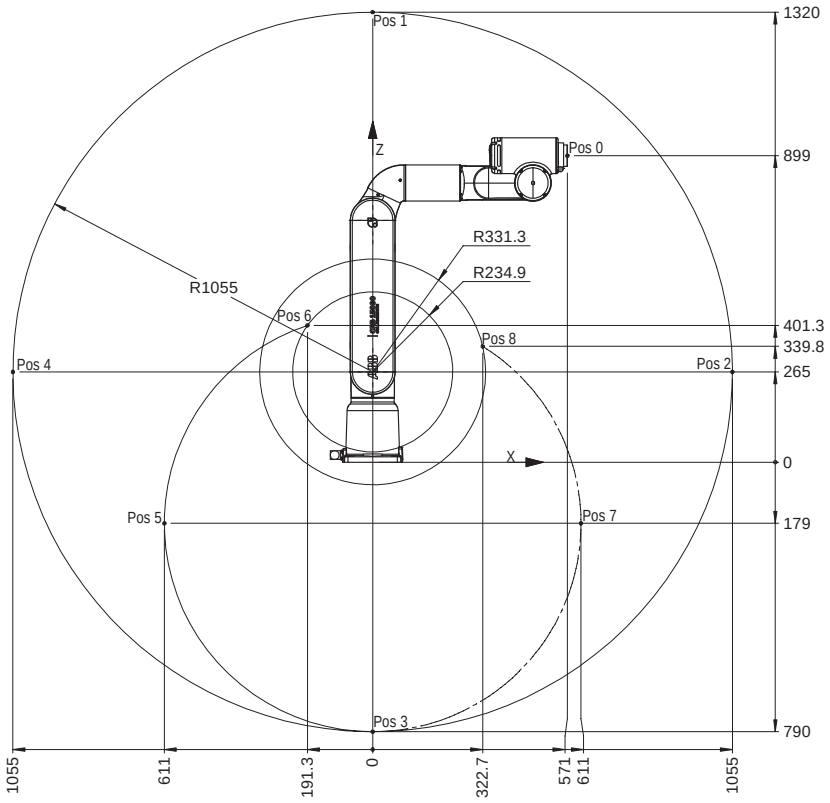
A violation of the standstill monitoring will result in a Category 0 stop (see ISO 10218-1 §5.5.3). Due to the brake closing time, the robot can fall some distance before it stops. Sufficient space must be provided around the robot to prevent an operator from being trapped. The falling distance and maximum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

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2.4 Working range

Illustration, working range CRB 15000-5/0.95

This illustration shows the unrestricted working range of the robot.



xx2400001418

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	axis 5
pos0	571	899	0°	0°	0°
pos1	0	1320	0°	-76.8°	25.2°
pos2	1055	265	90°	-76.8°	25.2°
pos3	0	-790	180°	-76.8°	25.2°
pos4	-1055	265	-90°	-76.8°	25.2°
pos5	-611	-179	180°	13.2°	25.2°
pos6	-191.3	401.3	180°	85°	25.2°
pos7	611	-179	180°	-166.8°	25.2°
pos8	322.7	339.8	180°	-225°	25.2°

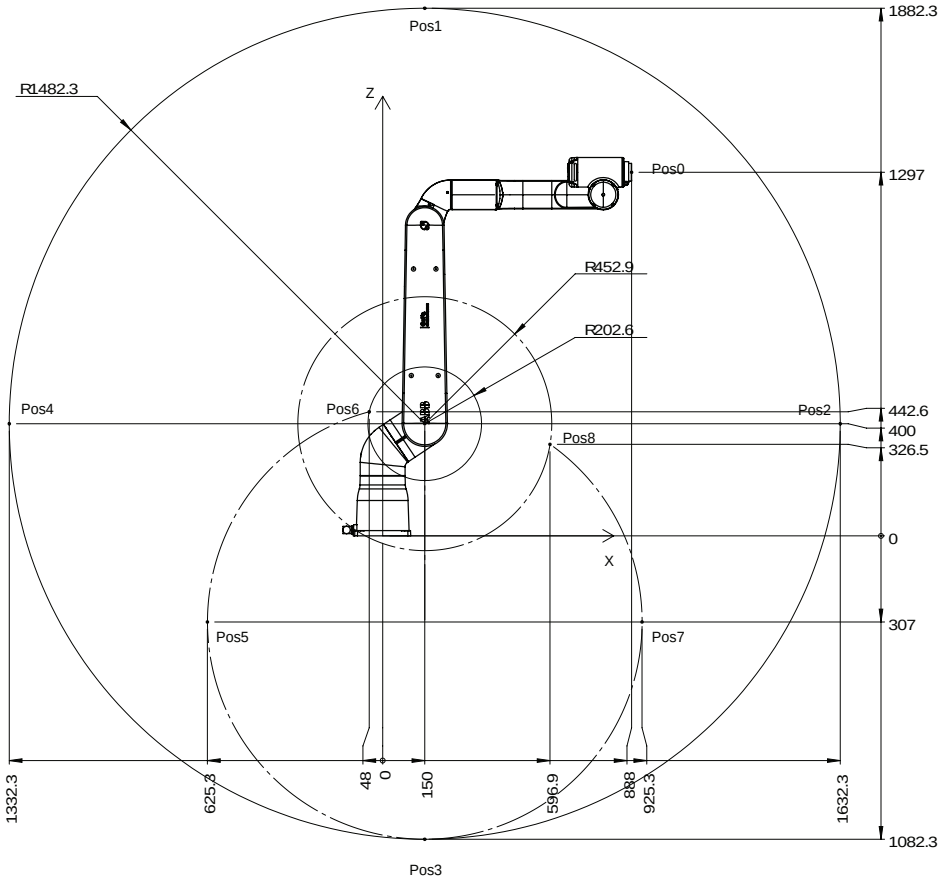
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2.4 Working range
Continued

Illustration, working range CRB 15000-10/1.52

This illustration shows the unrestricted working range of the robot.



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Positions at wrist center and angle of axes 2 and 3

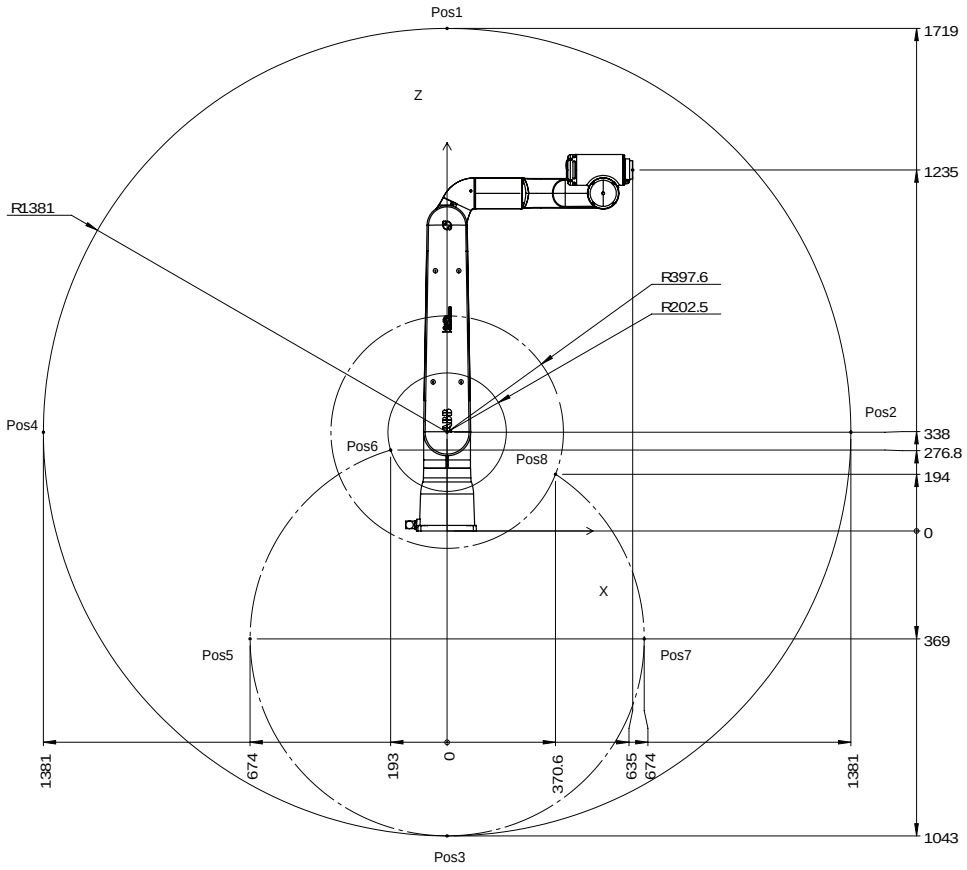
Position in the figure	Positions at wrist center (mm)		Angle (degrees)		
	X	Z	axis 2	axis 3	axis 5
pos0	888	1297	0°	0°	0°
pos1	150	1882.3	0°	-80.2°	28.58°
pos2	1632.3	400	90°	-80.2°	28.58°
pos3	150	-1082.3	180°	-80.2°	28.58°
pos4	-1332.3	400	-90°	-80.2°	28.58°
pos5	-625.3	-307	180°	9.8°	28.58°
pos6	-48	442.6	180°	85°	
pos7	925.3	-307	180°	-170.2°	28.58°
pos8	596.9	326.5	180°	-225°	28.58°

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Illustration, working range CRB 15000-12/1.27

This illustration shows the unrestricted working range of the robot.



xx2300000576

Positions at wrist center and angle of axes 2 and 3

Position in the figure	Positions at wrist center (mm)		Angle (degrees)		
	X	Z	axis 2	axis 3	axis 5
pos0	635	1235	0°	0°	0°
pos1	0	1719	0°	-78.4°	26.7°
pos2	1381	338	90°	-78.4°	26.7°
pos3	0	-1043	180°	-78.4°	26.7°
pos4	-1381	338	-90°	-78.4°	26.7°
pos5	-674	-369	180°	11.6°	26.7°
pos6	-193	276.8	180°	85°	26.7°
pos7	674	-369	180°	-168.4°	26.7°
pos8	370.6	194	180°	-225°	26.7°

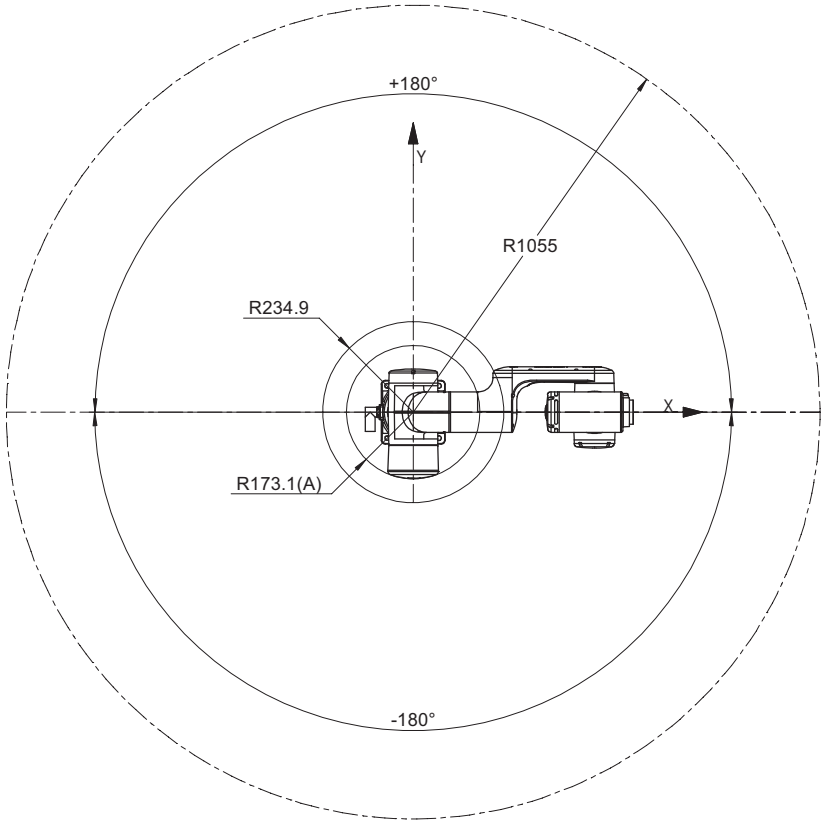
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2.4 Working range
Continued

Top view of working range

CRB 15000-5/0.95

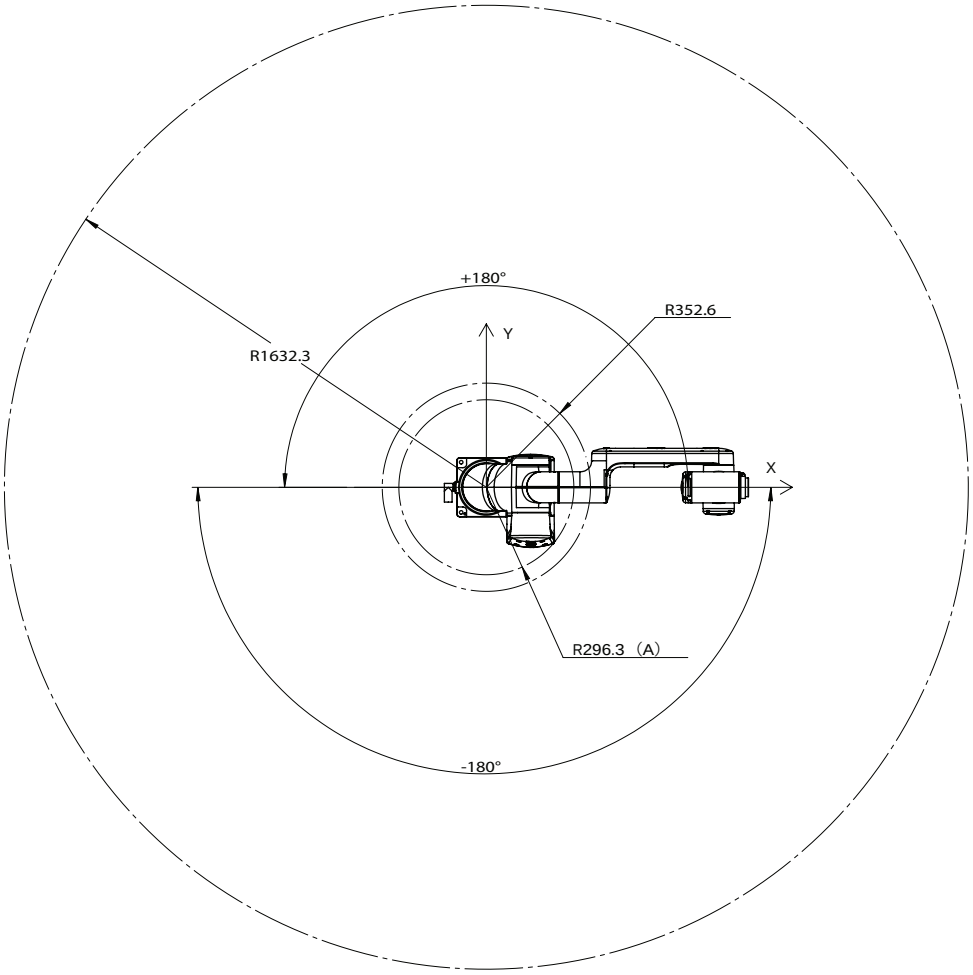


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CRB 15000-10/1.52



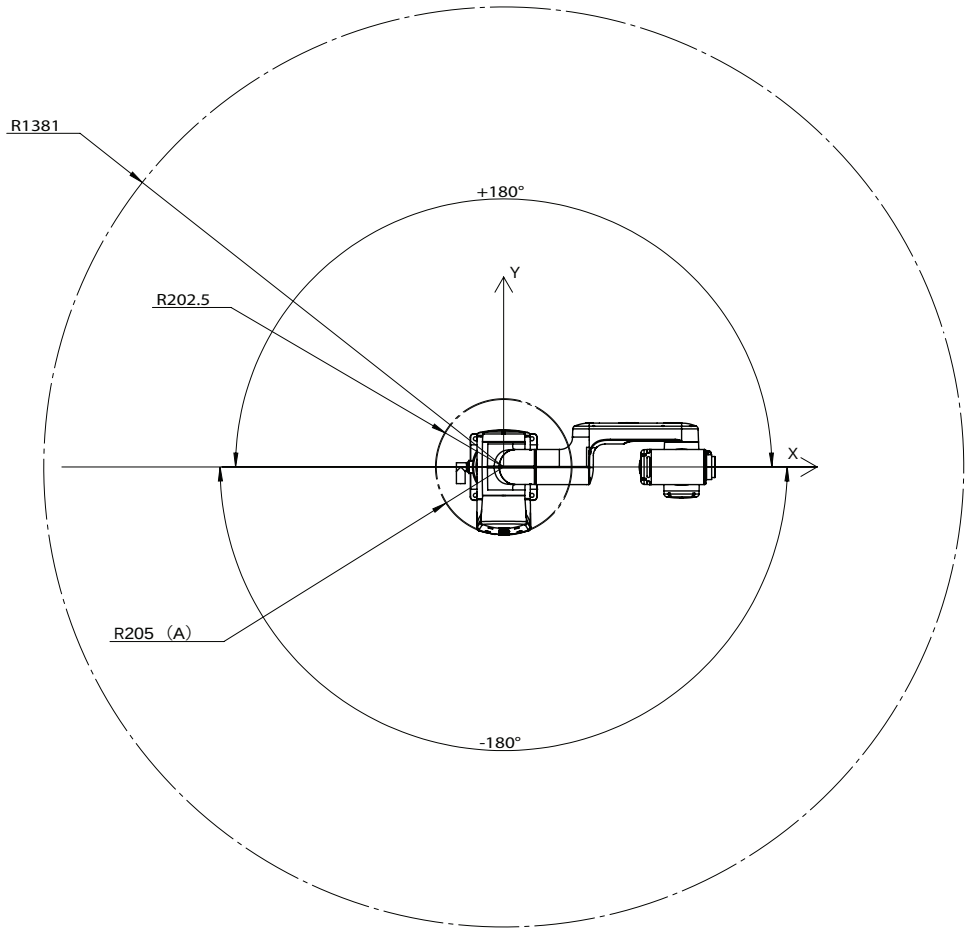
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2.4 Working range
Continued

CRB 15000-12/1.27



xx2300000578

Working range

Axis	Working range	Note
Axis 1	±180° [i] / ±270° [ii]	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	±180°	
Axis 3	-225°/+85°	
Axis 4	±180°	
Axis 5	±180°	
Axis 6	±270°	

i Valid for CRB 15000-5/0.95.
ii Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27.

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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.

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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.

The technical data is detailed in section *Technical data on page 40*.

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 17* 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*

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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. Wipe away the protective transportation grease applied to the tool flange.
5	Make sure that the lifting accessory used (if required) is suitable to handle the weight of the robot as specified in: *Weight, robot on page 40*
6	If the robot is not installed directly, it must be stored as described in: *Storage conditions, robot on page 43*
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: *Operating conditions, robot on page 43*
8	Before taking the robot to its installation site, make sure that the site conforms to: • *Loads on foundation, robot on page 40* • *Protection classes, robot on page 43* • *Requirements, foundation on page 42*
9	Before moving the robot, please observe the stability of the robot: *Risk of tipping/stability on page 57*
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: *On-site installation on page 60*
11	Install required equipment, if any.

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3.2.2 Risk of tipping/stability

Risk of tipping

CRB 15000-5/0.95 is delivered lying flat in the delivery package, while CRB 15000-10/1.52 and CRB 15000-12/1.27 are delivered in standing position in the package. The robot cannot stand on its own without being secured to the foundation.

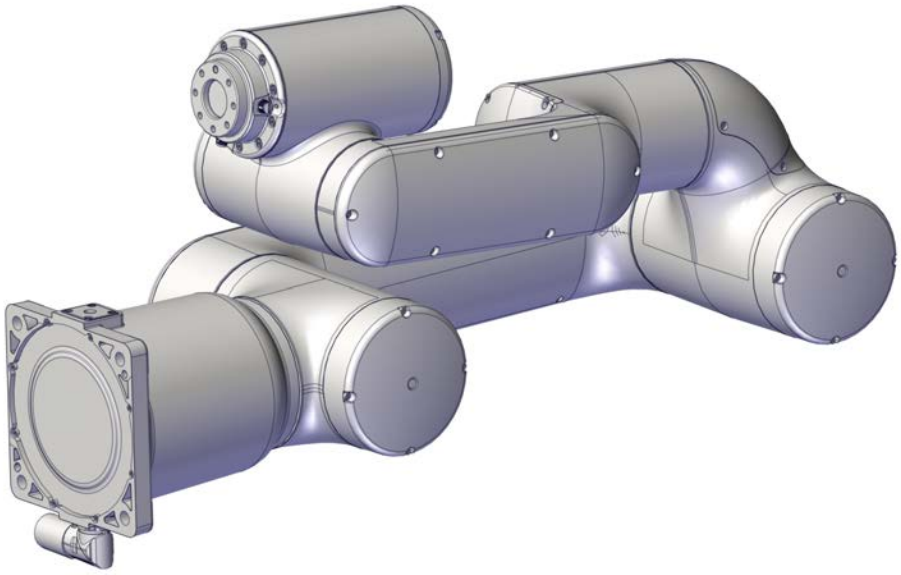
If the robot can not be fastened to the foundation directly, store it in the delivery package.

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

Transportation and shipping position

The figures show the robot in its shipping position, which also is a recommended transportation position.

CRB 15000-5/0.95



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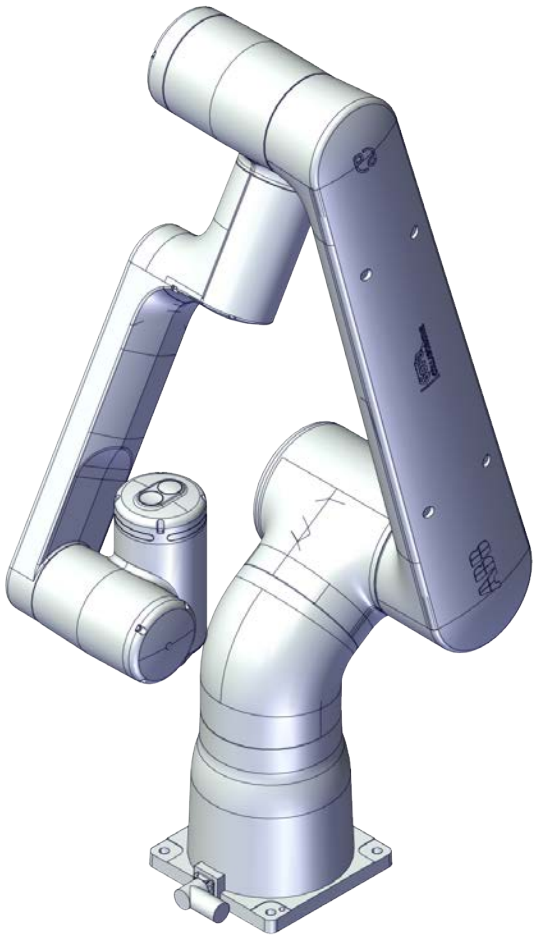
Axis 1	0°
Axis 2	0°
Axis 3	+85°
Axis 4	0°
Axis 5	0°
Axis 6	0°

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3.2.2 Risk of tipping/stability
Continued

CRB 15000-10/1.52



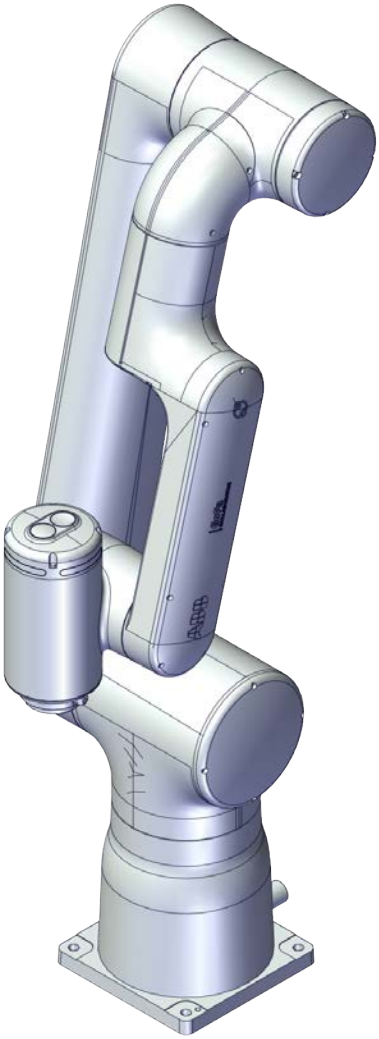
xx2300000380

Axis 1	0°
Axis 2	-15°
Axis 3	-225°
Axis 4	0°
Axis 5	-30°
Axis 6	0°

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CRB 15000-12/1.27



xx2300000381

Axis 1	0°
Axis 2	-10°
Axis 3	+85°
Axis 4	0°
Axis 5	+15°
Axis 6	0°

WARNING

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

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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 56*.

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 61*. See *Orienting and securing the robot on page 61*.
4	Connect the manipulator to the controller.	See • *Product manual - OmniCore C30*
5	Configure the safety settings.	See • *Product manual - OmniCore C30*
6	How to start and run the robot is described in the product manual for the controller.	See • *Product manual - OmniCore C30*
7	Install required equipment, if any. • *Installation of brake release tool on page 75*	
8	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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.

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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.

For CRB 15000-5/0.95, two persons are always required when lifting and securing the robot. For CRB 15000-10/1.52 and CRB 15000-12/1.27, lifting accessories, such as lifting roundslings, shall be prepared for the lifting and securing.

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	32 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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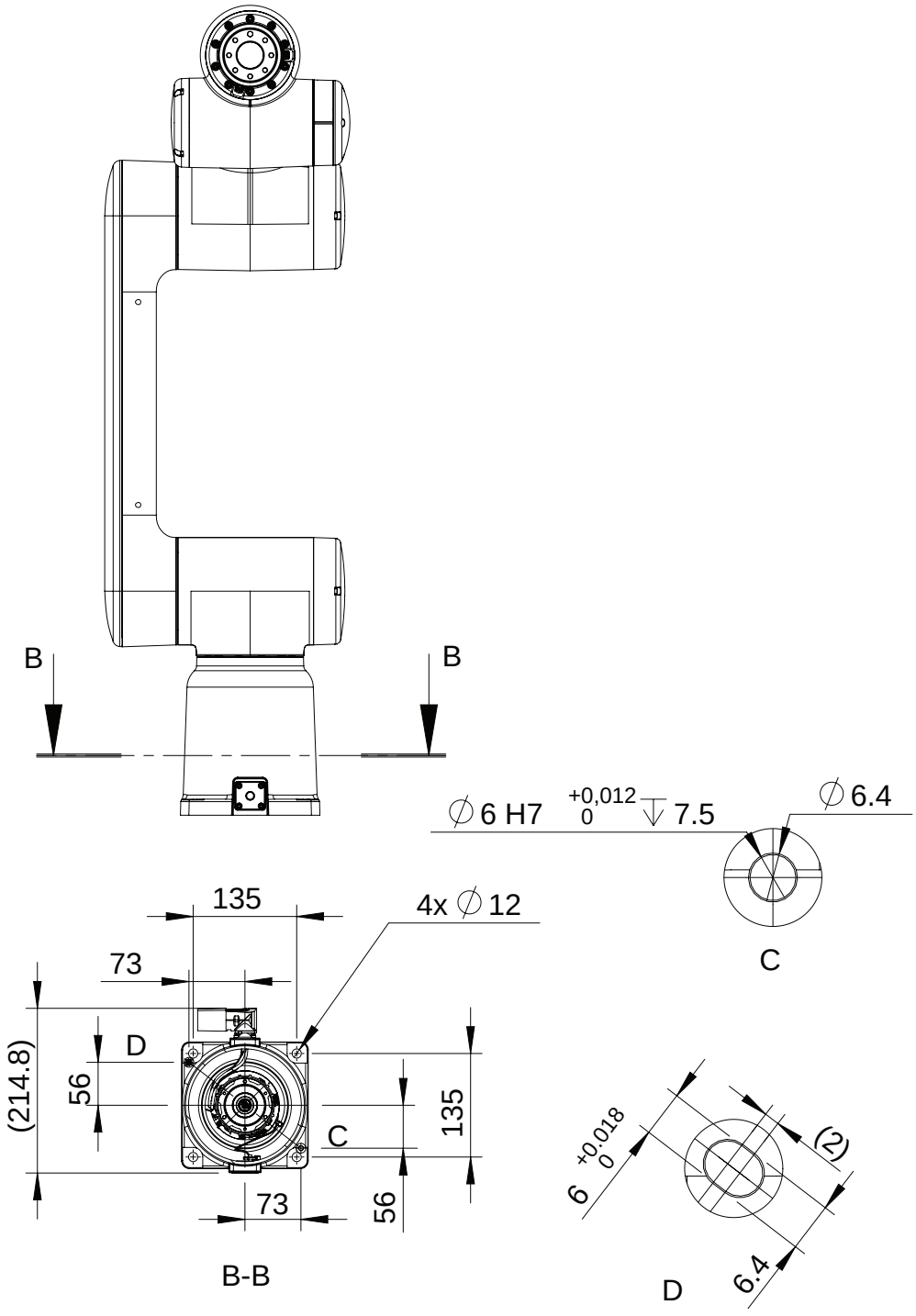
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3.3.2.1 Orienting and securing the robot
Continued

Hole configuration, base

CRB 15000-5/0.95

This illustration shows the hole configuration used when securing CRB 15000-5/0.95.



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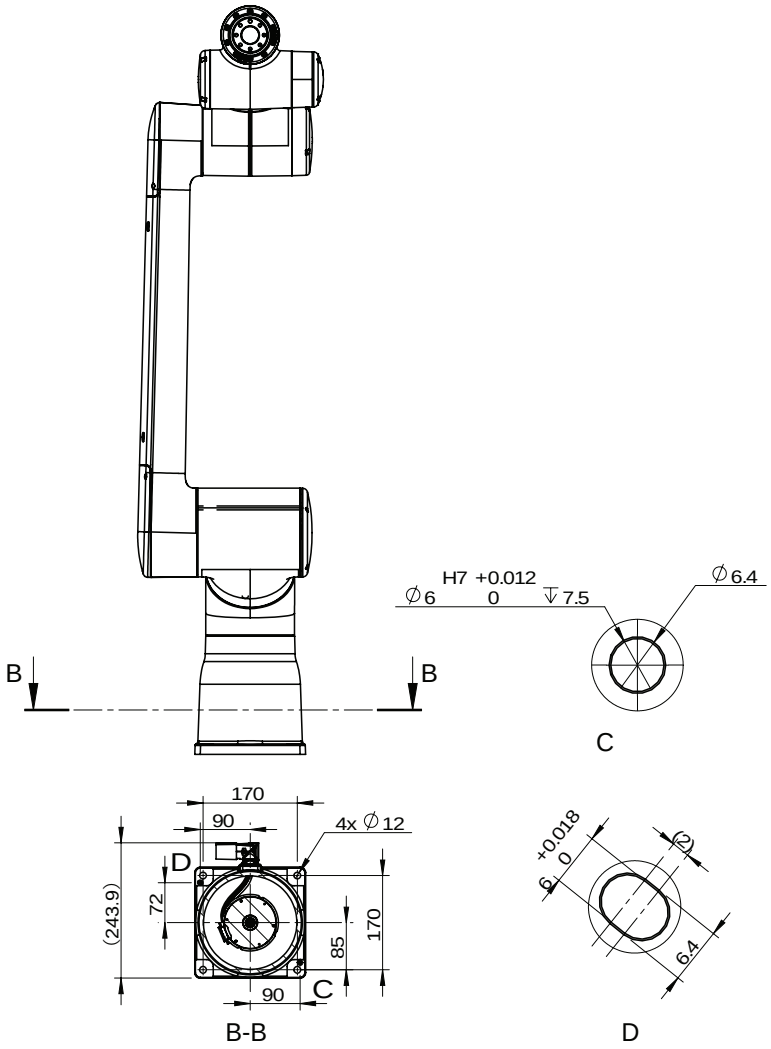
C	Circular hole for locating pin
D	Elongated hole for locating pin

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CRB 15000-10/1.52

This illustration shows the hole configuration used when securing CRB 15000-10/1.52.



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

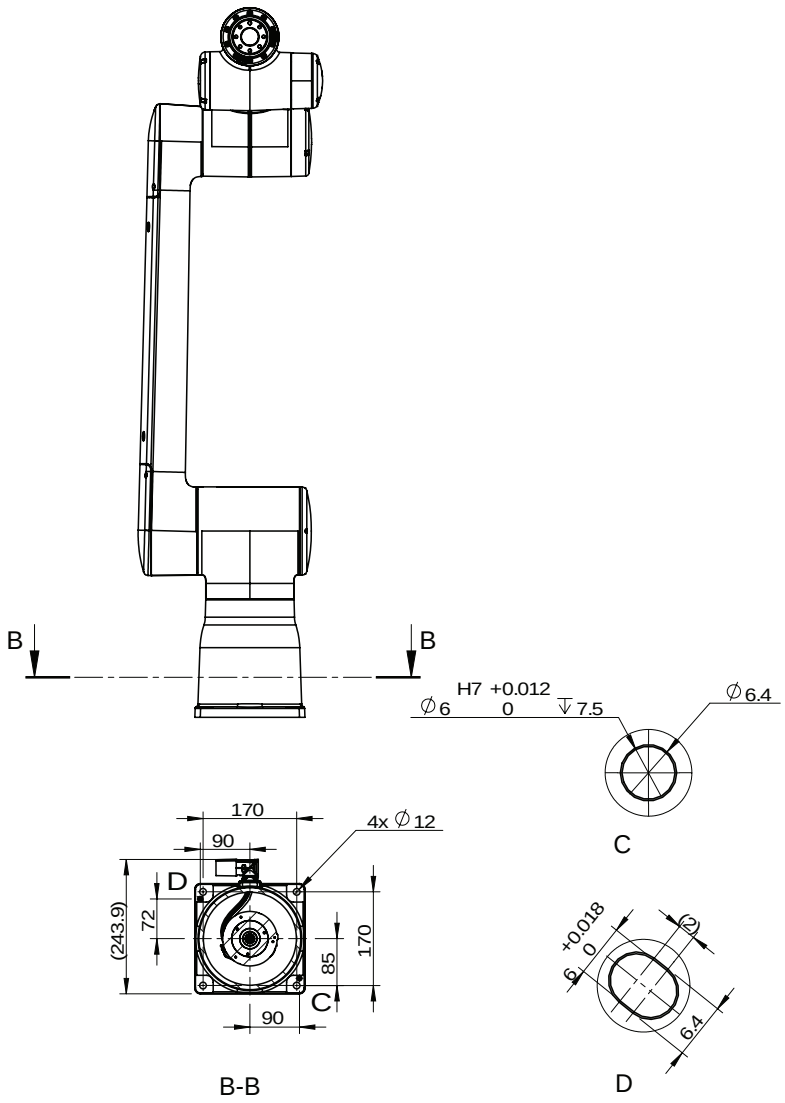
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3.3.2.1 Orienting and securing the robot
Continued

CRB 15000-12/1.27

This illustration shows the hole configuration used when securing CRB 15000-12/1.27.



xx2300000383

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

Lifting and securing the robot

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

Preparations of the installation site

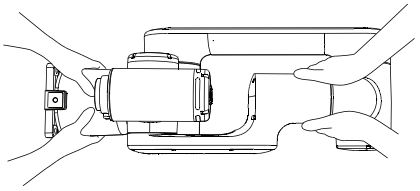
	Action	Note
1	Make sure the installation site for the robot conforms to the specifications in section *Technical data on page 40*.	

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	Action	Note
2	Prepare the installation site with attachment holes.	The hole configuration of the base is shown in *Hole configuration, base on page 62*.
3	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Prepare the lifting roundsling.	Length: 2 m Lifting capacity: >100 kg

Lifting and securing the robot (-5/0.95)

	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	Carry the robot to the installation site. **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. • 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: 32 Nm ±10%

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3.3.2.1 Orienting and securing the robot
Continued

Lifting and securing the robot (-10/1.52 and -12/1.27)

	Action	Note
1	Make sure the robot is positioned in the recommended position for transportation and lifting.  **WARNING** The robot is mechanically unstable if not secured to the foundation.	Recommended position for transportation and lifting is shown in *Transportation and shipping position on page 57*.
2	 **CAUTION** The weight of the CRB 15000 robot is up to 51 kg All lifting accessories used must be sized accordingly.	

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	Action	Note
3	Attach the roundslings to the robot according to the figure. Make sure the roundslings do not rub against any sharp edges.	**CRB 15000-10/1.52**  xx2300000384
		CRB 15000-12/1.27  xx2300000385
4	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
5	Raise the overhead crane to lift the robot.	
6	Move the robot to the installation site. **CAUTION** Do not leave the robot standing unfastened to the foundation, it is not stable on its own.	

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3.3.2.1 Orienting and securing the robot
Continued

	Action	Note
7	Fit two pins to the holes in the base.	Centering pins: DIN6325, hardened steel Ø6x24 mm, 2 pcs .
8	Guide the robot gently, using the attachment screws while lowering it into its mounting position.	Make sure the robot base is correctly fitted onto the pins.
9	Fit the securing screws and washers in the attachment holes of the base.	Screws: M10x35, 4 pcs, quality 8.8 Washers: 23/10.5/2.5 mm Steel
10	Tighten the bolts in a crosswise pattern to ensure that the base is not distorted.	Tightening torque: 32 Nm ±10%

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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 using the FlexPendant.

To fulfill ISO 10218-1:2011 5.13 Movement without drive power, a FlexPendant must be available on the site when using RobotWare 7.10 and higher.

CAUTION

On robots with RobotWare earlier than 7.10, the brakes are released using an external brake release tool, see *Manually releasing the brakes with the external tool on page 71*.

DANGER

If there is no FlexPendant connected, or in a system failure state, the brake release function is not immediately available. Dangerous clamping situations should always be mitigated using safety functions, see the section *Configuring the software on page 110*.

CAUTION

At least two persons should be present when releasing the brakes.

Releasing the brakes from the FlexPendant

Use this procedure to release the holding brakes using the FlexPendant.

Note

The manipulator needs to be powered and motors in state Motors OFF.

	Action	Note
1	Press the emergency stop. On the FlexPendant, a tab appears, **Brake Release**.	
2	Open the brake release window and select which brakes to release. Tap **Request Brake Release**. The LEDs on the arm-side interface starts blinking yellow.	See *Arm-side interface on page 101*.
3	**DANGER** When releasing the holding brakes, gravity can affect the robot so that the arm moves downwards quickly. Make sure that the arm is secured against collapsing under gravity and that no personnel is at risk of getting hit by the arm moving downwards.	

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3.3.3 Manually releasing the brakes

Continued

	Action	Note
4	Press the enabling device halfway in within 30 seconds. This releases the brakes.	If the enabling device is not pressed in within 30 seconds, the brake release function will be cancelled.
5	Move the robot arm to a desired position.	
6	The brake will function again as soon as the enabling device is released.	When the enabling device is released or pressed fully in, then the brakes are activated immediately. To continue moving the arm freely, the brake release function must be restarted.

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3.3.4 Manually releasing the brakes with the external tool

Introduction to manually releasing the brakes

This section describes how to release the holding brakes for the axes motors using an external brake release tool.

CAUTION

The external brake release tool works on robots with RobotWare earlier than 7.10. On robots with RobotWare 7.10 or later, the tool does not work.

How to release the brakes using the FlexPendant is described in section *Manually releasing the brakes on page 69*.

CAUTION

At least two persons should be present when releasing the brakes.

Required equipment

Equipment	Article number	Note
Brake release tool	3HAC079146-001	For releasing the holding brakes of a joint unit motor if the RobotWare version is 7.8 or older. **Note** The spare parts related to the brake release function using the external tool are discontinued from Q2 2023.

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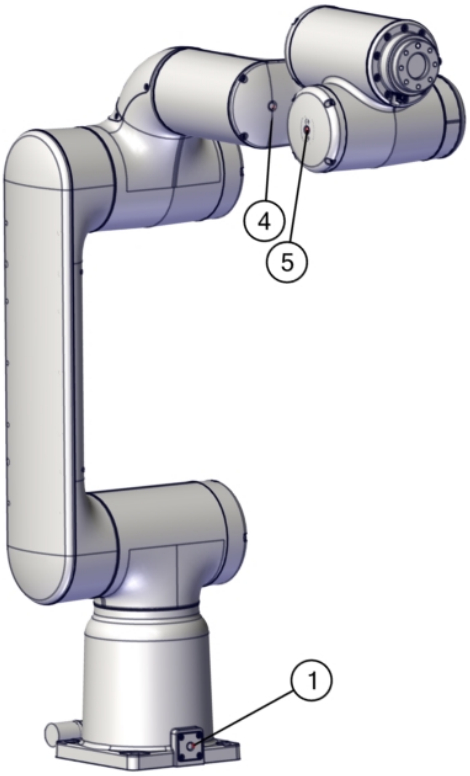
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3.3.4 Manually releasing the brakes with the external tool
Continued

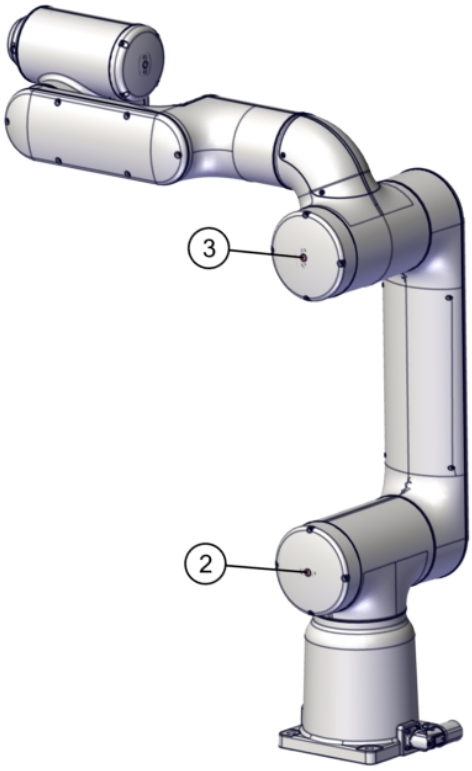
Location of the brake release points

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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xx2000002540

Releasing the brakes

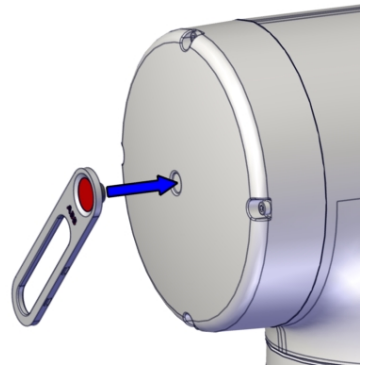
This procedure describes how to release the holding brakes using the brake release tool.

Note

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

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	Action	Note
1	Take out the tool from its holder.	Brake release tool: 3HAC079146-001  xx2000002542
2	**DANGER** When releasing the holding brakes, gravity can affect the robot so that the arm moves downwards quickly. Make sure that the arm is secured against collapsing under gravity and that no personnel is at risk of getting hit by the arm moving downwards.	
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 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 1059*.
4	Put back the tool in its holder and store on specified location close to the robot.	

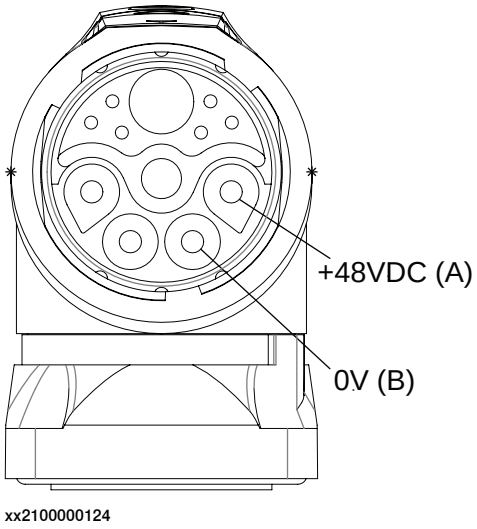
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3.3.4 Manually releasing the brakes with the external tool
Continued

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.	

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3.3.5 Installation of brake release tool

Brake release tool included in robot delivery

For robots delivered with RobotWare earlier than 7.10, a brake release tool is included in the robot package box. The tool is used for releasing the holding brakes of the axes motors.

> **CAUTION**
>
> The external brake release tool works on robots with RobotWare earlier than 7.10. On robots with RobotWare 7.10 or later, the tool does not work.
>
> How to release the brakes using the FlexPendant is described in section *Manually releasing the brakes on page 69*.



xx2000002541

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.

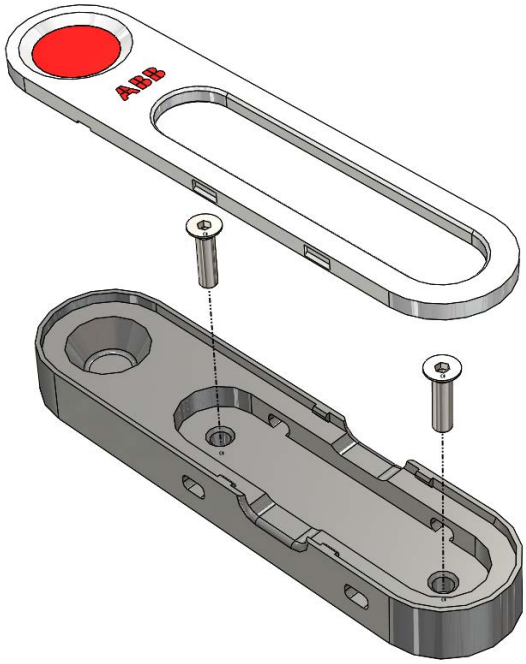
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3.3.5 Installation of brake release tool
Continued

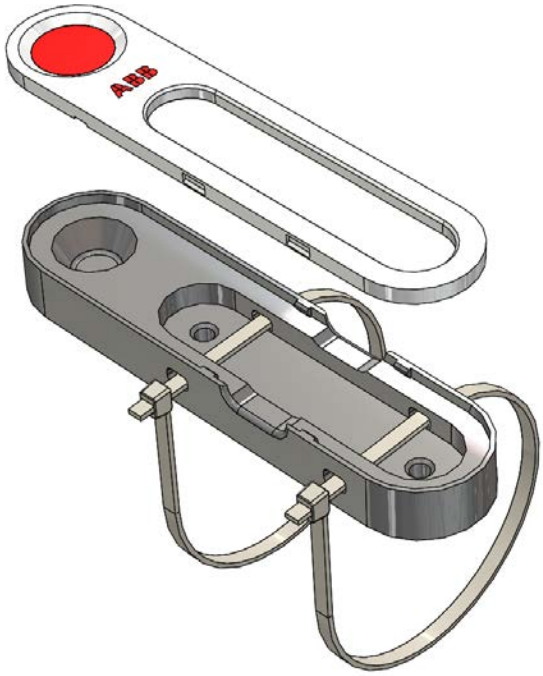
Securing the brake release tool holder

Securing with screws



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Securing with cable ties



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3.3.6 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. If the robot is mounted in any other angle than 0°, then 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 mounting positions are described in *Mounting positions on page 40*, and the requirements on the foundation are described in *Requirements, foundation on page 42*.

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 ±π/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 ±π/2 (±1.570796).

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

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3.3.6 Setting the system parameters for an inverted or a tilted robot
Continued

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

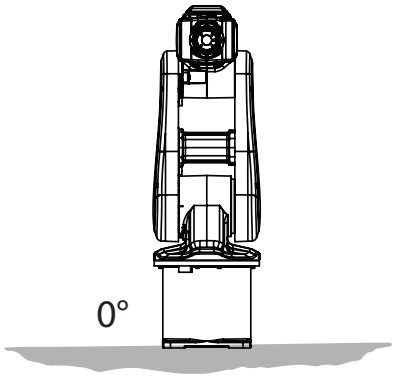
The parameter *Gravity Beta* (or *Gravity Alpha*) specifies the mounting angle of the robot in radians. It is calculated in the following way.

`Gravity Beta = A° x 3.141593/180 = B 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*)

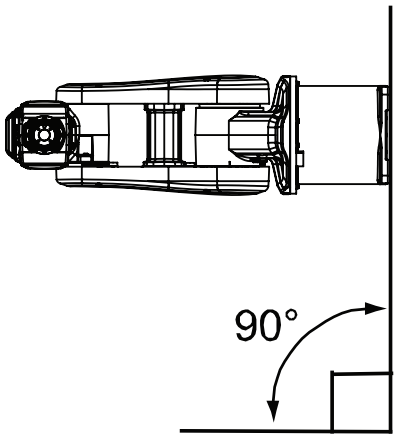
The following illustration shows the IRB 120, but the same principle applies for all robots.



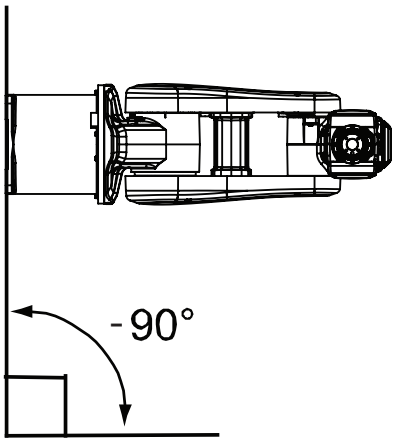
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Mounting angle	Gravity Alpha
0° (Floor mounted)	0
90° (Wall)	1.570796
-90° (Wall)	-1.570796

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 52*.

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.

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

Define loads carefully

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

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

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

Stopping time and braking distances

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

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

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3.3.8 Fitting equipment on the robot (robot dimensions)

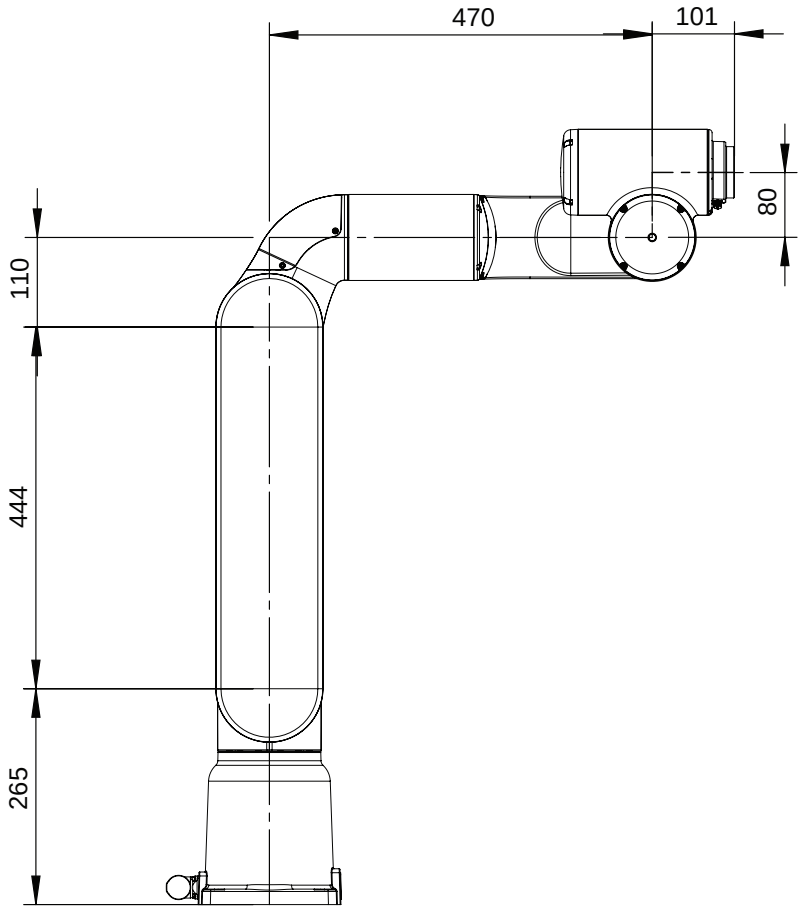
Note

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.

CRB 15000-5/0.95



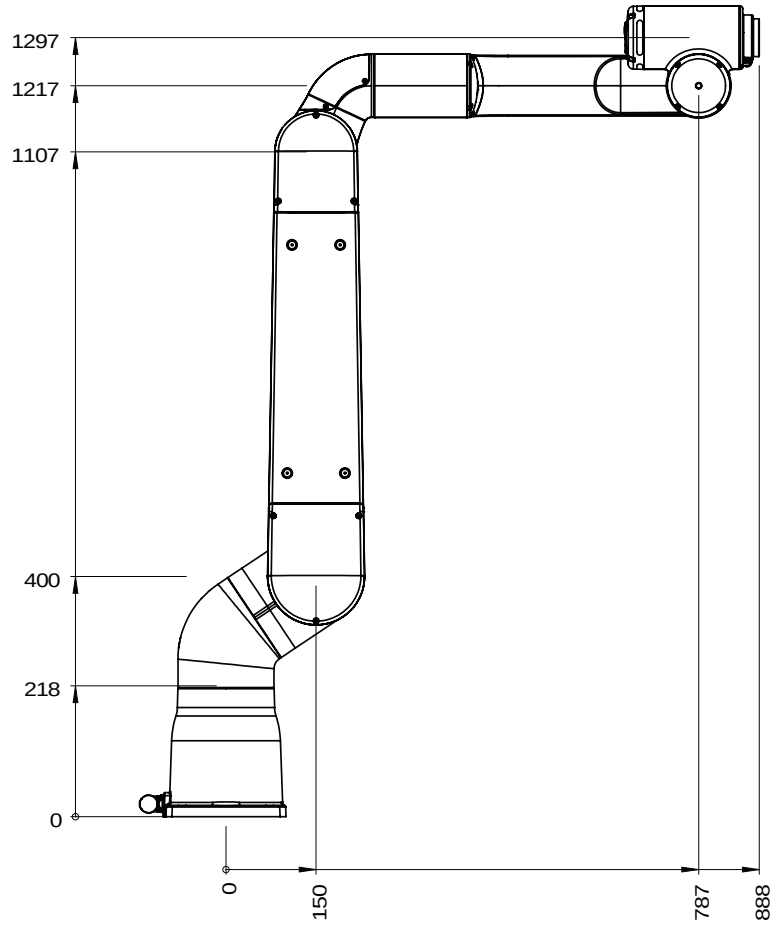
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3.3.8 Fitting equipment on the robot (robot dimensions)
Continued

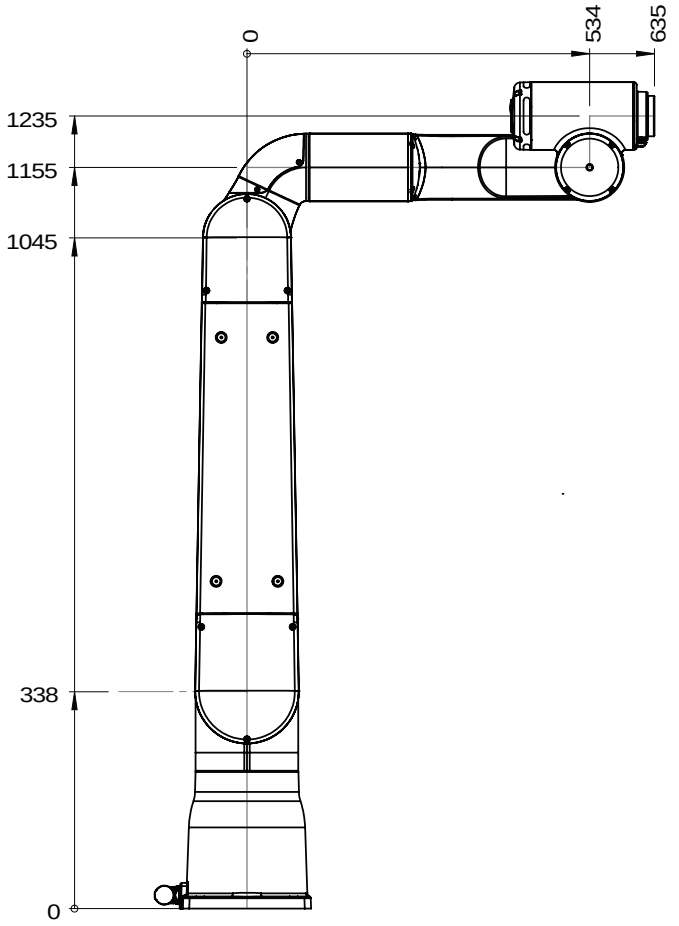
CRB 15000-10/1.52



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Fitting equipment on the robot arm

ELECTRICAL SHOCK

External cable routing where voltages deemed to be hazardous live, ground resistance path shall not exceed 0.1 ohms for all metal parts exposed or likely to be touched by a person during normal operation, and likely to become energized through electrical malfunction.

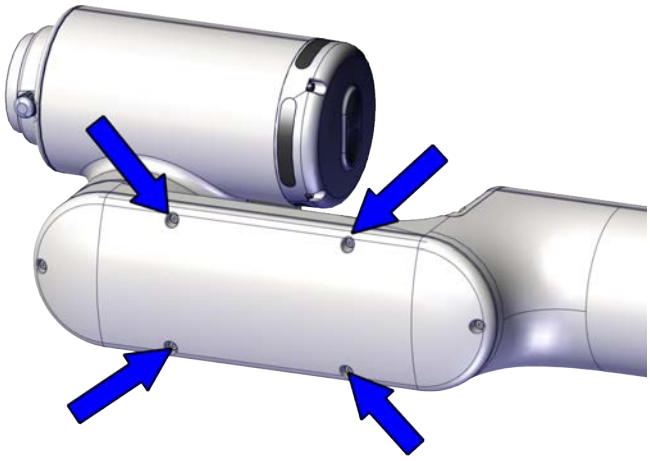
Upper arm

The robot upper 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, or to replace the four screws on the upper arm cover with hex spacers, as shown in the following figure (taking CRB 15000-5/0.95 as an example).

Continues on next page

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3.3.8 Fitting equipment on the robot (robot dimensions)
Continued



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Definitions of dimensions and masses are shown in *Holes for fitting extra equipment on page 85*. Requirements on hex spacers are shown in *Fastener quality for hex spacers on page 87*.

Note

Sharp edges or other hazards related to the hex spacers or fitted equipment must be taken into consideration.

Note

If the gasket screws on the upper arm cover of CRB 15000-5/0.95 are replaced with hex spacers, then the IP54 is no longer fulfilled.

Before fitting equipment to the robot upper arm, special considerations must be taken:

- 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 using the external brake release tool.

  Brake release points are shown in *Manually releasing the brakes on page 69*.

  CAUTION

  The external brake release tool works on robots with RobotWare earlier than 7.10. On robots with RobotWare 7.10 or later, the tool does not work.

- The armload interface can handle loads up to 1 kg. This includes the weight of the cabling, tools, and workpiece (if lifted).

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Note

When the arm load is defined, the maximum payload capacity may be reduced in certain poses. A simulation in RobotStudio shall be performed to verify that the combination of arm load and payload works in the intended application.

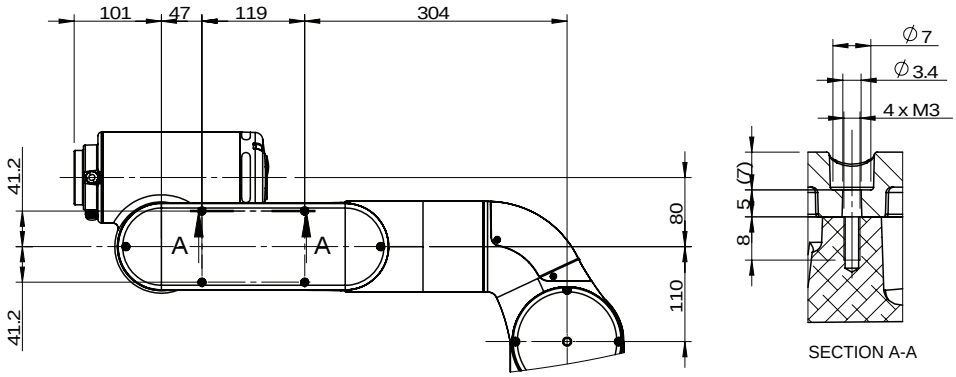
Housing and lower arm

For CRB 15000-10/1.52 and CRB 15000-12/1.27, robot housing and lower arm can also handle extra loads up to 1 kg respectively. Definitions of dimensions and masses are shown in *Holes for fitting extra equipment on page 85*.

Maximum allowed arm load depends on center of gravity of arm load and robot payload. When an armload is attached, the payload on the wrist is reduced.

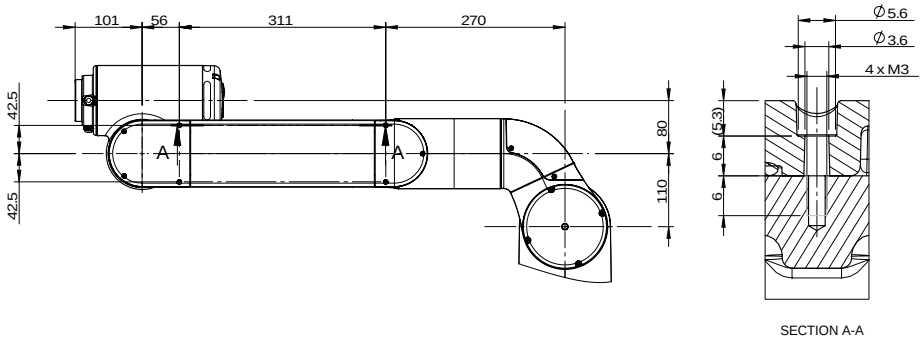
Holes for fitting extra equipment

Upper arm, CRB 15000-5/0.95



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Upper arm, CRB 15000-10/1.52



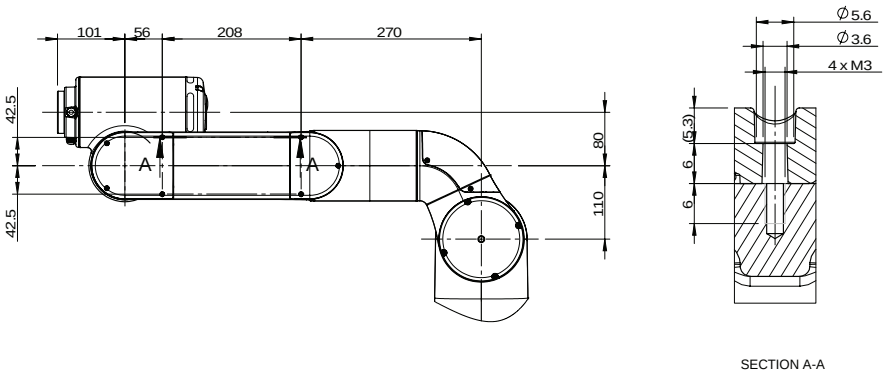
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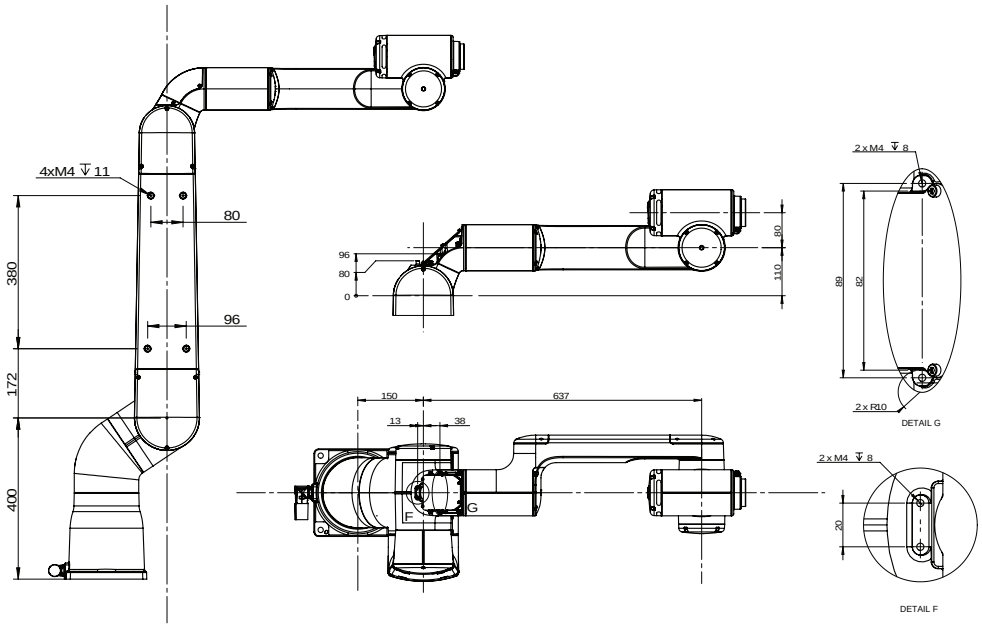
3.3.8 Fitting equipment on the robot (robot dimensions)
Continued

Upper arm, CRB 15000-12/1.27



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Housing and lower arm, CRB 15000-10/1.52

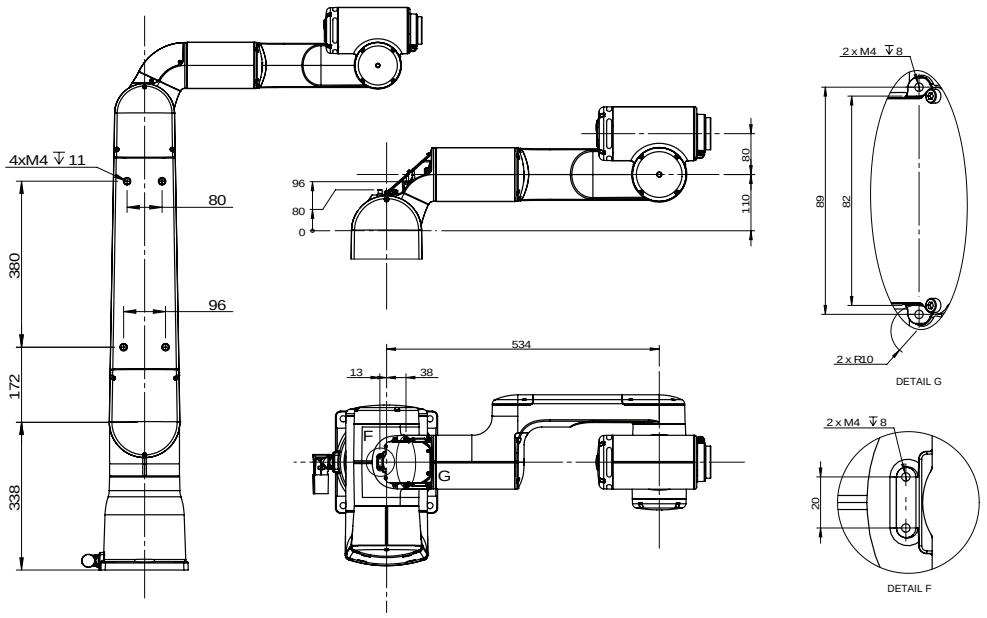


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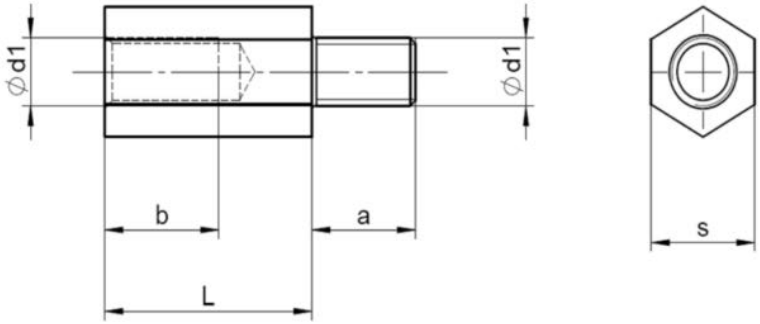
Housing and lower arm, CRB 15000-12/1.27



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Fastener quality for hex spacers

The following table shows the requirements on hex spacers for fitting equipment on the upper arm covers.



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	CRB 15000-5/0.95	CRB 15000-10/1.52 CRB 15000-12/1.27
Material	Stainless steel 4.8, or higher	Stainless steel 4.8, or higher
Tightening torque	0.6 Nm+/-5%	0.6 Nm+/-5%
Minimum thread length (a)	8 mm	10 mm
Thread length (b)	8 mm	10 mm
Screw head width (S)	5 mm	5 mm
Length (L)	18 mm	25 mm

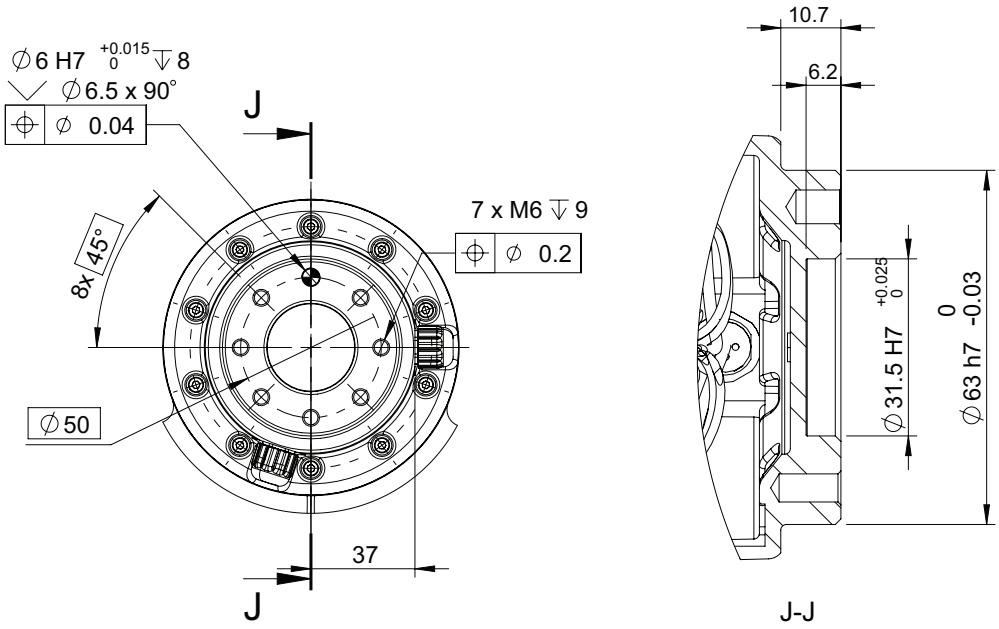
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3.3.8 Fitting equipment on the robot (robot dimensions)
Continued

	CRB 15000-5/0.95	CRB 15000-10/1.52 CRB 15000-12/1.27
Example of suitable hex spacer	Bossard, article number: 304318041152 Keystone, article number: 24289~24294	Bossard, article number: 304325041152 Bossard, article number: 304330041152

Tool flange



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Fastener quality on tool flange

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

Screws with quality class 12.9 are recommended.

Also note the thread depth on the tool flange. Using too long screws may damage the tool flange and cause the tool to be improperly fastened, which is a safety hazard.

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3.3.9 Test run after installation, maintenance, or repair

Safe handling

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

DANGER

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

	Action
1	Remove all tools and foreign objects from the robot and its working area.
2	Verify that the robot is properly secured to its position by all screws, before it is powered up.
3	Verify that any safety equipment installed to secure the position or restrict the robot motion during service activity is removed.
4	Verify that the fixture and work piece are well secured, if applicable.
5	Verify that 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.

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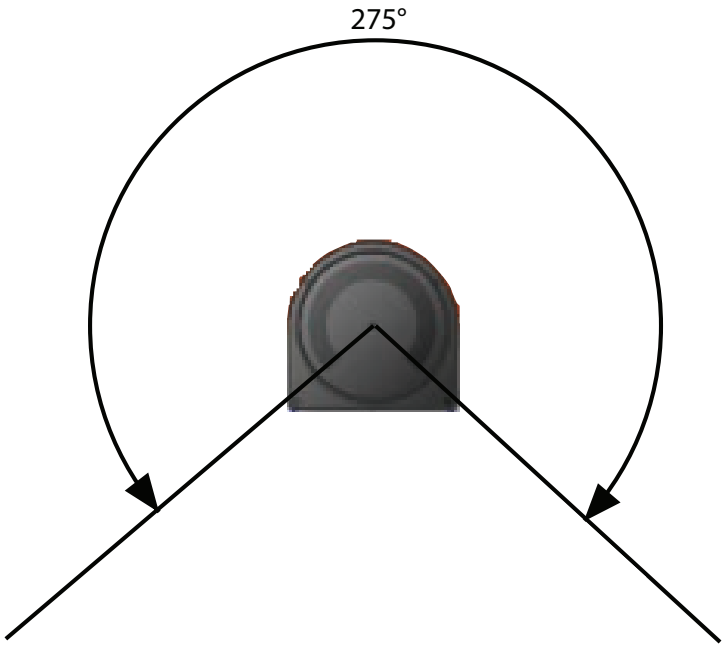
3.3.10 Installation of laser scanner

Overview

ABB provides safety separation and speed control functions to CRB 15000 by installing the Collaborative Speed Control add-in in the robot system and connecting the robot with one or two safety laser scanners. The 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 PROFIsafe-based laser scanner (option 3051-1 PROFIsafe scanner)
- 2 PROFIsafe-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)

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Connection between PROFIsafe-based laser scanners and the OmniCore controller differs according to the PROFINET options selected and installed in the system.

- If only options [3020-2] PROFINET Device and [3023-2] PROFIsafe Device are selected and installed, the 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.
- If options [3020-1] PROFINET Controller and [3023-1] PROFIsafe Controller are selected and installed, the laser scanner could communicate with the OmniCore controller directly via the LAN port.

SafetyIO-based laser scanners connects to the OmniCore controller with SafeMove and installed with the scalable I/O device DSQC1042 Safety digital base (option 3037-2). 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, which are available on *SICK®* website.

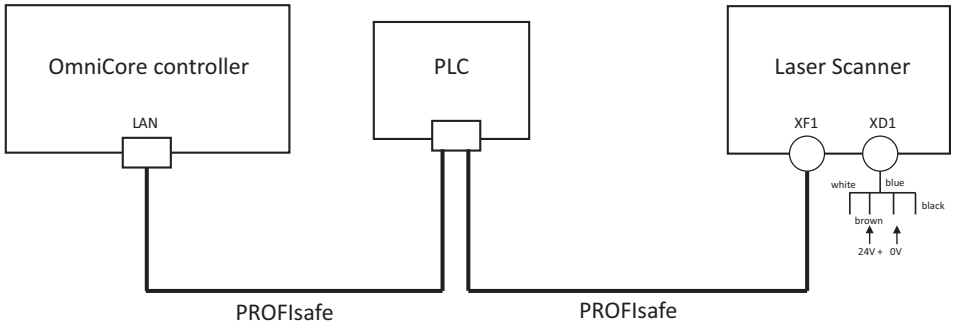
Connecting the laser scanner(s)

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

Note

External 24V power supply shall be prepared for power connection of laser scanners.

1 PROFIsafe-based laser scanner (option 3051-1), with PLC connected



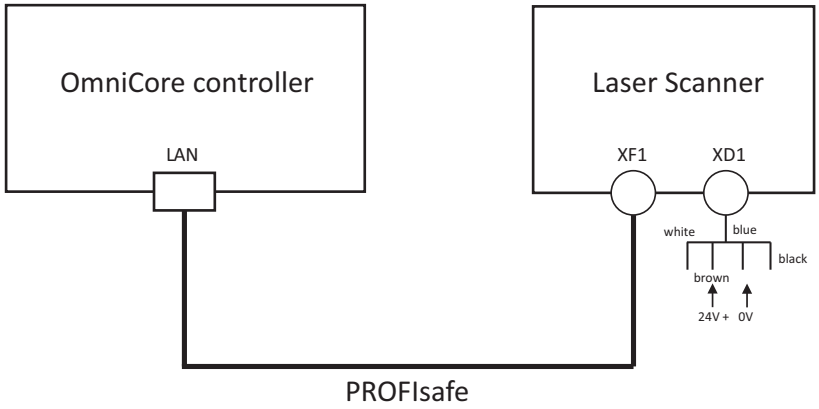
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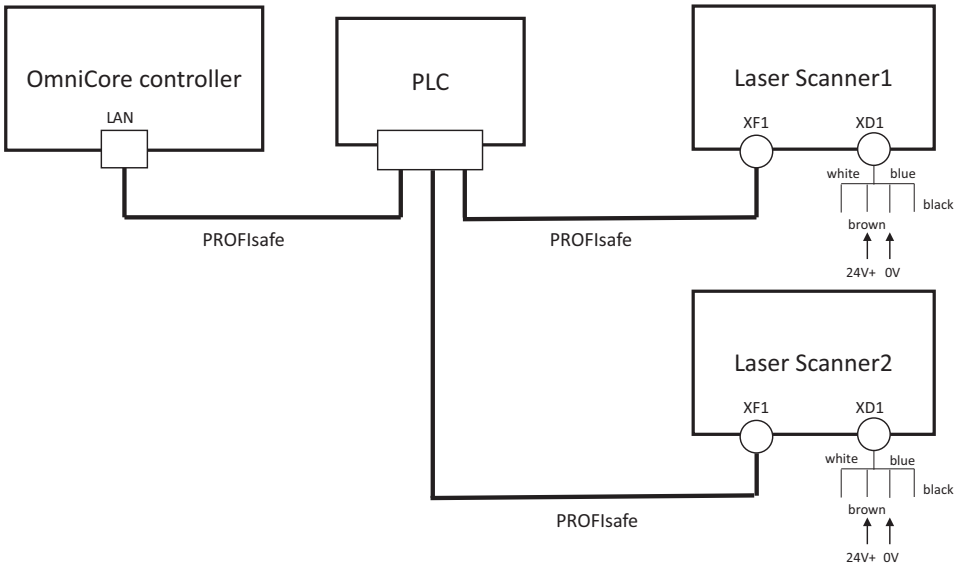
3.3.10 Installation of laser scanner
Continued

1 PROFIsafe-based laser scanner (option 3051-1), without PLC connected



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2 PROFIsafe-based laser scanners (option 3051-3), with PLC connected

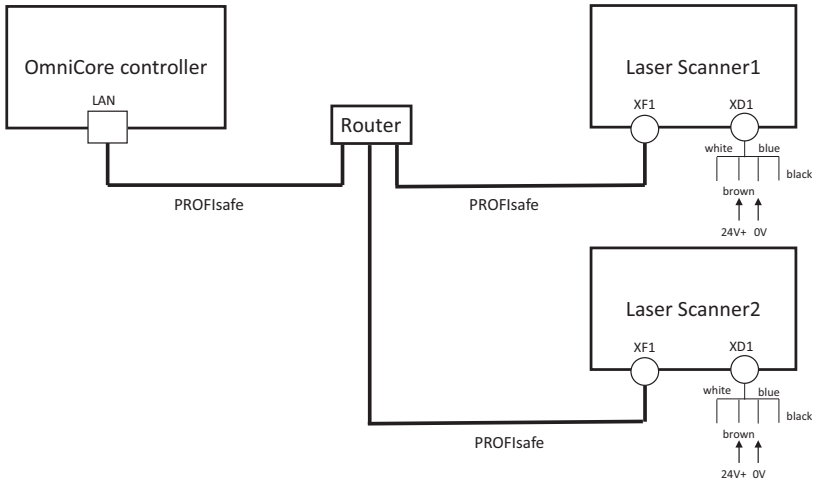


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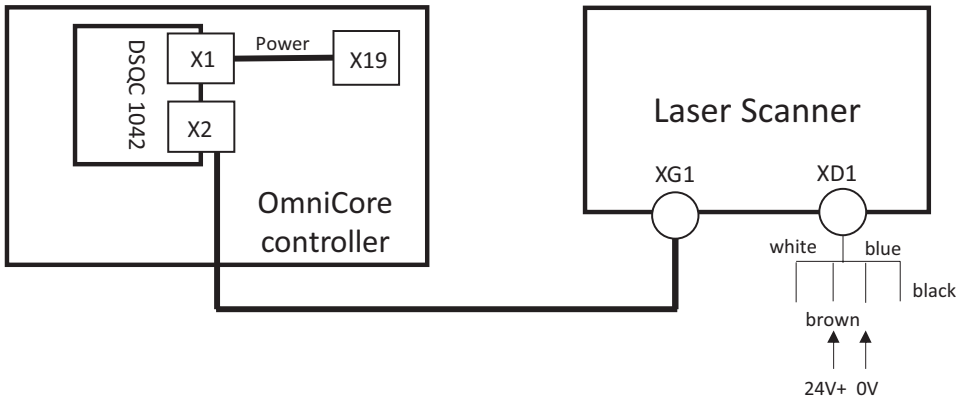
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2 PROFIsafe-based laser scanners (option 3051-3), without PLC connected



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



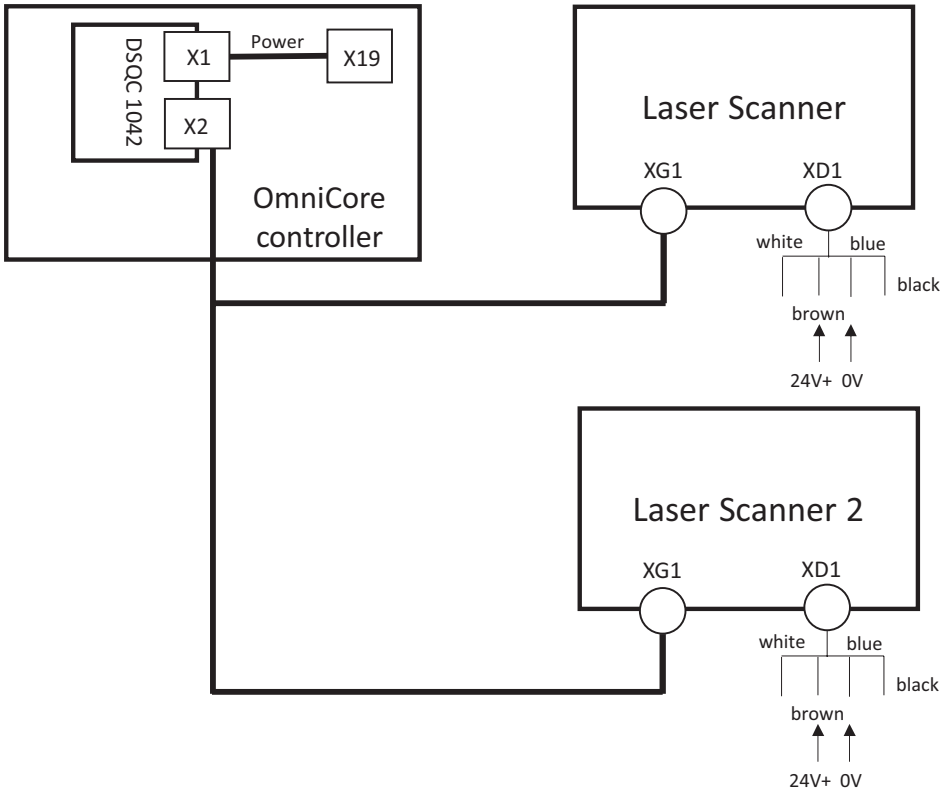
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3.3.10 Installation of laser scanner
Continued

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



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Note

For PROFIsafe-based laser scanner, if working with the CRB 15000 in a version 1.2.1 or earlier, the scanners should connect to the WAN port on the controller.

Note

If there are additional scalable I/O devices available, install and configure the additional devices by following the detailed procedures in *Application manual - Scalable I/O*.

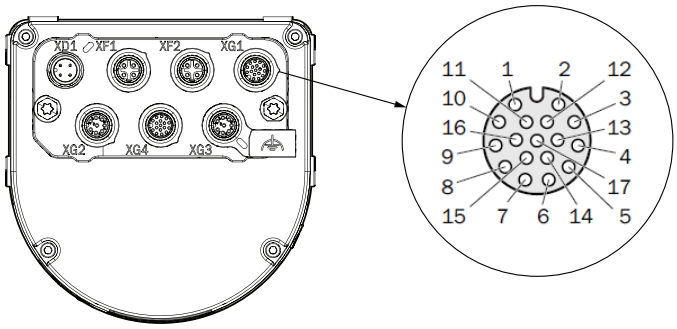
Connector information

Pin assignment on XG1 of SafetyIO-based laser scanners

XG1 connector on SafetyIO-based laser scanner is a 17-pin, A-coded M12 female connector. Pins 1-4 and pin 17 on XG1 are occupied for connecting the laser scanner and scalable I/O device, while other 12 pins can be used for local inputs and outputs.

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Pin	Description	Wiring color
1	OSSD pair 1, OSSD A	Brown
2	OSSD pair 1, OSSD B	Blue
3	OSSD pair 2, OSSD A	White
4	OSSD pair 2, OSSD B	Green
5	Universal input 1	Pink
6	Universal input 2	Yellow
7	Universal input 3	Black
8	Universal input 4	Grey
9	Universal input 5	Red
10	Universal input 6	Violet
11	Universal input 7	Grey with pink
12	Universal input 8	Red with blue
13	Universal input 9	White with green
14	Universal input 10	Brown with green
15	Universal output 1	White with yellow
16	Universal output 2	Yellow with brown
17	Voltage 0 V DC	White with grey

Configuring the laser scanner(s)

Laser scanner configuration depends on the type and number of scanners connecting to the robot and RobotWare version, and also based on the installation of the Collaborative Speed Control add-in. See *Application manual - Collaborative Speed Control add-in* for details about how to configure the laser scanners to implement speed control.

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3.4 Electrical connections

3.4.1 Robot cabling and connection points

Introduction

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

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

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

Main cable categories

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

Cable category	Description
Robot cables	Handles power supply to and control of the robot's motors. Specified in the table *Robot cables on page 96*.
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

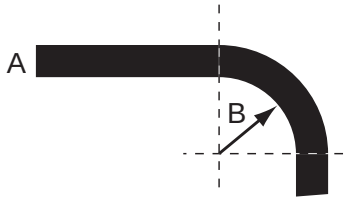
Cable length	Article number
Hybrid floor cable 3 m	3HAC073212-001
Hybrid floor cable 7 m	3HAC073212-002
Hybrid floor cable 15 m	3HAC073212-003
Drag chain cable 15 m	3HAC086915-003

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Bending radius for interconnection cables

The minimum bending radius is listed as follows for the interconnection cables.



xx1600002016

A	Diameter
B	Hybrid floor cable (fixed): ≥ 70 mm
	Drag chain cable (fixed): ≥ 44 mm
	Drag chain cable (moved): ≥ 145 mm

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3.4.2 Customer connections on the manipulator

Introduction

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

Customer cabling

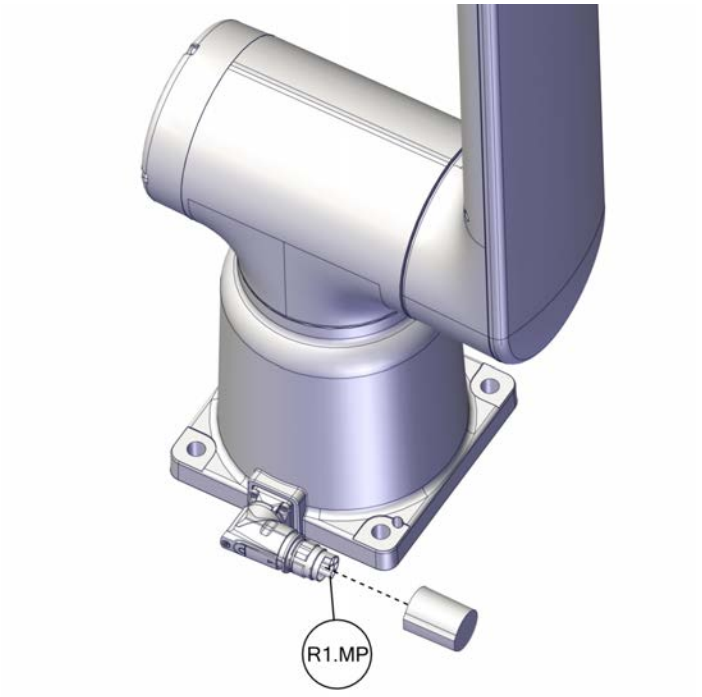
Customer connection	Cable specification	Article number	Rating in each wire[i]	Note
Customer power (CP)	Raw cable is twisted pair 1x2xAWG24	See *Product manual, spare parts - CRB 15000*	24V[ii] 3A	Routed internally with the manipulator cable harness.
Customer signal (CS)	2x2xAWG26 in 4x2XAWG26 cable	See *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

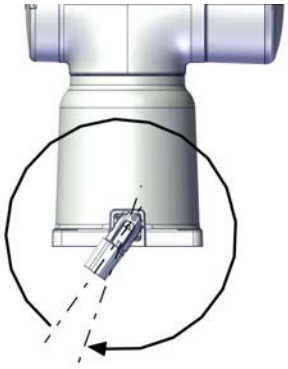
The R1.MP on the base is used for transferring DC bus, EtherCat and customer signals (CP/CS).



xx2100000228

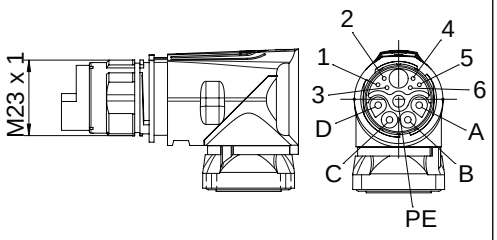
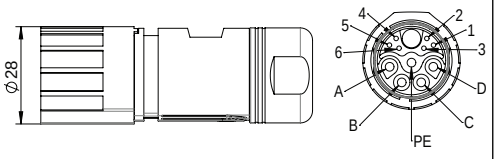
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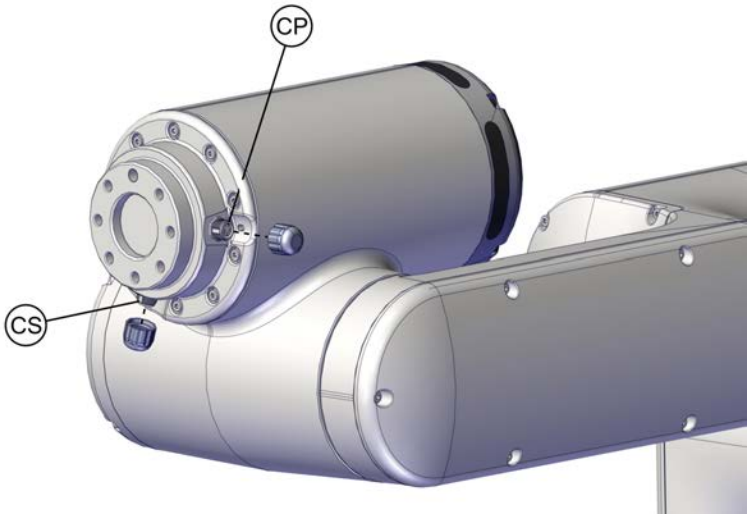


xx2100002065

-	The connector can be rotated 330° clockwise.

Pos	Connector type	Layout
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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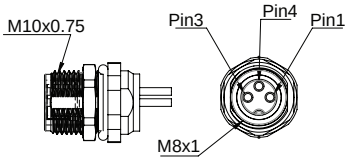
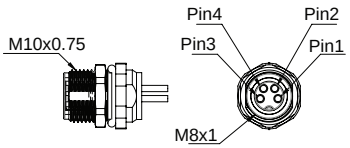
3.4.2 Customer connections on the manipulator
Continued

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/un-mating	Layout	Pin specification
CP	M8 3 pin female, 200 mm wire, straight (two pins for use, one pin is spare)	0.4 Nm	 xx2100000220	Pins on R2.CP: 1: CP+ 3: CP- 4: NC
CS	M8 4 pin female, 200 mm wire, straight	0.4 Nm	 xx2100000219	Pins on R2.CS: 1: CS Pair_1 + 2: CS Pair_1 - 3: CS Pair_2 + 4: CS Pair_2 -

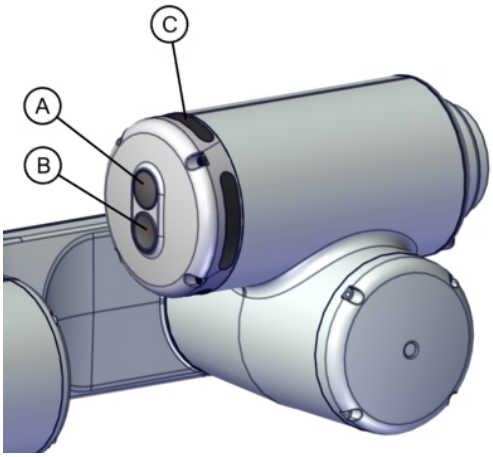
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3.5 Arm-side interface

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 117*, 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

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3.5.1 Configuring the arm-side interface
Continued

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 107*.

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	Description
White	Stand by state
Green	Program running
Yellow, steady	Lead through/programming mode
Yellow, blinking	Brake release signal is activated
Red	Error

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Configuring the buttons

Note

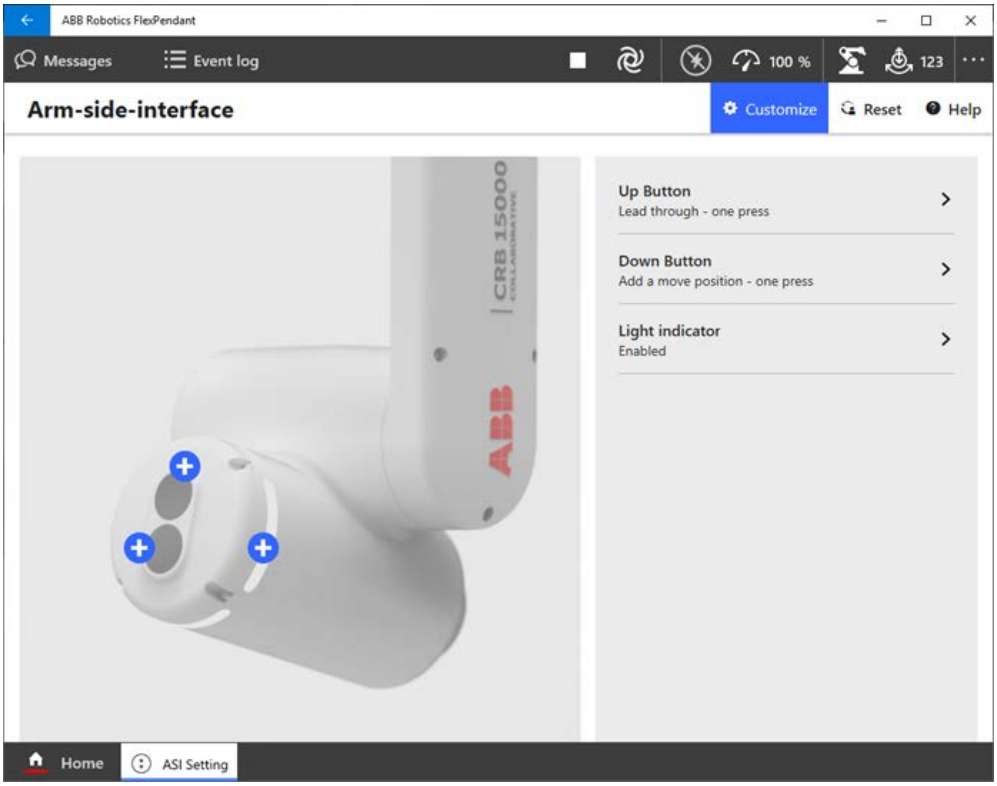
The buttons are deactivated until there is a valid safety configuration in the robot controller.

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**.



xx2100000080

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

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

Continues on next page

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3.5.1 Configuring the arm-side interface
Continued

Gripper

There is a routine available for the up button that can open and close a gripper. The function is toggled by each press of the button. To enable the gripper routine, open the Wizard web app.

> **CAUTION**
>
> Protect users from falling workpieces.

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. This can be used to verify to which robot the FlexPendant is connected, see *Testing the FlexPendant connection on page 106*.

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

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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 101*.

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 117*, 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 114*.

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.

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3.5.3 Testing the FlexPendant connection

Introduction

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.

> **Note**
>
> This technique should also be used to verify a Robot Control Mate connection before starting work.

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3.5.4 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.

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3.5.4 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 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, Robot Control Mate, 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

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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.

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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

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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

The functional safety and SafeMove configuration can be done in RobotStudio or on the FlexPendant. The functionality in RobotStudio is more extensive. Both interfaces are described in detail in *Application manual - Functional safety and SafeMove*. The FlexPendant user interface is also described in this manual, see *The SafeMove configurator app on FlexPendant on page 117*.

Singularities

Some positions in the robot working space can be attained using an infinite number of robot configurations to position and orient the tool. These positions, known as singular points (singularities), constitute a problem when calculating the robot arm angles based on the position and orientation of the tool.

Generally speaking, a robot has two types of singularities; arm singularities or wrist singularities.

The wrist singularities for the GoFa robot are different from other robots, due to the design.

Note

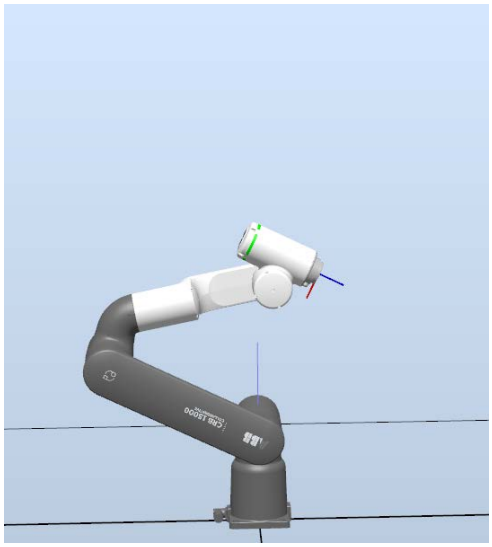
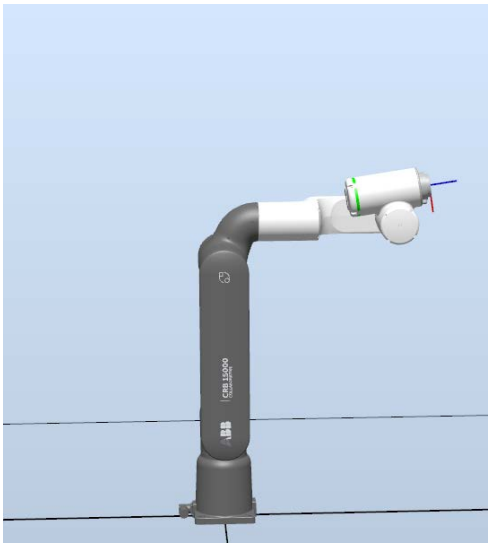
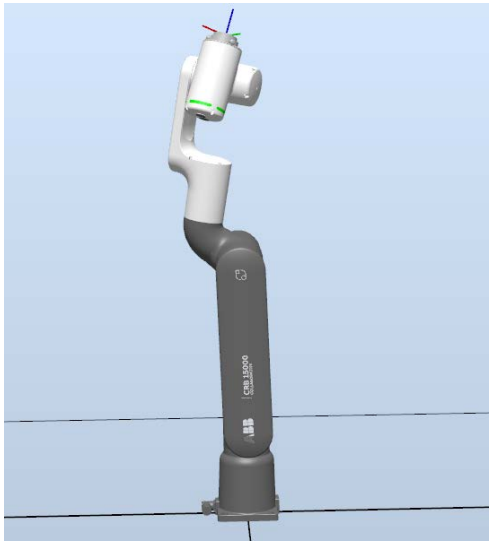
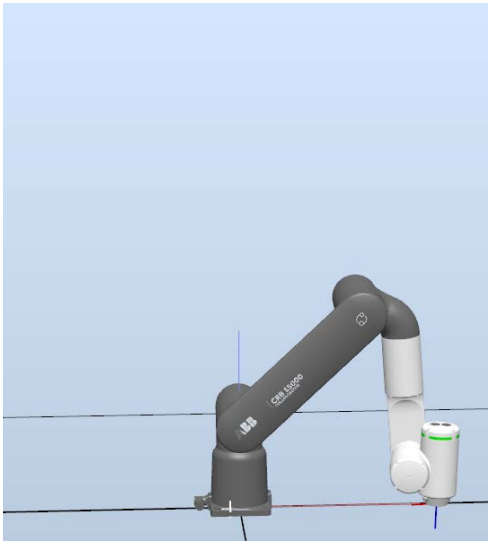
The singularities can, in combination with large tools, require thorough validation of forces if there is a risk of clamping situations.

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3.6.1 Information about software for the CRB 15000
Continued

Some typical examples of singularity positions for GoFa are shown here.

Typical arm singularities	Typical wrist singularities
	
xx2300000098	xx2300000099
	
xx2300000101	xx2300000100

For more information about singularity, see *Technical reference manual - RAPID Overview*, section *Singularities*.

About Collaborative Speed Control add-in

The Collaborative Speed Control add-in is a RobotWare add-in enabling a robot to setup safe collaborative configurations. Combining ABB SafeMove solution, the Collaborative Speed Control add-in provides safety separation and speed control functions to robots connected with safety laser scanner(s), and lead-through function to robots connected with a lead-through device.

The Collaborative Speed Control add-in is pre-installed in the robot system at delivery if any of following option is selected.

- 3313-1 Lead-through device

Continues on next page

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- 3351-*X*, any of safety laser scanner options
- 3143-1 Collab. speed control

It is also available separately in the add-ins section in RobotStudio to allow an installation to an existing controller or do an update.

Installing the Collaborative Speed Control add-in

Perform the following procedure to install the Collaborative Speed Control add-in, if it needs to be added to or updated for an existing robot system:

1. Start RobotStudio and click **Gallery** in the **Add-Ins** ribbon.
2. In the displayed **Gallery** window, use the **Search** function or **Common tags** to find the Collaborative Speed Control 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. Select **Add Controller** > **Connect to Controller** in the **Controller** ribbon.
6. In the **Connect to Controller** window, connect to a real controller or select/create a virtual controller and tap **OK**.
7. Request write access.
8. Launch the **Modify Installation** dialog from the **Controller** ribbon.
9. Select **Software** > **Available**.

   The **Available Software** window displays all distribution packages that have been installed with RobotStudio.

   Select the Collaborative Speed Control add-in package and required version to be added to the system and click **Include**.
10. Proceed to the **Features** tab page and modify the system as required.
11. Choose required option in the **Collaborative Features** group.

    Note

    If a real controller is connected, the **Collaborative Features** options are available only when corresponding license for Safety laser scanner is added.
12. The **Summary** tab shows an overview of all the changes.
13. Select **Apply** to confirm and save the changes.

    The controller is restarted automatically to apply the changes.

See more details about how to use Modify Installation for RobotWare 7 and how to install a distribution package, see *Operating manual - RobotStudio*.

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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.

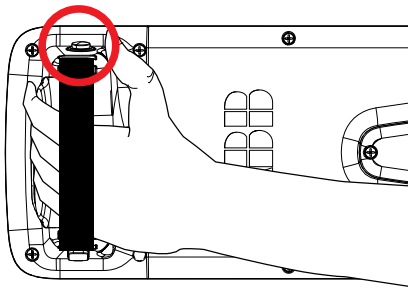
Using lead-through, you can grab the robot arm and move it manually to a desired position, as an alternative to jogging.

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.



xx2100000331

- 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.

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.

Continues on next page

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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 101*. 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.

For the CRB 15000, if varying loads from cables and other disturbances are causing the robot to drift during lead-through, this can often be improved by setting the system parameter *Lead through load compensation* to *Always*. See *Technical reference manual - System parameters*, section *Motion*, type *Robot*.

Align to a coordinate system

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

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

1 In the Lead-through page select the a mode in the **Lead-through Mode** section.
2 In the **Align to coordinate system** section, select the required coordinate system.
3 Enable the motors.

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3.6.2 Lead-through
Continued

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

4 Tap and hold the **Press and Hold Align** button.
The robot is aligned to the selected coordinate system.

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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 120*.

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 available for the following robots:

- CRB 1100
- CRB 1300
- 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 129*.

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 supervision settings.
- The tab **Synchronization** contains functions for software synchronization.
- 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*.

Continues on next page

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3.6.3 The SafeMove configurator app on FlexPendant
Continued

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.

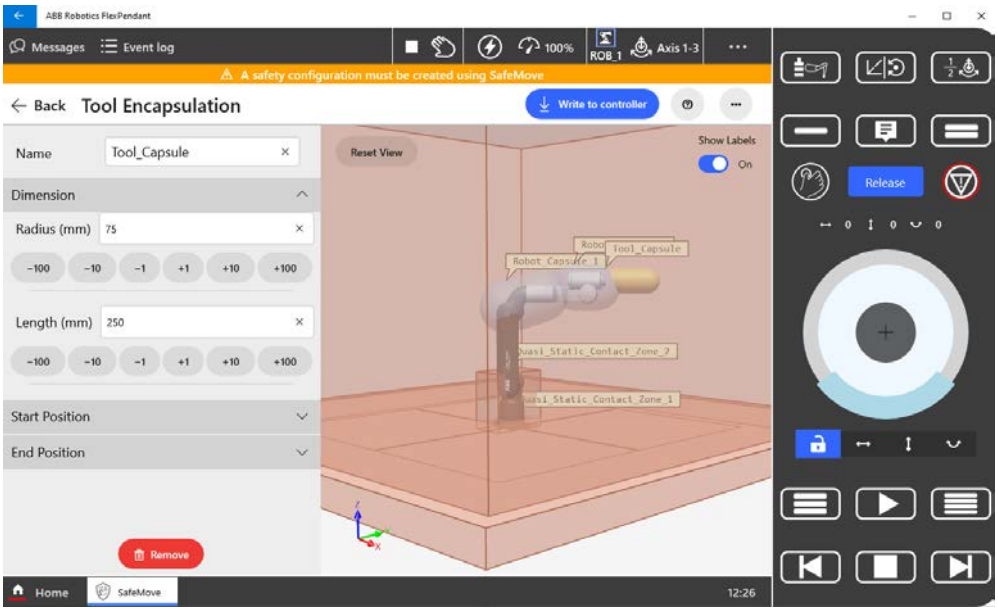
Template configurations

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, length, and position. A lozenge capsule can also be modified in rotation.



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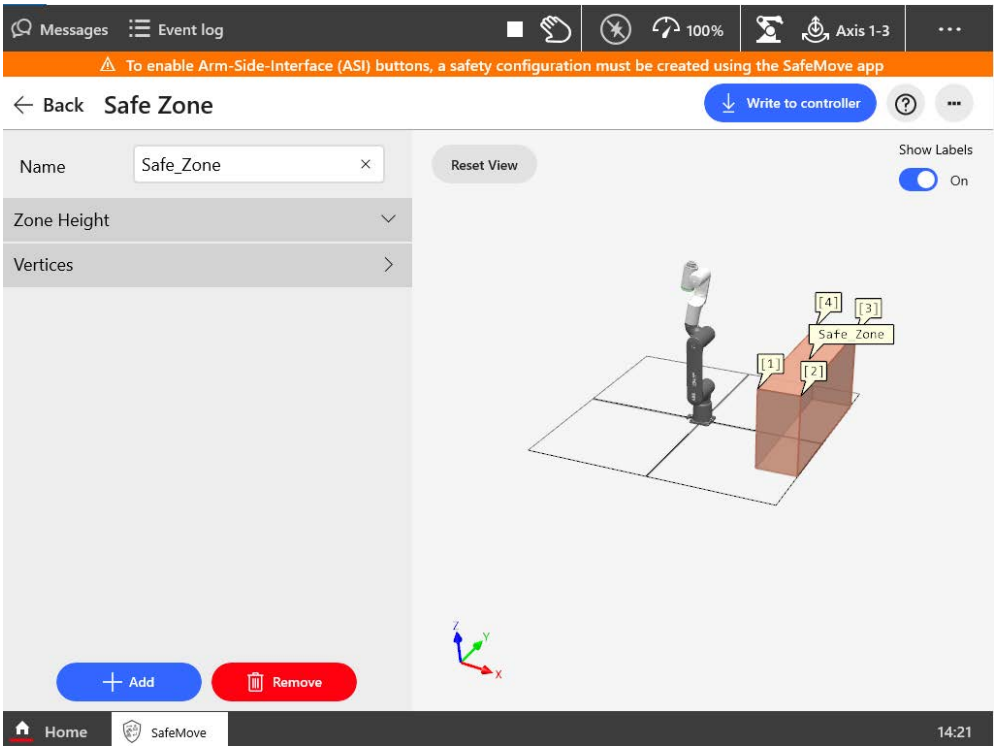
Safe zones

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.

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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.

Display of safety violations

During the validation of a robot cell using the SafeMove app, it is possible to check whether the robot is committing a safety violation. For example, robot crossing a forbidden zone, robot speed or force exceeding a certain value, and so on. Once a violation is detected and displayed on the SafeMove app, it is possible to take the necessary actions.

For more information about the Display of safety violations, see *Application manual - Functional safety and SafeMove*.

Supervision functions

The global supervision functions are not connected to a specific safe zone or safe range. They can be added, modified, and deactivated.

For more information about the global supervision functions, see *Application manual - Functional safety and SafeMove*.

Synchronization

The **Synchronization** tab is used to manually set the current joint positions for the robot.

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

Continues on next page

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3.6.3 The SafeMove configurator app on FlexPendant
Continued

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 safety configuration template or an existing configuration from the **Context** menu (...).
4. Configure encapsulations.
5. Configure zones and the supervision functions.
6. Load the configuration to the safety controller.
7. Restart the controller.
8. In the **Settings** app, tap **Safety Controller** and validate the configuration.
9. In the **Settings** app, tap **Safety Controller** and set the safety configuration to validated and then lock it.

For more details, see *Use cases on page 120*.

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

Use cases

Start 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 using the **Modify Installation** function in RobotStudio and add that 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 *Load a safety configuration template on page 120*.

Load a safety configuration template

The safety configuration template feature is available from RW 7.12 onwards. Systems with RW 7.10 or earlier will still have the default template solution.

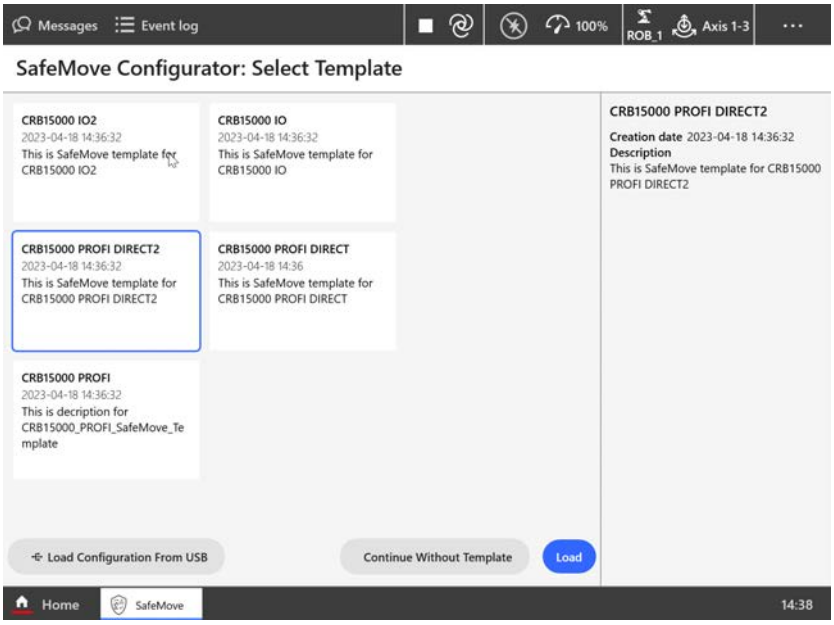
Use the following procedure to load a predefined safety configuration template and apply it to the robot controller.

1. Log in as a user with safety user grants.
2. Open the SafeMove app.
3. Tap **Enable Edit Mode**.

   The **SafeMove Configurator: Select Template** page is displayed with a list of available templates.

Continues on next page

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4 Select a template from the list.

   The metadata of the selected template is displayed on the right side panel.

5 Tap **Load**.

   The **Load Safety Configuration** dialogue is displayed.

6 Tap **Yes**.

   The selected safety configuration template is loaded on the FlexPendant.

7 Review that the selected template configuration is suitable for the intended application.

   If modifications are needed, see *Modify a loaded safety configuration on page 122*.

> **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.

8 If the template configuration is suitable, select **Write to controller**.

   The safety report is presented on the screen.

9 Save the safety report. Take a print out and sign this safety report.

   See *ABB Safety Configuration Report on page 127*. More information about the safety report and how to validate is described in *Application manual - Functional safety and SafeMove*.

10 Tap **Apply to controller**.

   The **Saved** dialogue is displayed

11 Tap **Restart Controller**.

Continues on next page

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3.6.3 The SafeMove configurator app on FlexPendant
Continued

The controller is restarted and loads the newly saved safety configuration template.

> **Note**
>
> To change the loaded safety configuration template, tap the **Context** menu, select **Open Template Selector**, select the required template from the list, and follow the rest of the steps.

Modify a loaded safety configuration

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

1. Log in as a user with safety user grants.
2. Open the SafeMove app.

   The **SafeMove Configurator** page is displayed along with the saved safety configuration.
3. Select **Enable Edit Mode** to edit the loaded safety configuration.
4. 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.
5. 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 122*.
6. To add or modify a global setting, tap **Add** and select which supervision to modify.
7. 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.
8. Save the safety report. Take a 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*.
9. Tap **Apply to controller**.

   The **Saved** dialogue is displayed
10. Tap **Restart Controller**.

    The controller is restarted and loads the newly saved safety configuration.

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.

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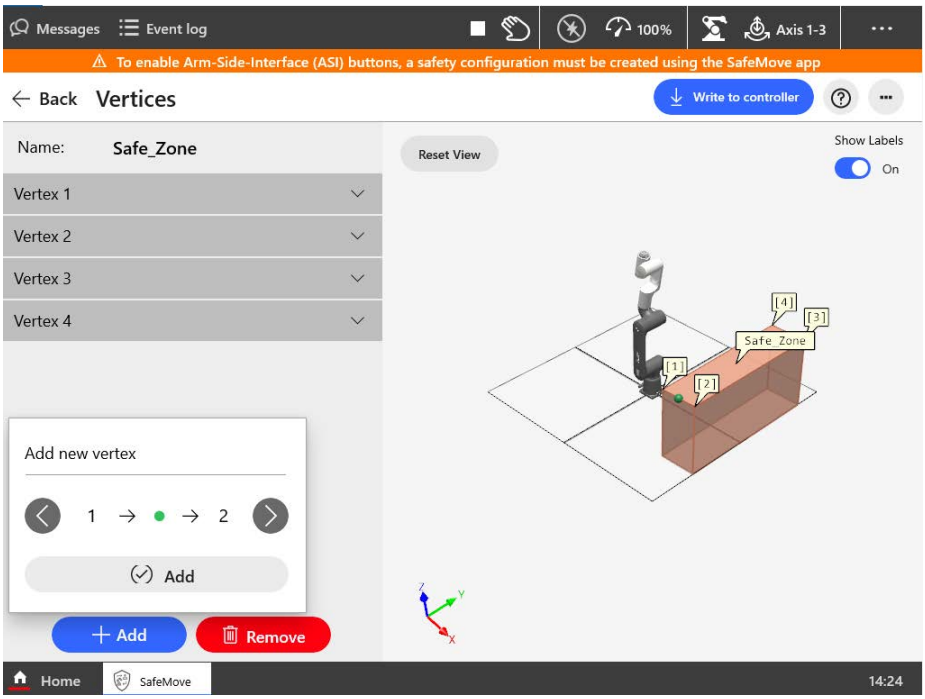
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2 Tap **Safe Zones** to open the attributes.

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.



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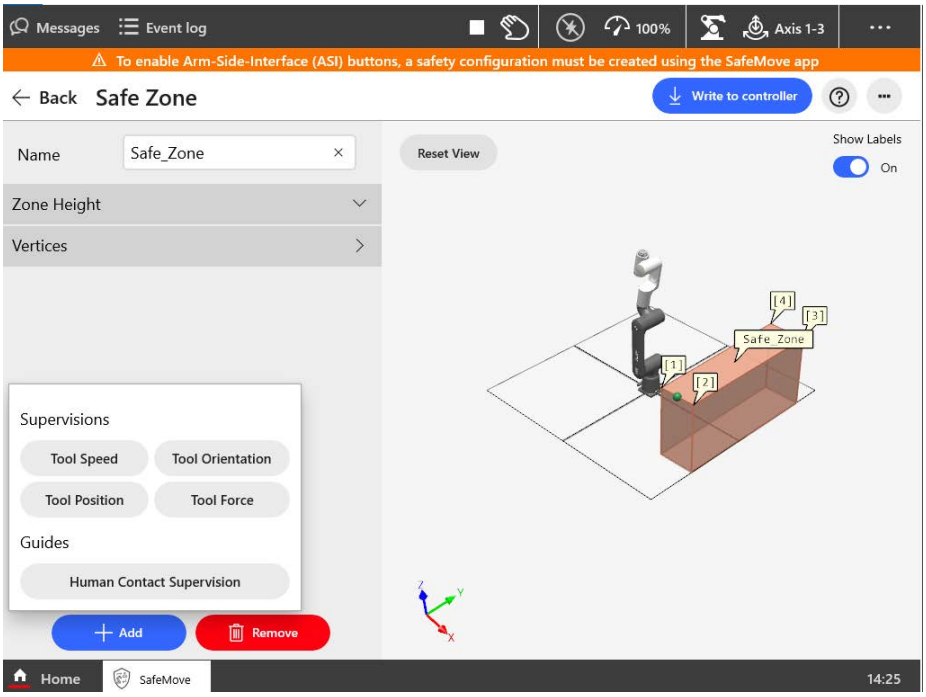
4 To add a supervision to a safe zone, tap to select the safe zone in the 3D view, then tap **Add**.

5 Select a supervision function or guide.

Continues on next page

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3.6.3 The SafeMove configurator app on FlexPendant
Continued



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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 124*.

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 129*.

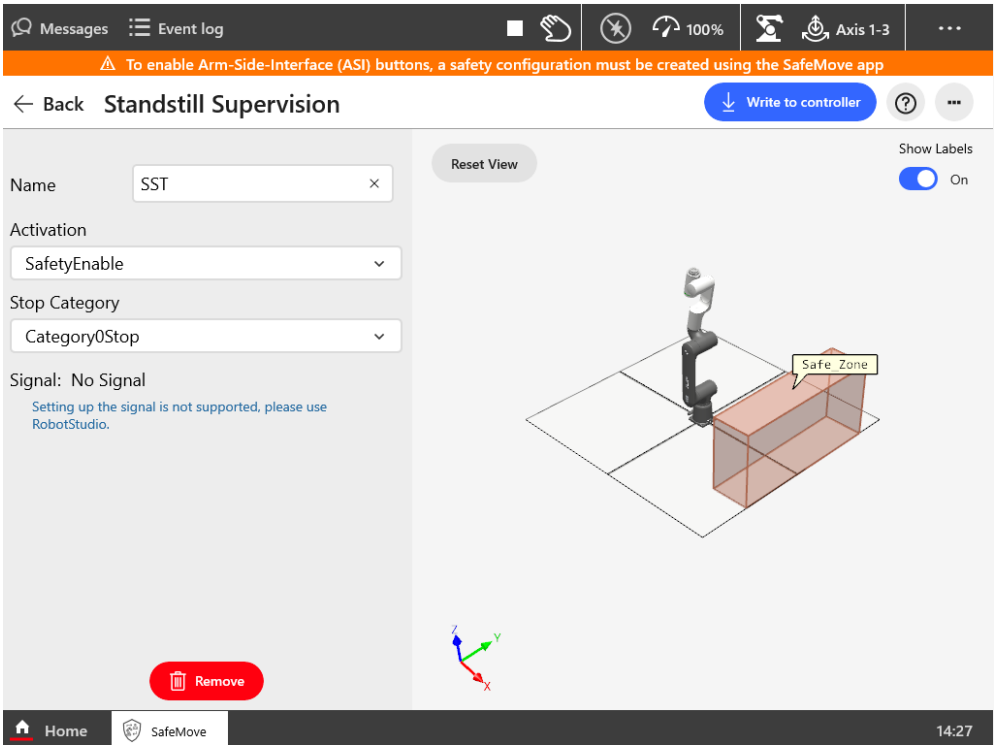
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Modify the Standstill Supervision settings

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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Modify the global supervision settings

The global supervision functions are not connected to a specific safe zone or safe range. They can be added, modified, and deactivated.

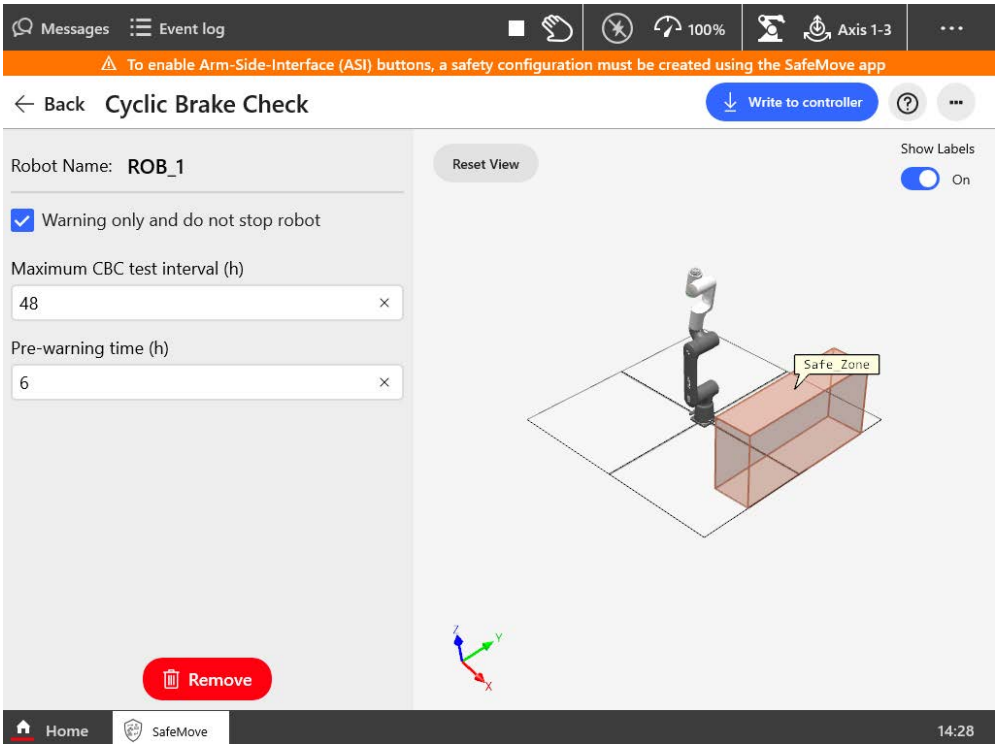
Modify the Cyclic Brake Check settings

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

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3.6.3 The SafeMove configurator app on FlexPendant
Continued



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

Continues on next page

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- 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. Turn off collision detection during validation of any tool force supervision
5. Start the validation procedure.

   If using protected groups in the safety configuration, only the modified parts must be validated.

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 (multiple checksums if using protected groups in the safety configuration). The checksum can also be read using the RAPID function `SafetyControllerGetChecksum` or `SafetyControllerGetGroupChecksum`.

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 checkbox **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.

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3.6.3 The SafeMove configurator app on FlexPendant
Continued

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

Concluding steps

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

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

About *Human Contact Supervision*

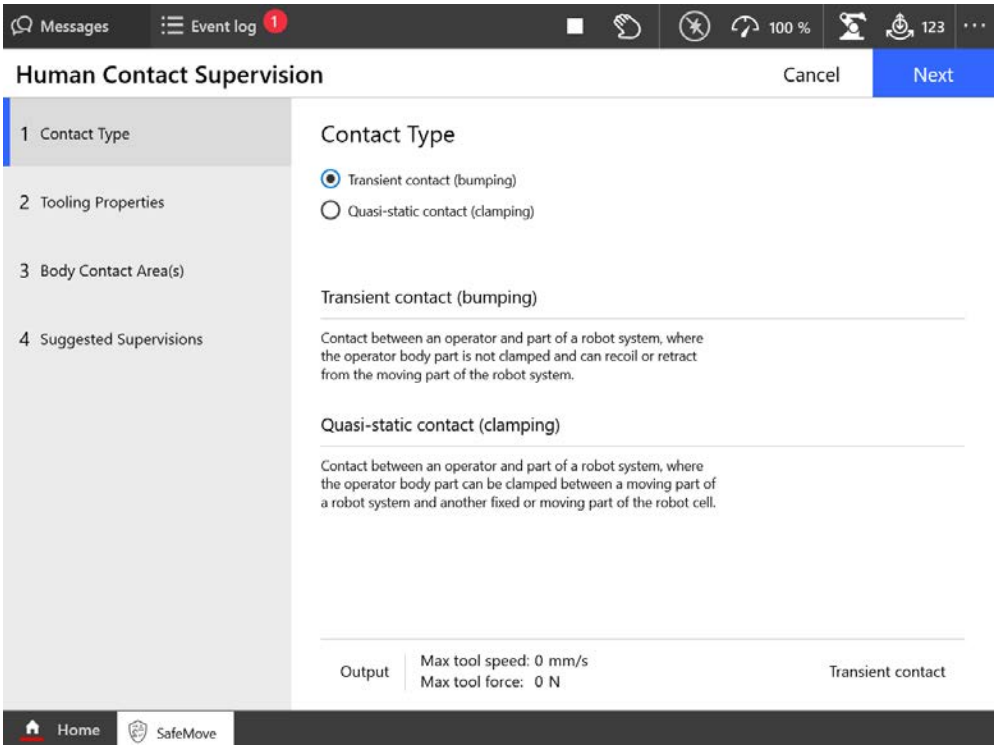
The CRB 15000 robot is designed with collaborative applications in focus, where occasional contact between the human and the robot are foreseen. This is according to ISO/TS 15066.

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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Body model

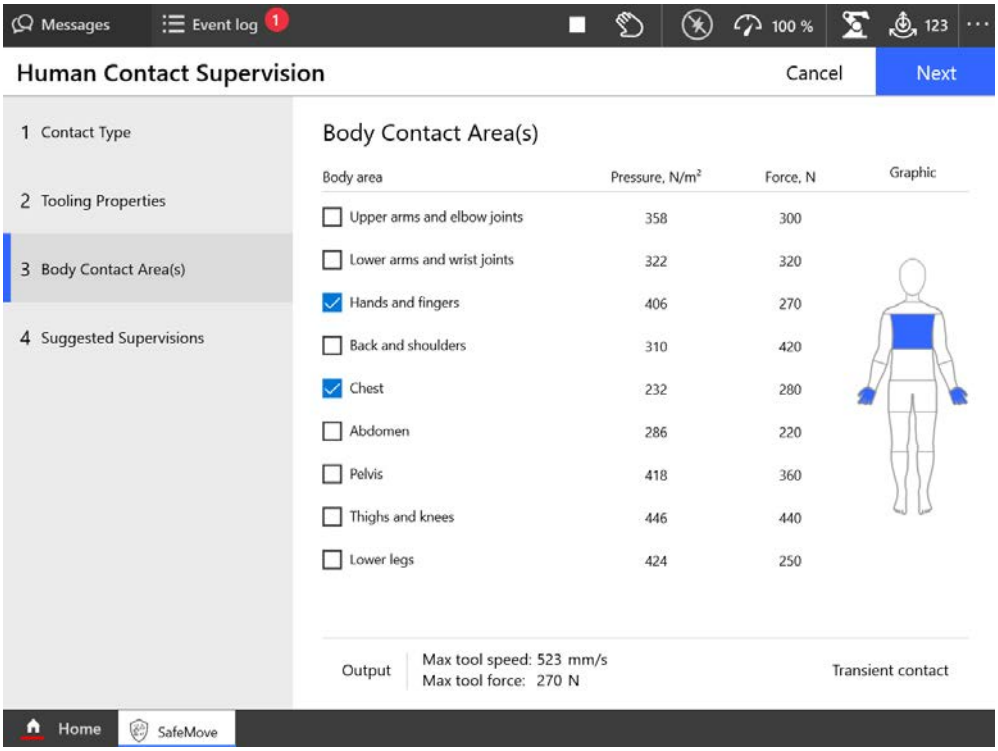
As defined in ISO/TS 15066, the body model is a representation of the human body consisting of individual body segments characterized by biomechanical properties.

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.

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



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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.

Conclusion

The values calculated in the **Human Contact Supervision** function are conservative. However, if the risk assessment 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.

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3.6.5 Speed control

Overview

Speed control function is available to the robots with the Collaborative Speed Control add-in installed and any of following options is ordered:

- 3051-*X*, any of safety laser scanner options
- 3143-1 Collab. speed control

For PROFIsafe-based scenarios where a PLC is connected to act as a master and SafetyIO-based scenarios, with the Collaborative Speed Control add-in is installed, a predefined template SafeMove configuration file is also available for easy configuration of basic SafeMove functions.

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. Speed control strategies for typical scenarios are detailed in following sections.

Note

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

To use the latest features of the CRB 15000, it always recommended to upgrade the RobotWare and RobotStudio to the latest versions.

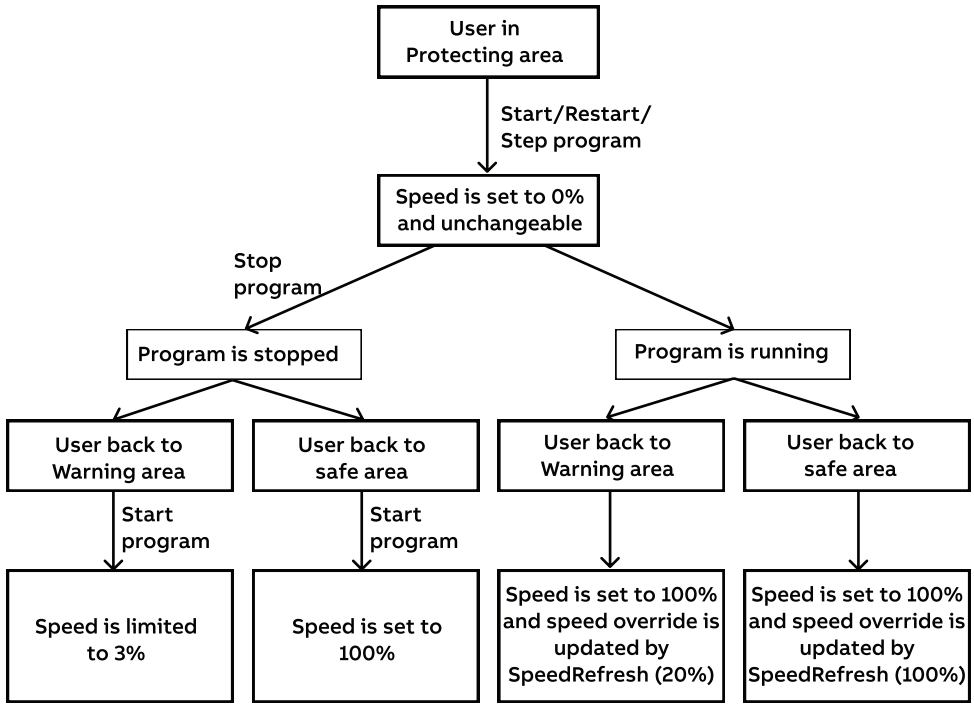
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3.6.5 Speed control
Continued

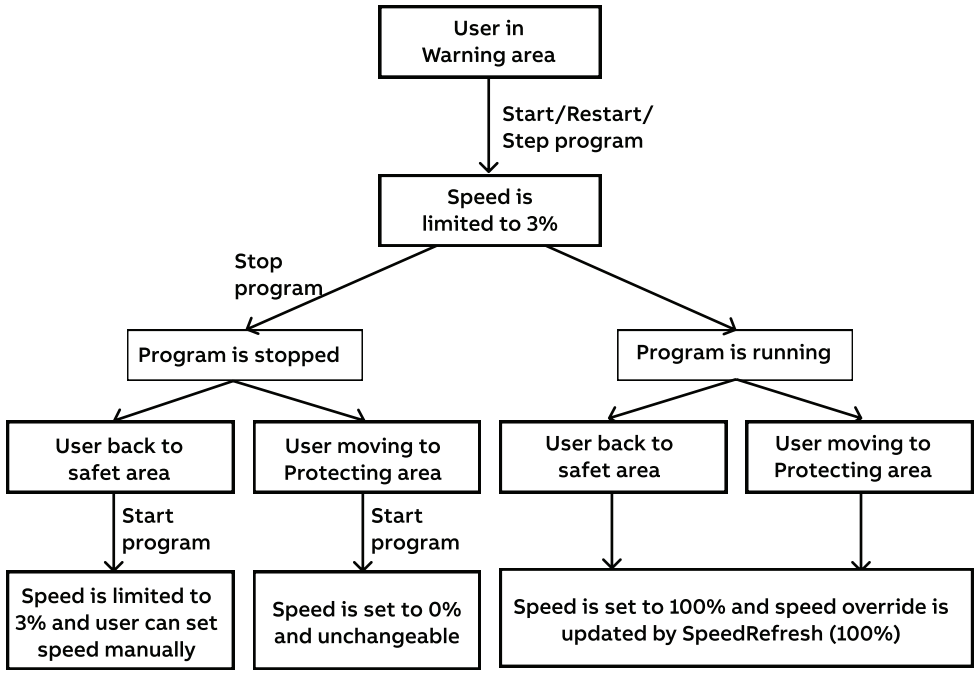
Strategies (RobotWare 7.5)

Users in Protecting area



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Users in Warning area

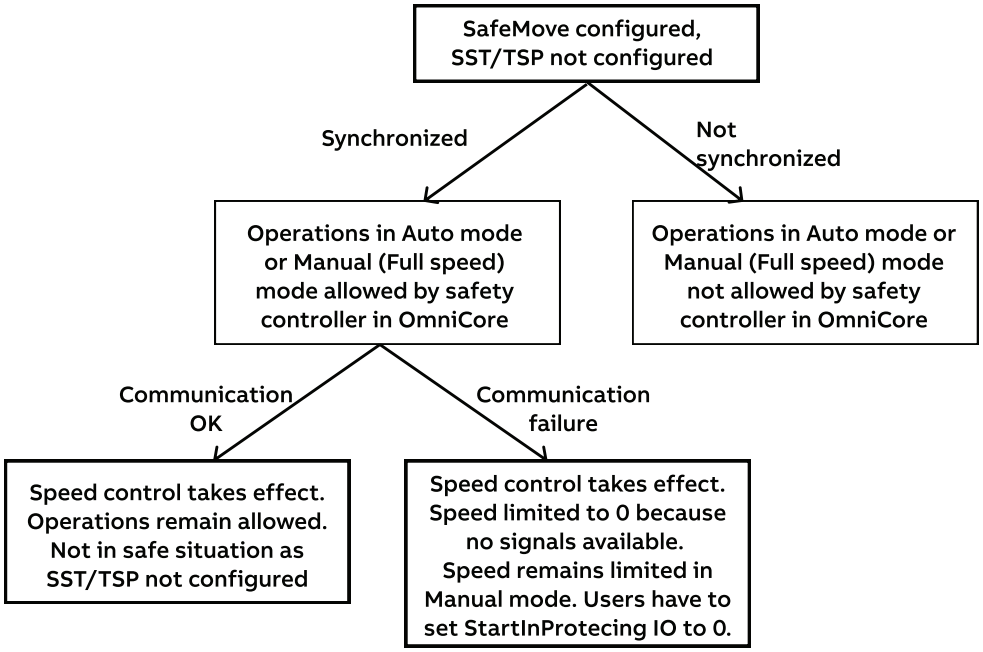


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SafeMove triggered but SST/TSP not configured



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Strategies (RobotWare 7.6 or later)

Note

The speed control strategy in protecting area applies only to the robots with laser scanners in intermittent collaborative mode.

The speed control strategy in warning area applies to both the robots with laser scanners in intermittent collaborative mode and those with laser scanners in cooperation mode.

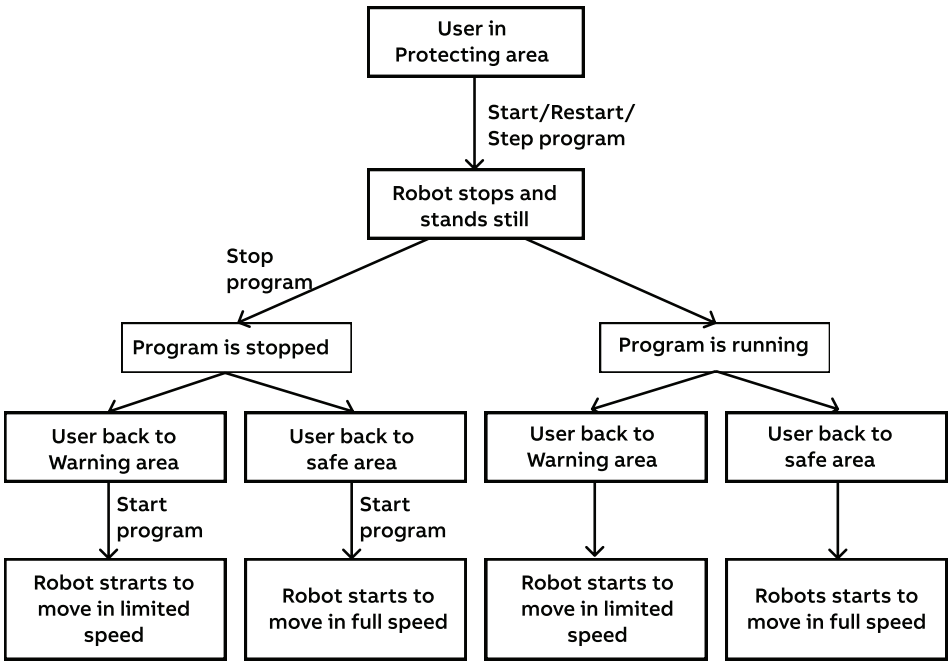
See *Application manual - Collaborative Speed Control add-in* for details about the working modes and protection fields of the laser scanners.

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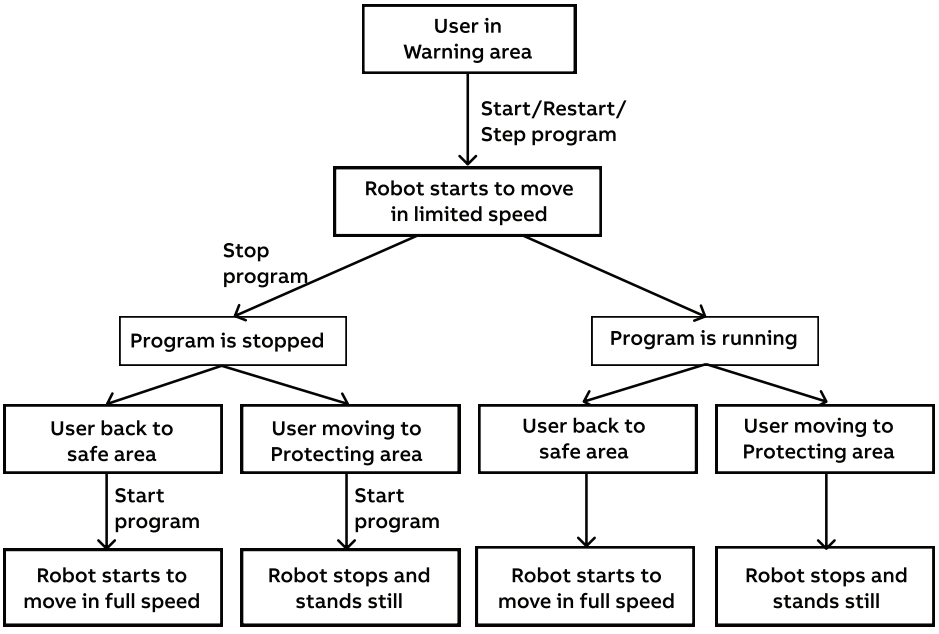
3.6.5 Speed control
Continued

Users in Protecting area



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Users in Warning area



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Configuring speed control

A general configuration procedure is listed as below.

	Action	Reference to...
1	Configure software for robot system as required.	• *Information about software for the CRB 15000 on page 110* • *Operating manual - Integrator's guide OmniCore*
2	Configure SafeMove.	• *Application manual - Collaborative Speed Control add-in* • *Application manual - Functional safety and SafeMove*
	For PROFIsafe-based scenarios with a PLC acting as the master connected (any supported RobotWare version) **For SafetyIO-based scenarios** Upload the template SafeMove configuration file using the SafeMove configurator app on FlexPendant.	
	For PROFIsafe-based scenarios with the controller acting as the master (RobotWare 7.10 or later) Configure the template SafeMove configuration file using **Visual SafeMove** in RobotStudio and upload to the controller.	
3	Configure laser scanner(s) and apply speed control strategies.	*Application manual - Collaborative Speed Control add-in*
4	If required, modify customizable safety configurations.	*Application manual - Collaborative Speed Control add-in*

See more details about speed control in *Application manual - Collaborative Speed Control add-in*.

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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 maintenance work.

There are general safety aspects that must be read through, as well as more specific safety information that describes the danger and safety risks when performing the procedures. Read the chapter *Safety on page 17* before performing any maintenance 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 96*.

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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.

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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.

Additional information of expected component life for robots in Lifescience, Healthcare,and Pharmaceutical (L/H/P) applications are specified in the section *CRB 15000 lifetime - for L/H/P applications on page 140*

Maintenance schedule

Maintenance activities	Regularly	Every 6 months	Every 12 months	Reference
Cleaning the robot	x			*Cleaning the CRB 15000 on page 151*
Inspecting the robot	x			*Inspecting the robot on page 141*
Inspecting the robot harness		x [i]		*Inspecting the cable harness on page 146*
Testing the brake release functionality		x		*Testing the brake release functionality on page 153*
Testing the brake release tool		x		*Testing the brake release functionality on page 153*
Running the *Cyclic Brake Check* routine [ii]	x			*Running the Cyclic Brake Check routine on page 155* *Application manual - Functional safety and SafeMove*
Testing the functionality of the joint electronics		x		*Testing the functionality of the joint electronics on page 156*

[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.

CRB 15000 lifetime

In a standard operational scenario, the CRB 15000 robot does not require any maintenance activity before the lifetime expiration of its critical components.

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4.2.2 Maintenance schedule
Continued

However, to ensure optimal performance and application safety, the following regular activities are recommended:

- Clean the robot.
- Visually inspect the robot.
- Inspect the robot harness.
- Test the brake release functionality.
- Run the cyclic brake check routine.
- Test the functionality of the joint electronics.

Additionally, unpredictable situations may necessitate extra inspections of the robot. Any damage discovered must be addressed immediately.

The expected lifespan of specific components can vary significantly based on the intensity of use, which includes factors such as operational load (workload, cycle time), usage patterns (duty cycle and application), and environmental conditions.

The expected lifetimes of critical components are detailed in the table below.

Component	Expected life	Note
Gearboxes, normal usage	35000 hours	Example: Material handling applications

For comprehensive details and maintenance intervals, see *Maintenance schedule on page 139*.

CRB 15000 lifetime - for L/H/P applications

The demanding nature of using CRB 15000 in a Lifescience, Healthcare,and Pharmaceutical (L/H/P) application where extensive cleaning are applied can shorten the life of the robot's components compared to that of standard robots in a typical robotic application. See *CRB 15000 lifetime on page 139* for robots in a standard operational scenario. Depending on the actual cleaning in the L/H/P application, the compromise of lifetime of CRB 15000 in L/H/P applications will depend on a number of factors. The most important factors are:

- The cleaning detergent and cleaning protocol/regime applied.
- The ambient environment including temperature, humidity, water quality, etc.

  Using elevated temperature for cleaning bath is not recommended.
- Installation, maintenance, and repair procedures.
- The operation cycle of the robot.

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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 1083*.

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 101*.

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 151*.
2	Check for loose hardware at robot arms, base (foundation screws), and tool flange.	Tighten loose hardware at base (foundation screws tightening torque: 32 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 143*.

Inspecting the floor cable

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

	Action	Note
1	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

Continues on next page

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4.3.1 Inspecting the robot

Continued

	Action	Note
2	 **ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
3	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 96*.
4	Make sure that protective earth is properly connected to ensure continuity of protective conductor, according to IEC 60204-1.	For more information see: • *Product manual - OmniCore C30* • *Robot cabling and connection points on page 96*.

Checking the presence of the brake release tool



Note

This inspection is only needed for robots using the external brake release tool, see *Installation of brake release tool on page 75*.

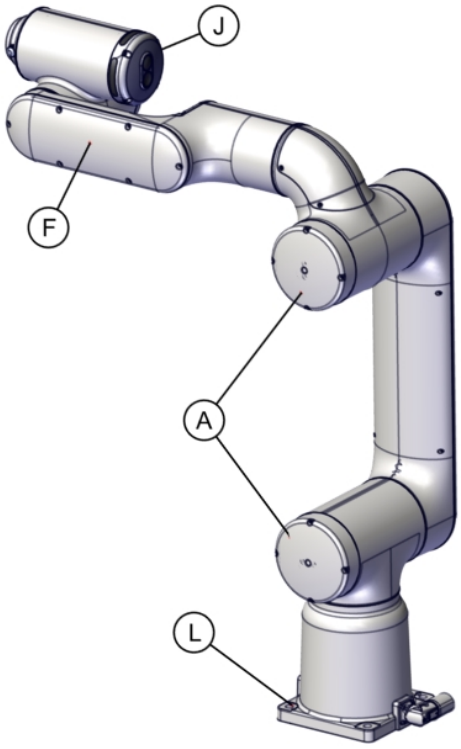
	Action	Note
1	Check that the brake release tool is available at its storage location close to the robot.	Brake release tool: 3HAC079146-001. See *Installation of brake release tool on page 75*.

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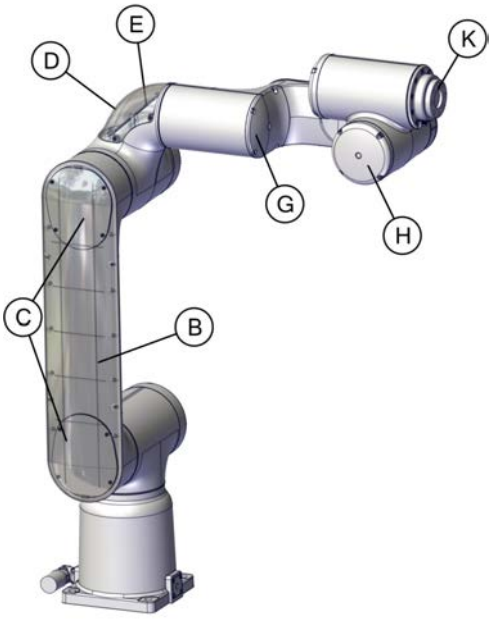
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Tightening torques to be inspected

Tightening torques, CRB 15000-5/0.95



xx2000002565



xx2000002566

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
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 of CRB 15000-5/0.95. 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

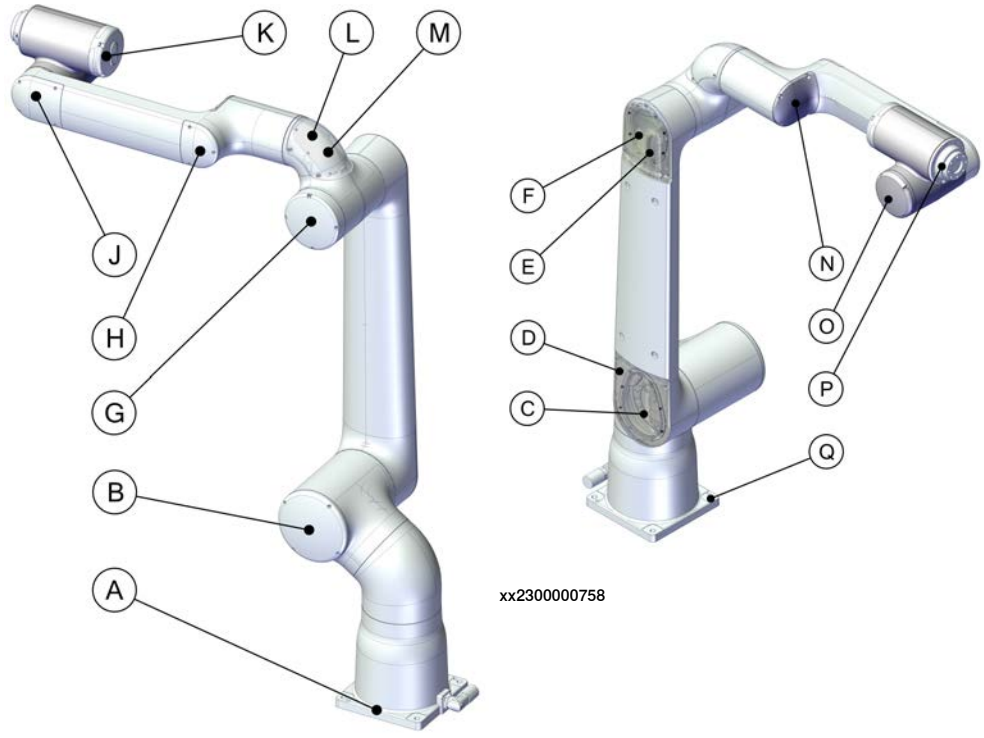
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4.3.1 Inspecting the robot
Continued

Position	Cover	Screws	Tightening torque
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	32 Nm ±10%

Tightening torques, CRB 15000-10/1.52 and CRB 15000-12/1.27



xx2300000758

xx2300000757

Position	Cover	Screws	Tightening torque
A	Base cover	Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9	1.4 Nm
B	Swing cover	Hex socket head cap screw M3x12 12.9 Lafre 2C2B/FC6.9	1.4 Nm
C	Lower arm cover, lower	Hex socket head cap screw M3x12 12.9 Lafre 2C2B/FC6.9	1.4 Nm
D	Lower arm, inner cover, lower	Hex socket head cap screw M3x12 12.9 Lafre 2C2B/FC6.9	1.4 Nm
E	Lower arm cover, upper	Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9	1.4 Nm

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Position	Cover	Screws	Tightening torque
F	Lower arm, inner cover, upper	Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9	1.4 Nm
G	Housing side cover	Hex socket head cap screw M3x30 12.9 Lafre 2C2B/FC6.9	1.4 Nm
H	Tubular cover, lower	Hex socket head cap screw M3x12 12.9 Lafre 2C2B/FC6.9	1.4 Nm
J	Tubular cover, upper	Hex socket head cap screw M3x12 12.9 Lafre 2C2B/FC6.9	1.4 Nm
K	Arm side interface	Hex socket head cap screw M3x20 12.9 Lafre 2C2B/FC6.9	0.45 Nm
L	Housing cover	Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9	0.45 Nm
M	Housing inner cover	Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9	1.4 Nm
N	Axis-4 cover	Hex socket head cap screw M3x8 12.9 Lafre 2C2B/FC6.9	0.9 Nm
O	Axis-5 cover	Hex socket head cap screw M3x12 12.9 Lafre 2C2B/FC6.9	1.4 Nm
P	Axis-6 flange	Hex socket head cap screw M3x12 12.9 Lafre 2C2B/FC6.9	1.9 Nm
Q	Base	M10x35 8.8	32 Nm ±10%

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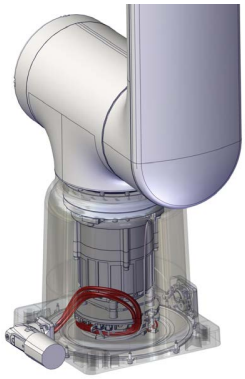
4.3.2 Inspecting the cable harness

Location of cable harness

Cable harness, CRB 15000-5/0.95

The figures show the location for the cable harness of CRB 15000-5/0.95.

A



xx2100000056

B



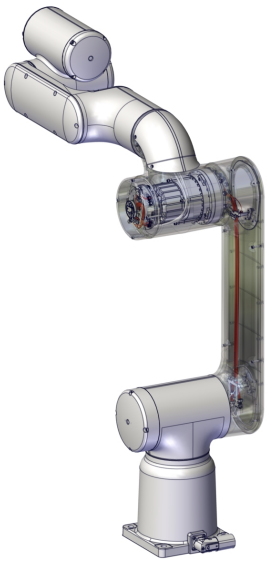
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C



xx2100000058

D



xx2100000059

	Spare part	Spare part number
A	Cable harness, base socket	3HAC083725-001
B	Cable harness, joint 1	3HAC073204-001
C	Cable harness, joint 2	3HAC073205-001
D	Cable harness, joint 3	3HAC073207-001

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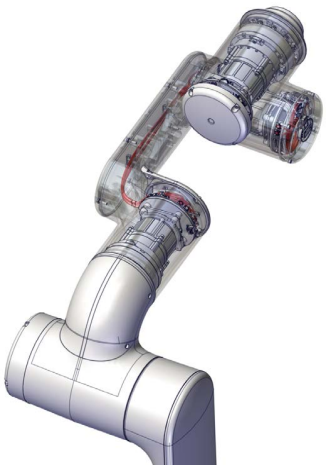
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A



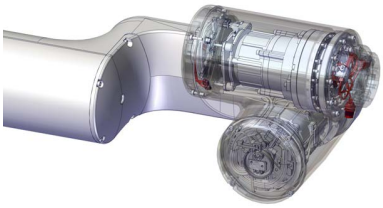
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B



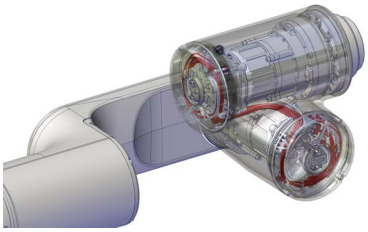
xx2100000061

C



xx2100000062

D



xx2100000091

	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	3HAC083726-001

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4.3.2 Inspecting the cable harness
Continued

Cable harness, CRB 15000-10/1.52 and CRB 15000-12/1.27

A



xx2300000530

B,C



xx2300000531

D



xx2300000532

E



xx2300000533

	Spare part	Spare part number
A	Cable harness, base socket	3HAC083725-001
B	Cable harness, joint 1 (CRB 15000-10/1.52)	3HAC083661-001
C	Cable harness, joint 1 (CRB 15000-12/1.27)	3HAC080959-001
D	Cable harness, joint 2	3HAC080960-001
E	Cable harness, joint 3	3HAC080965-001

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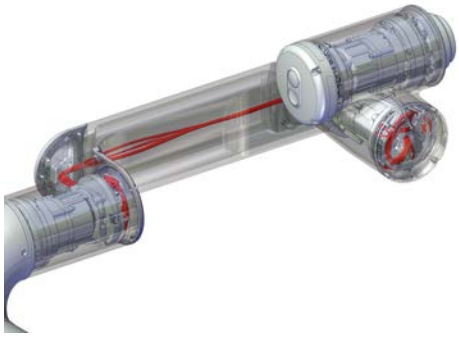
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A



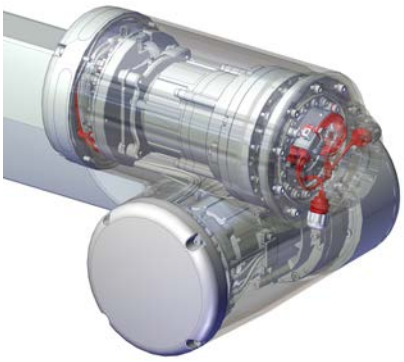
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B,C



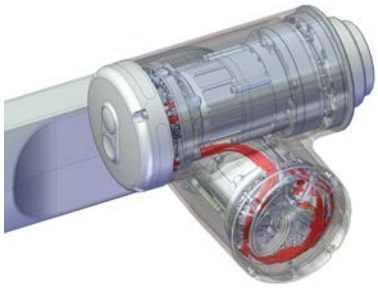
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D



xx2300000536

E



xx2300000537

	Spare part	Spare part number
A	Cable harness, joint 4	3HAC080961-001
B	Cable harness, joint 5 (CRB 15000-10/1.52)	3HAC083669-001
C	Cable harness, joint 5 (CRB 15000-12/1.27)	3HAC083668-001
D	Cable harness, joint 6	3HAC073208-001
E	Cable harness, transition joint-5 and joint-6	3HAC083726-001

Required equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

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4.3.2 Inspecting the cable harness
Continued

Inspecting the cable harness

	Action	Note
1	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
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 pare part numbers and tightening torques for the attachment screws are detailed in section *Tightening torques to be inspected on page 143*.

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4.4 Cleaning activities

4.4.1 Cleaning the CRB 15000

General

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 use compressed air to clean the robot.
- Do not use solvents that are not approved by ABB to clean the robot.
- Do not remove any covers or other protective devices before cleaning the robot.

Cleaning methods

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

Protection type	Cleaning method			
	Vacuum cleaner	Wipe with cloth	Rinse with water	High pressure water, steam or spray
Standard	Yes	Yes. With mild cleaning detergent.	No	No

Usable detergents

This table specifies approved mild cleaning detergents according to methods in the table *Cleaning methods on page 151*.

Detergent [i]	Concentration	Maximum cleaning frequency
Isopropyl Alcohol (IPA)	70%	Daily
Ethanol	70%	Daily
Peroxide (H_2O_2)	3%	Weekly

[i] The manipulator can be cleaned (wiped with cloth) occasionally with specified detergents. Long term use may lead to surface/apperance deterioration.

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Ready-to-use pre-wetted wipes are allowed to use in condition of that the main detergent component and its concentration in the wipes meet the detergent specifciation specified in the previous table.

Followings are some recommended examples of detergent brands and types:

- Ecolab Klerwipe™ Alcodes GF
- Ecolab Klerwipe™ DrySan Duo
- Diversey® Clearklens Wipes
- Diversey® Suma Wipes
- Diversey® Oxivir Excel Wipes

Wiping with cloth

Cleaning and disinfection instructions for robots

Wipe-down cleaning method is recommended. Robot surfaces shall be wiped with clean and low particle emission cleanroom cloth which is soaked with approved cleaning detergents specified in *Usable detergents on page 151*.

Use the following procedure to clean the robots:

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

Note

End users/system integrators shall take the responsibility of assessing whether the disinfection is sufficiently implemented and reaches the disinfection degree required for the intended application and environment.

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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.

CAUTION

Depending on what RobotWare version is installed, the brake release functionality differs. On robot with RobotWare 7.10 or later, the brakes are released from the FlexPendant, see *Testing the brake release functionality from the FlexPendant on page 153*. On robots with RobotWare earlier than 7.10, the brakes are released using an external brake release tool, see *Testing the brake release functionality with external tool on page 153*.

CAUTION

At least two persons should be present when releasing the brakes.

Testing the brake release functionality from the FlexPendant

	Action	Note
1	Test the brake release functionality on each axis, by using the FlexPendant.	See *Manually releasing the brakes on page 69*.
2	If the holding brake does not release, check following: • Check for event log messages on the FlexPendant.	All event logs can be seen on the FlexPendant, or in *Technical reference manual - Event logs for RobotWare 7*.

Testing the brake release functionality with external tool

Required equipment

Equipment	Article number	Note
Brake release tool	3HAC079146-001	For releasing the holding brakes of a joint unit motor if the RobotWare version is 7.8 or older. **Note** The spare parts related to the brake release function using the external tool are discontinued from Q2 2023.

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4.5.1 Testing the brake release functionality

Continued

	Action	Note
1	Test the brake release functionality on each axis, by using the brake release tool.	See *Manually releasing the brakes on page 69*.
2	If the holding brake does not release, check following: • 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 1059*.	For OmniCore, all event logs from the software can be seen on the FlexPendant, or in *Technical reference manual - Event logs for RobotWare 7*.

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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 35* can be used to check that the brakes still function correctly.

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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.

Note

Unless otherwise specified, the repair activities are available for all the robot variants, but only the CRB 15000-5/0.95 is illustrated.

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 17* 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*

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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 following procedures describe how to fit rotating sealings.

CAUTION

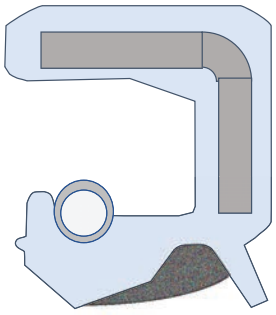
Please observe the following before commencing any assembly of sealings:

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

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

Radial sealings

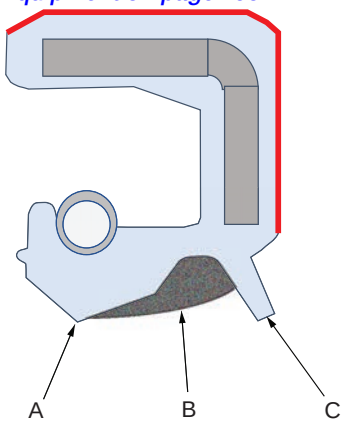
A radial sealing consists of a flexible rubber lip bonded to a rigid metal case. Only one side of the sealing is static with a metal insert.



xx2300000433

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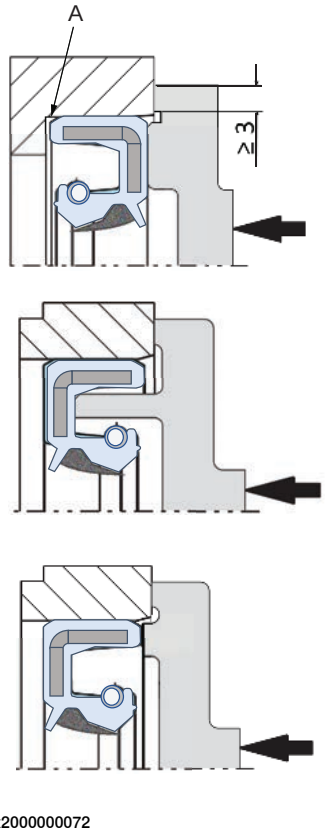
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	Action	Note
1	Check the sealing to ensure that: • The sealing is of the correct type. • There is no damage on the main lip.	
2	Inspect the shaft surface before mounting. If scratches or damage are found, the shaft must be replaced since it may result in future leakage. Do not try to grind or polish the shaft surface to get rid of the defect.	
3	Lubricate the sealing with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the sealing.) Fill 2/3 of the space between the dust lip and the main lip with grease. If the sealing is without dust lip, just lubricate the main lip with a thin layer of grease.	Article number is specified in *Equipment on page 158*.  xx2000000071 A Main lip B Grease C Dust lip **Note** Ensure that no grease is applied to the red marked surface.

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5.2.1 Mounting instructions for sealings
Continued

	Action	Note
4	Mount the sealing correctly with a mounting tool. Never hammer directly on the sealing as this may result in leakage.	 xx2000000072 A Gap

Flange sealings and static sealings

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

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

O-rings

The following procedure describes how to fit o-rings.

	Action	Note
1	Ensure that the correct o-ring size is used.	
2	Check the o-ring for surface defects, burrs, shape accuracy, or deformation.	Defective o-rings, including damaged or deformed o-rings, may not be used.

Continues on next page

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	Action	Note
3	Check the o-ring grooves and mating surfaces. They should be free of pores, contamination and obvious scratches/damage.	
4	Lubricate the o-ring with grease.	
5	Tighten the screws evenly while assembling.	
6	Check that the o-ring is not squashed outside the o-ring groove.	

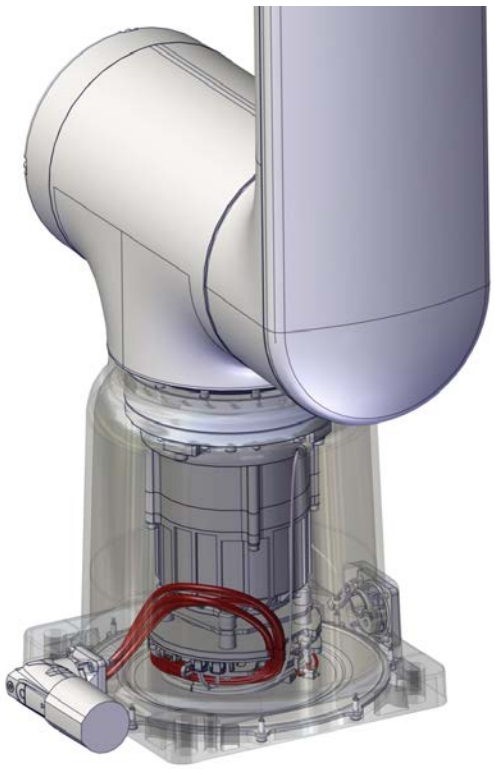
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5.3 Cable harness

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.
   - For CRB 15000-5/0.95, this step requires two persons.
   - For CRB 15000-10/1.52 and CRB 15000-12/1.27, the robot requires to be lifted using lifting roundslings.
3. Remove the base cover.
4. Replace the cabling.

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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Cable harness, base socket	3HAC083725-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cable ties	-	
O-ring	3HAB3772-64	Base cover, used for CRB 15000-5/0.95.
Grease	3HAC042536-001	Shell Gadus S2

Removing the base cabling

Use these procedures to remove the base cabling.

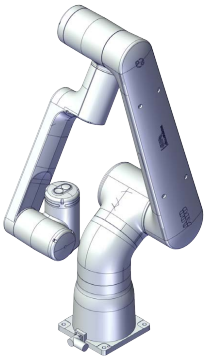
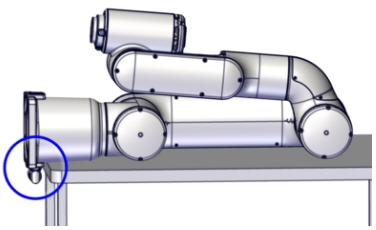
Preparations before removing the cabling

	Action	Note
1	Jog the robot to the specified position.	
	Valid for CRB 15000-5/0.95 • Axis 1: 0° • Axis 2: 0° • Axis 3: +85° • Axis 4: 0° • Axis 5: 0° • Axis 6: 0°	 xx2100000113

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5.3.1 Replacing the base cabling
Continued

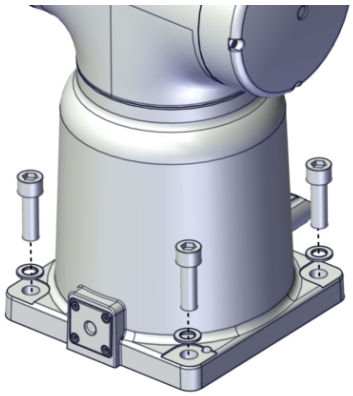
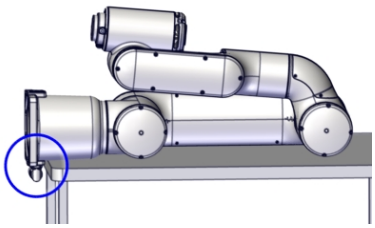
	Action	Note
	Valid for CRB 15000-10/1.52 • Axis 1: 0° • Axis 2: -15° • Axis 3: -225° • Axis 4: 0° • Axis 5: -30° • Axis 6: 0°	 xx2300000380
	Valid for CRB 15000-12/1.27 • Axis 1: 0° • Axis 2: -10° • Axis 3: +85° • Axis 4: 0° • Axis 5: +15° • Axis 6: 0°	 xx2300000381
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	
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 (-5/0.95)

	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.	

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	Action	Note
2	Loosen the robot from the foundation. • 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. **CAUTION** Do not leave the robot standing unfastened to the foundation, it is not stable on its own.	 xx2100000415  xx2100000414

Laying down the robot (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** The weight of the CRB 15000 robot is up to 51 kg All lifting accessories used must be sized accordingly.	

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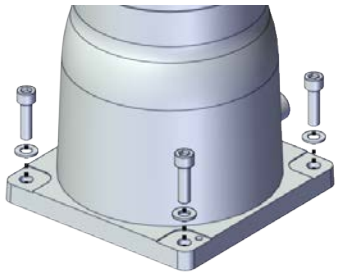
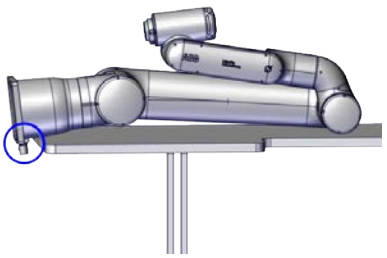
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5.3.1 Replacing the base cabling
Continued

	Action	Note
2	Attach the roundslings to the robot according to the figure. Make sure the roundslings do not rub against any sharp edges.	**CRB 15000-10/1.52**  xx2300000384
		CRB 15000-12/1.27  xx2300000385
3	Stretch the roundsling to take the weight of the robot. **Note** Do not stretch the roundsling too much.	

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	Action	Note
4	Loosen the robot base from the foundation by removing the foundation attachment screws.	 xx2300001060
5	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
6	Lay the robot down on its back on a working bench. Do not damage the base socket.	 xx2300001061

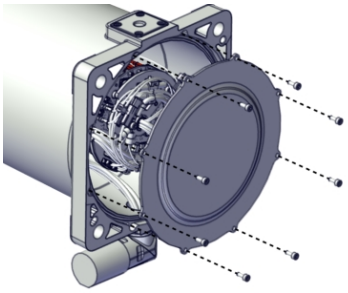
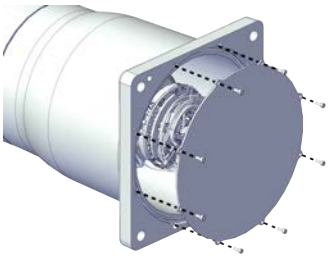
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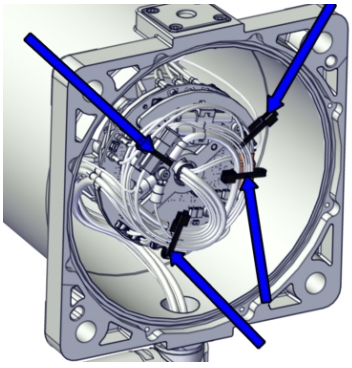
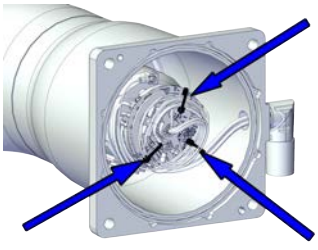
5.3.1 Replacing the base cabling

Continued

Removing the base cover

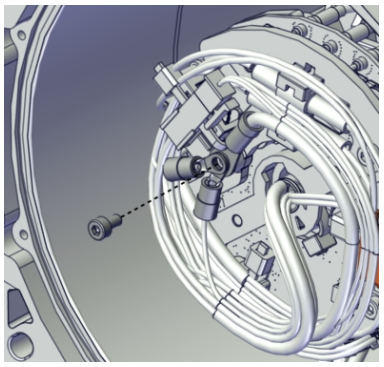
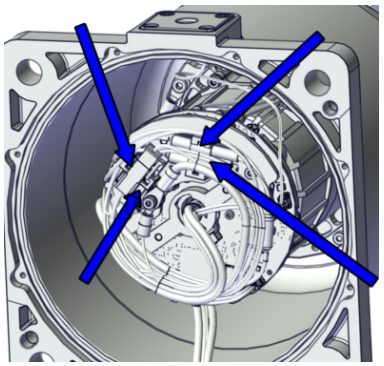
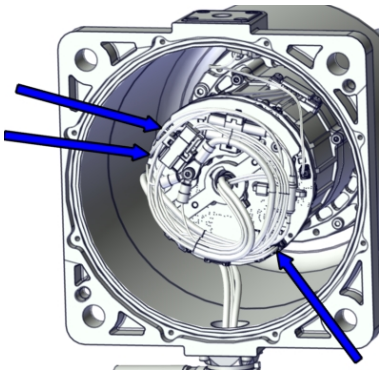
	Action	Note
1	Remove the bottom cover by removing the attachment screws.	**Valid for CRB 15000-5/0.95**  xx2000002007 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000760

Disconnecting the base cabling

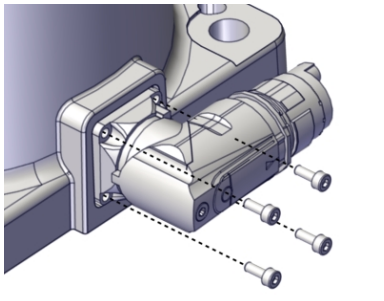
	Action	Note
1	Cut the cable ties.	**Valid for CRB 15000-5/0.95**  xx2100000424 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000761

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	Action	Note
2	Remove the functional and protective earth cables by removing the screw.	 xx2100000425
3	Snap loose and disconnect the connectors: • J1.DC+ • J1.DC- • J1.CS • J1.CP	 xx2100000426
4	Disconnect the connectors from the drive board. • D1.X1 from X1 • D1.DC+ from DC+ • D1.DC- from ground	 xx2100000405

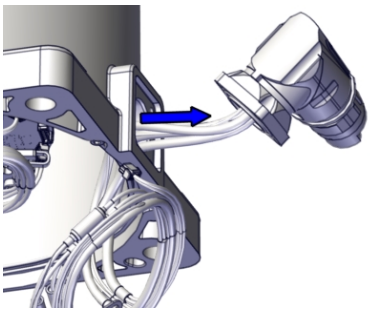
Removing the base cabling

	Action	Note
1	Remove the attachment screws.	 xx2100000406

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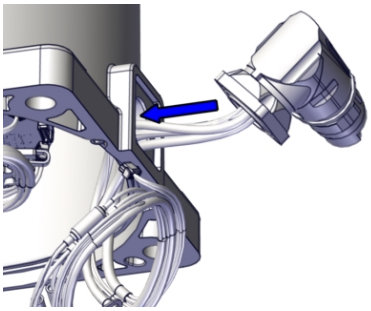
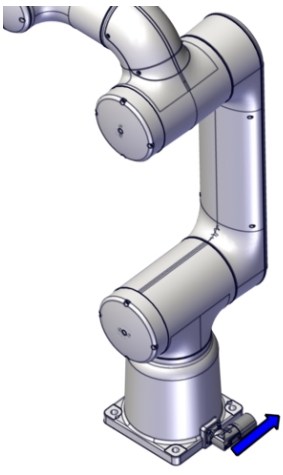
5.3.1 Replacing the base cabling
Continued

	Action	Note
2	Pull out the cabling from the base.	 xx2100000407

Refitting the base cabling

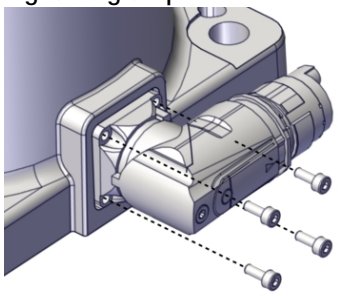
Use these procedures to refit the base cabling.

Refitting the base cabling

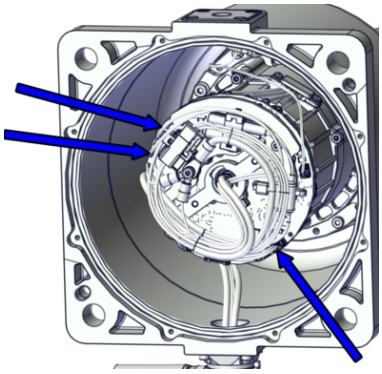
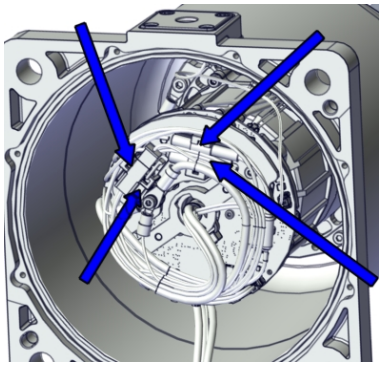
	Action	Note
1	Insert the cabling into the base.	 xx2100000408
2	Orient the base connector so that it points to the right, seen from back of the robot.	 xx2100000409

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	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

Connecting the base cabling

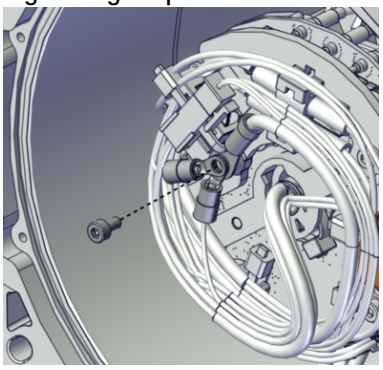
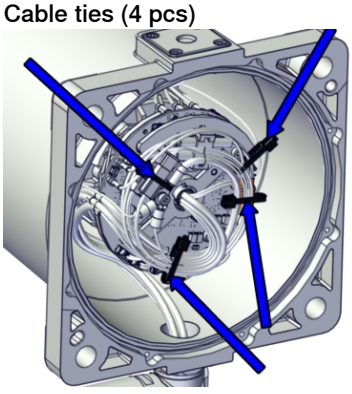
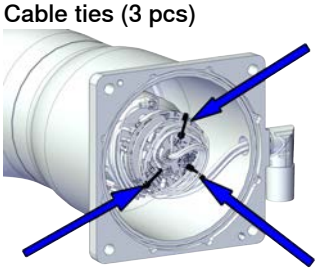
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Reconnect the connectors to the drive board. • D1.X1 to X1 • D1.DC+ to DC+ • D1.DC- to Ground	 xx2100000405
3	Connect the connectors to each other and snap them to the cable holders. • J1.DC+ to J1.DC+ • J1.DC- to J1.DC- • J1.CS to J1.CS • J1.CP to J1.CP	 xx2100000426

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5.3.1 Replacing the base cabling

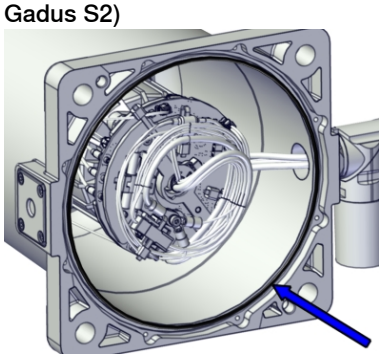
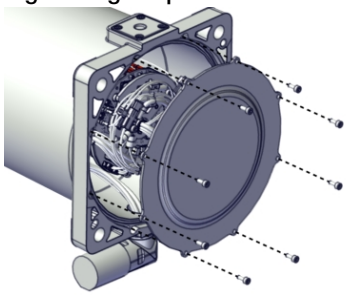
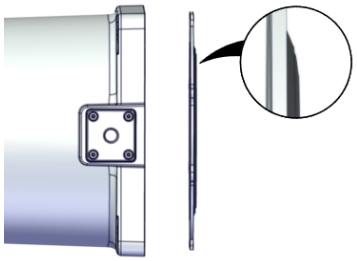
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	Action	Note
4	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2100000425
5	Secure the cabling with cable ties.	**Valid for CRB 15000-5/0.95** Cable ties (4 pcs)  xx2100000424 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Cable ties (3 pcs)  xx2300000761

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Refitting the base cover (-5/0.95)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAB3772-64 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016
2	Refit the bottom cover with the attachment screws. **Note** For CRB 15000-5/0.95, 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

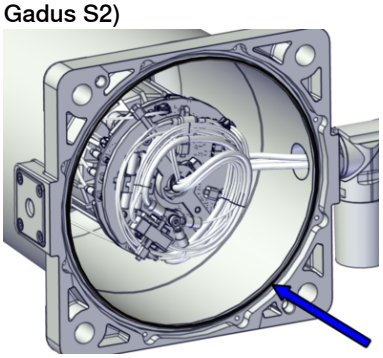
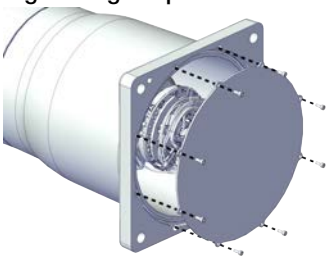
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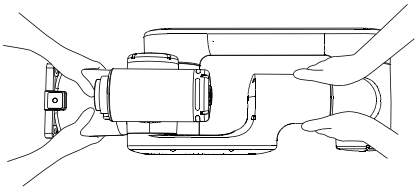
5.3.1 Replacing the base cabling

Continued

Refitting the base cover (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	3HAC061327-072 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016
2	Refit the bottom cover with the attachment screws. **Note** For CRB 15000-5/0.95, 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: 1.4 Nm.  xx2300000760

Lifting and securing the robot (-5/0.95)

	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

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	Action	Note
3	Carry the robot to the installation site.  **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. • 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: 32 Nm ±10%

Lifting and securing the robot (-10/1.52 and -12/1.27)

	Action	Note
1	Make sure the robot is positioned in the recommended position for transportation and lifting.  **WARNING** The robot is mechanically unstable if not secured to the foundation.	Recommended position for transportation and lifting is shown in *Transportation and shipping position on page 57*.
2	 **CAUTION** The weight of the CRB 15000 robot is up to 51 kg All lifting accessories used must be sized accordingly.	

Continues on next page

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5.3.1 Replacing the base cabling

Continued

	Action	Note
3	Attach the roundslings to the robot according to the figure. Make sure the roundslings do not rub against any sharp edges.	**CRB 15000-10/1.52**  xx2300000384
		CRB 15000-12/1.27  xx2300000385
4	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
5	Raise the overhead crane to lift the robot.	
6	Move the robot to the installation site. **CAUTION** Do not leave the robot standing unfastened to the foundation, it is not stable on its own.	

Continues on next page

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	Action	Note
7	Fit two pins to the holes in the base.	Centering pins: DIN6325, hardened steel Ø6x24 mm, 2 pcs .
8	Guide the robot gently, using the attachment screws while lowering it into its mounting position.	Make sure the robot base is correctly fitted onto the pins.
9	Fit the securing screws and washers in the attachment holes of the base.	Screws: M10x35, 4 pcs, quality 8.8 Washers: 23/10.5/2.5 mm Steel
10	Tighten the bolts in a crosswise pattern to ensure that the base is not distorted.	Tightening torque: 32 Nm ±10%

Concluding procedure

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

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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*.

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Spare part	Article number	Note
Cable harness, joint 1	3HAC073204-001	Used for CRB 15000-5/0.95. Also order new Cable tie: 3HAC075545-001.
Cable harness, joint 1 (CRB 15000-10/1.52)	3HAC083661-001	Used for CRB 15000-10/1.52. Also order new Cable tie: 3HAC075545-001.
Cable harness, joint 1 (CRB 15000-12/1.27)	3HAC080959-001	Used for CRB 15000-12/1.27. 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 Used for joint unit of CRB 15000-5/0.95. 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.
Ferrite core	3HAC092224-001	

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95. Attachment screws M4x35 (4 pcs) are enclosed.
Lifting aid	3HAC087787-001	For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27. A plate, a beam, a pair of semicircular blocks and attachment screws M5x30 (2 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M5x125	3HAC087786-001	Always use guide pins in pairs. For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint units of CRB 15000-5/0.95.
Protection plate	3HAC087789-001	For protection of drive board during cabling installation on joint units of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M5x75	3HAC087786-002	Always use guide pins in pairs.

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5.3.2 Replacing the axis-1 cabling
Continued

Equipment	Article number	Note
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cable ties	-	
O-ring	3HAB3772-64	Base cover, used for CRB 15000-5/0.95.
O-ring	3HAC061327-072	Base cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27.
O-ring	3HAC061327-044	Lower arm, inner cover of CRB 15000-5/0.95. 1 pcs / cover. Replace if damaged.
O-ring	3HAC061327-075	Lower arm, lower inner cover of CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-074	Swing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
Grease	3HAC042536-001	Shell Gadus S2
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)

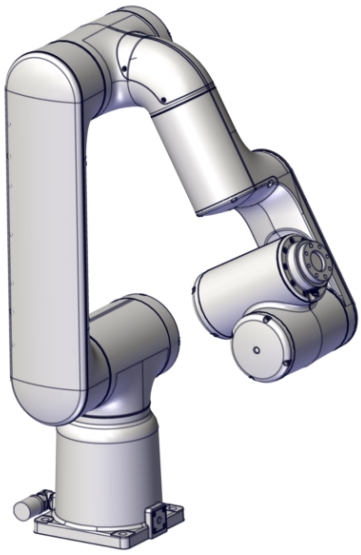
Removing the joint cabling (-5/0.95)

Use these procedures to remove the joint-1 cabling.

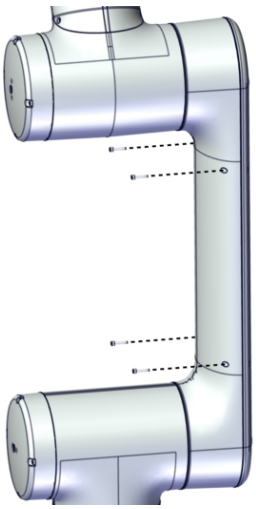
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Preparations before removing the cabling

	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 0° • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance.	 xx2100000044
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

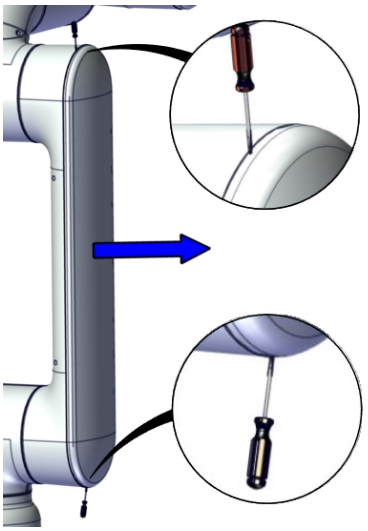
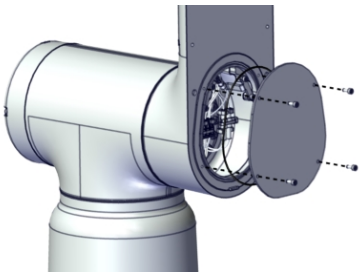
Removing the lower arm covers (-5/0.95)

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

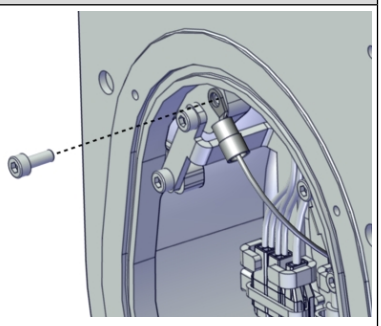
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5.3.2 Replacing the axis-1 cabling
Continued

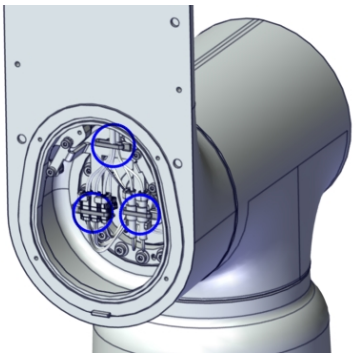
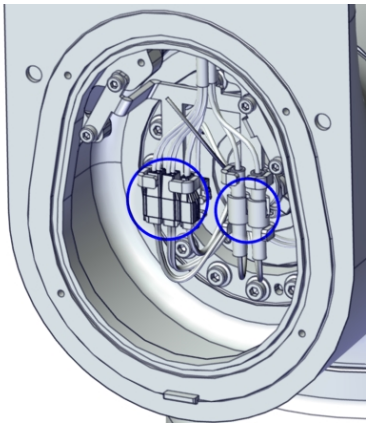
	Action	Note
3	Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267
4	Remove the inner cover by removing the four screws.	 xx2000001930

Disconnecting the cabling between the lower arm and the swing

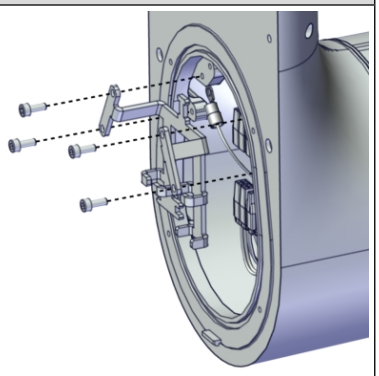
	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936

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	Action	Note
2	Cut the cable ties.	 xx2000001937
3	Snap loose and disconnect all connectors.	 xx2000001938

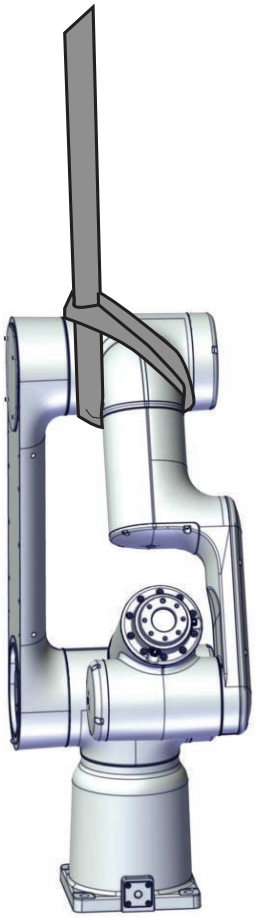
Removing the lower and upper arm assembled

	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939

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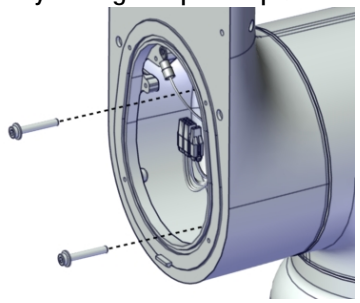
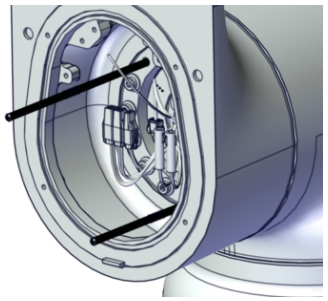
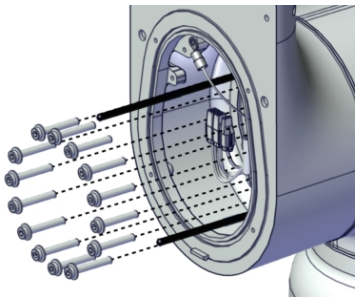
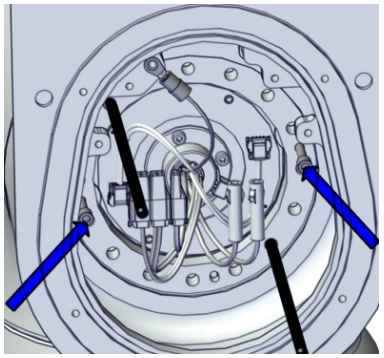
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5.3.2 Replacing the axis-1 cabling
Continued

	Action	Note
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. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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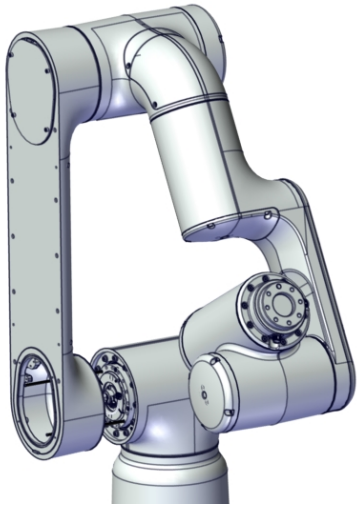
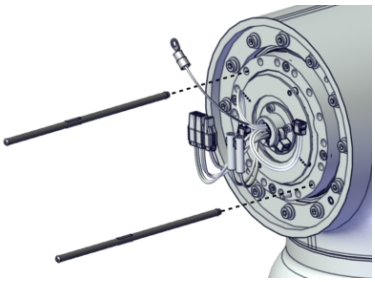
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	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

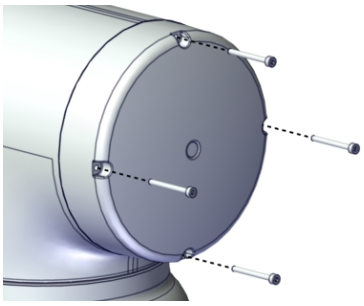
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5.3.2 Replacing the axis-1 cabling
Continued

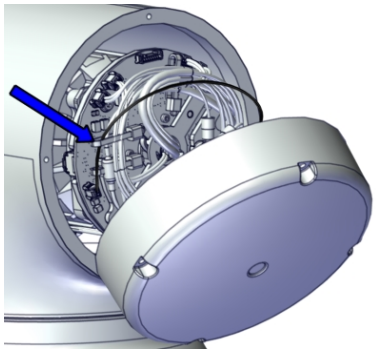
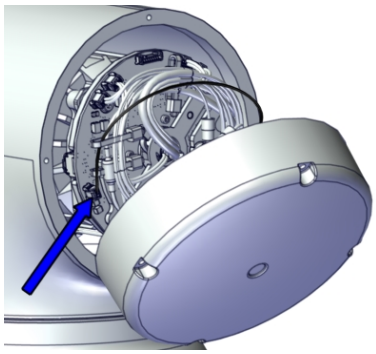
	Action	Note
6	Remove the complete arm system from the swing.	 xx2000001941
7	Remove the guide pins.	 xx2000002432

Removing the swing cover (-5/0.95)

	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
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000001931
5	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000001932

Disconnecting the axis-2 joint unit cabling

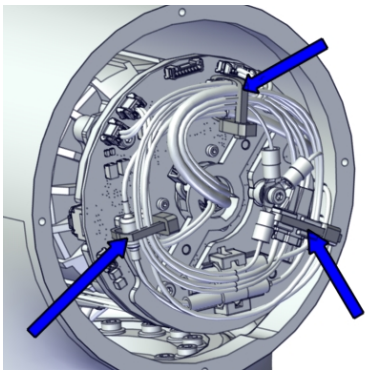
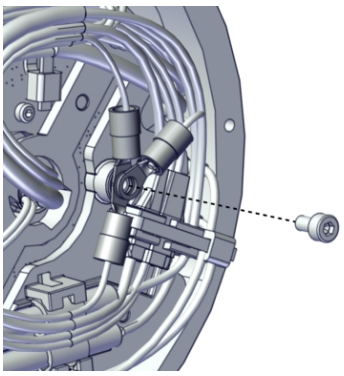
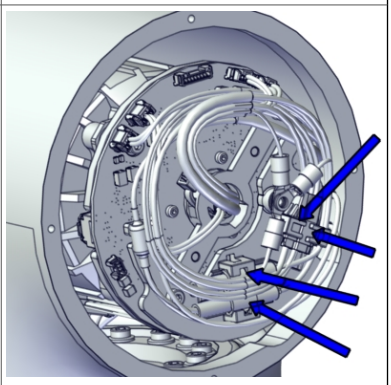
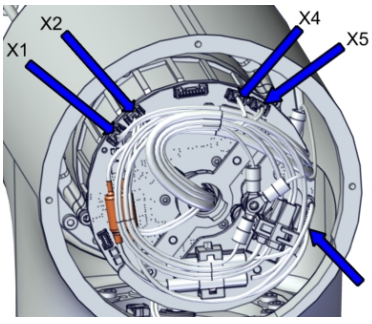
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	

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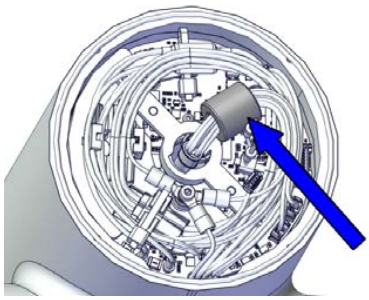
5.3.2 Replacing the axis-1 cabling

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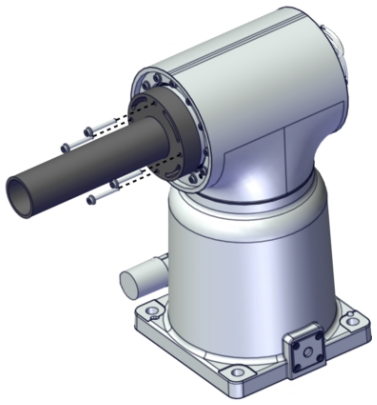
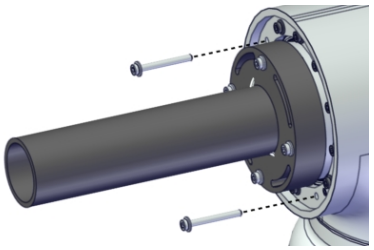
	Action	Note
2	Cut the cable ties.	 xx2000001946
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: • J2.DC+ • J2.DC- • J2.CS • J2.CP	 xx2000001944
5	Disconnect the connectors from the drive board. • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002013

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	Action	Note
6	Remove the ferrite core by pulling the cables D2.X4 and D2.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-2 joint unit (-5/0.95)

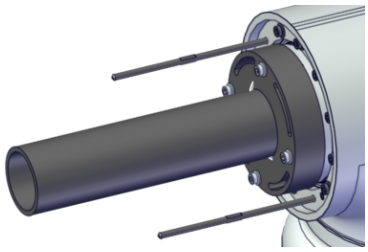
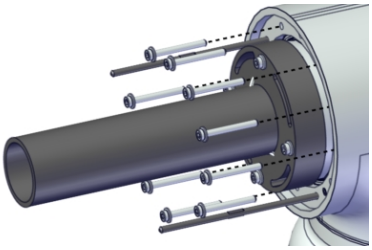
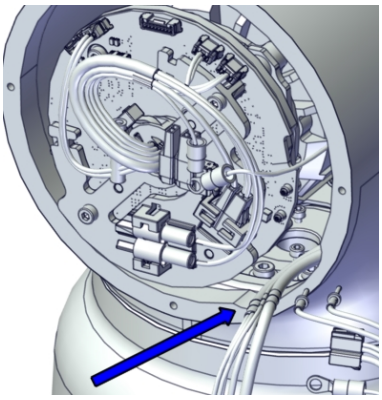
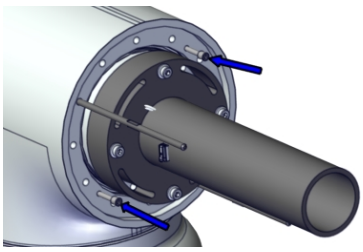
	Action	Note
1	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001956
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000295

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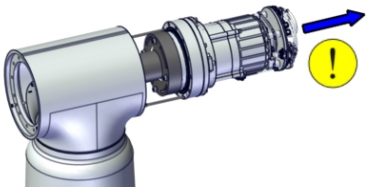
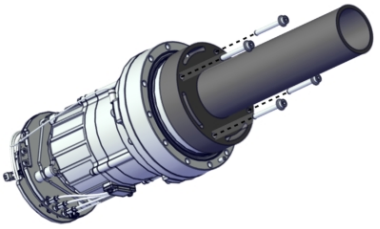
5.3.2 Replacing the axis-1 cabling

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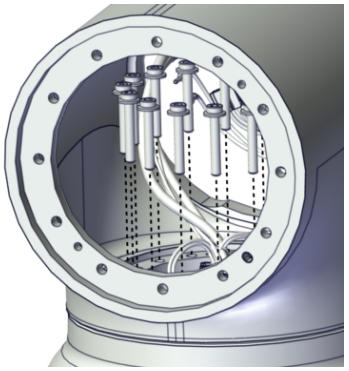
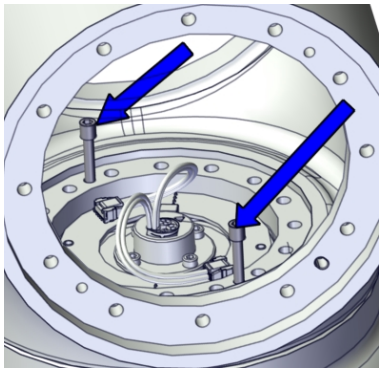
	Action	Note
3	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002433
4	Remove the remaining attachment screws. Use two screws 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.	 xx2000001943
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

Continues on next page

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	Action	Note
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 swing (-5/0.95)

	Action	Note
1	Remove the swing attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001987
2	Use two fully threaded attachment screws as removal tools to press the swing out of position. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000002152
3	Lift away the swing. **CAUTION** The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	

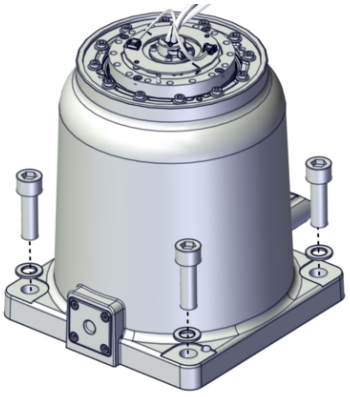
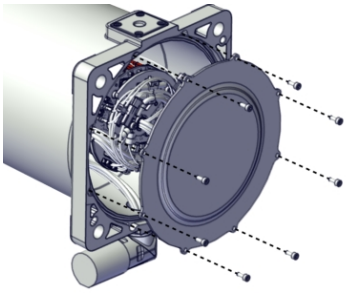
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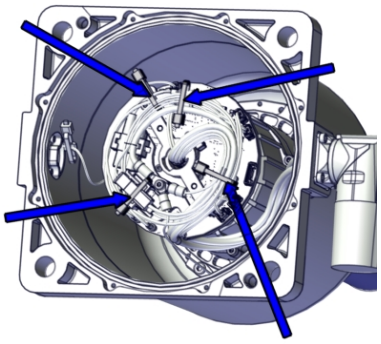
5.3.2 Replacing the axis-1 cabling

Continued

Loosening the base and removing the base cover

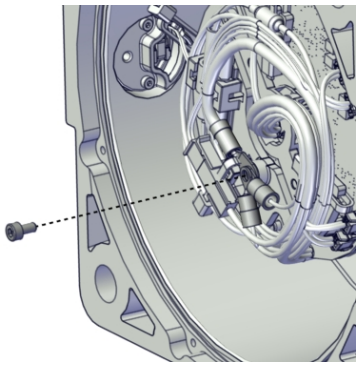
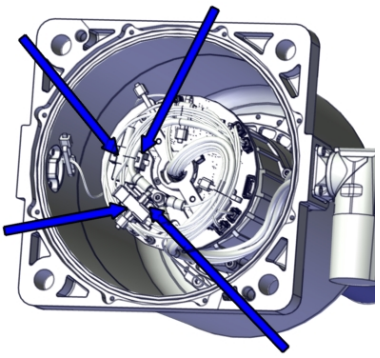
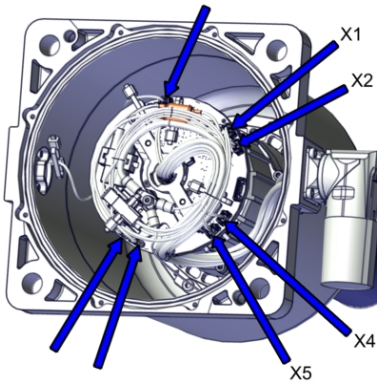
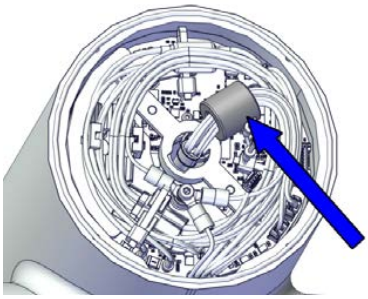
	Action	Note
1	Loosen the base from the foundation by removing the attachment screws and washers.	 xx2000002006
2	Tilt the base on to its side and remove the bottom cover by removing the attachment screws.	 xx2000002007

Disconnecting the axis-1 joint unit cabling

	Action	Note
1	Cut the cable ties.	 xx2000002012

Continues on next page

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	Action	Note
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
4	Disconnect the connectors from the drive board. • 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 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002009
5	Remove the ferrite core by pulling the cables D1.X4 and D1.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

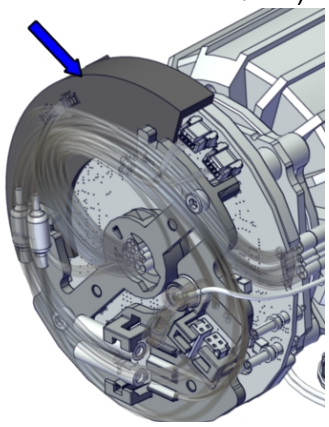
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5.3.2 Replacing the axis-1 cabling

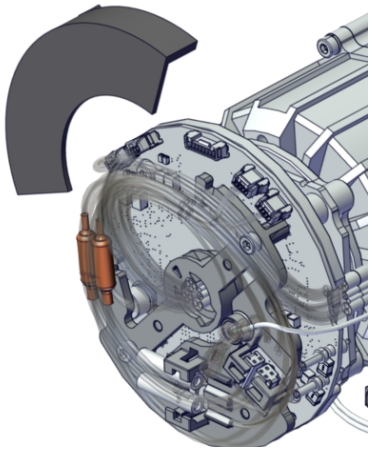
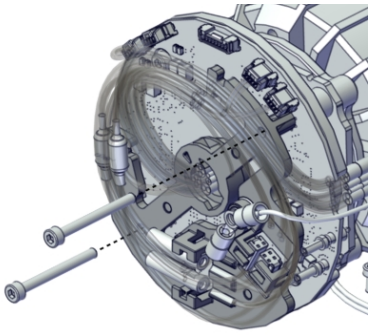
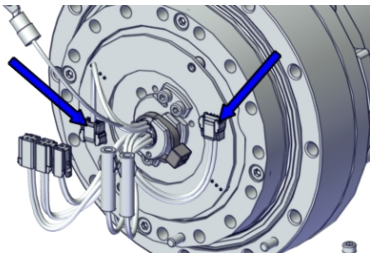
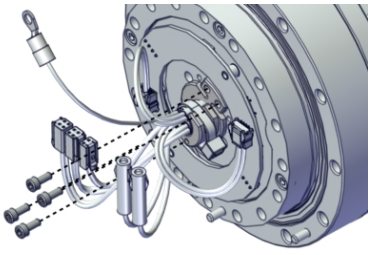
Continued

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 53*.	
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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
3	Cut the cable tie at the drive board.	 xx2000002058

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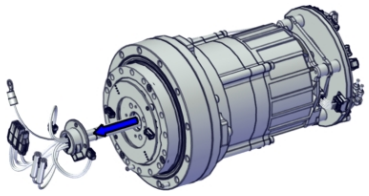
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	Action	Note
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. • TQ.A • TQ.B	 xx2000002053
7	Remove the cable plate by removing the attachment screws.	 xx2000002049

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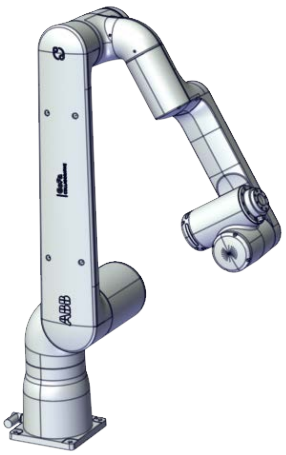
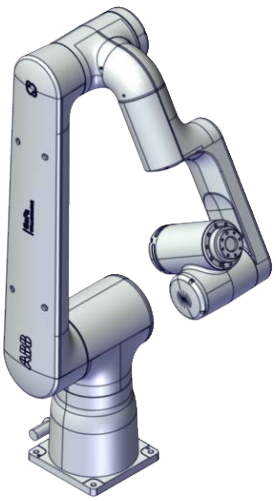
5.3.2 Replacing the axis-1 cabling
Continued

	Action	Note
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

Removing the joint cabling (-10/1.52 and -12/1.27)

Use these procedures to remove the joint-1 cabling.

Preparations before removing the cabling

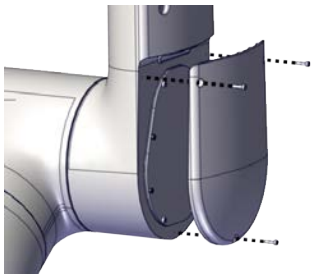
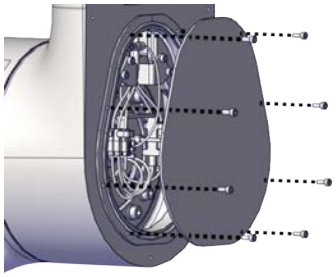
	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 0° • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance.	**Valid for CRB 15000-10/1.52**  xx2300001062 **Valid for CRB 15000-12/1.27**  xx2300001063

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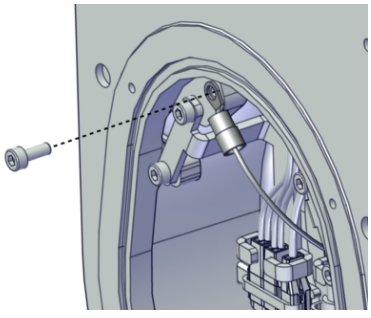
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	Action	Note
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the lower arm covers (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the lower cover of lower arm by removing the screws.	 xx2300000812
3	Remove the lower inner cover by removing the screws.	 xx2300000813

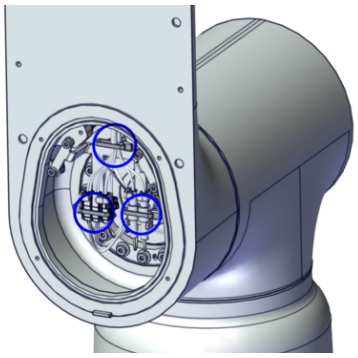
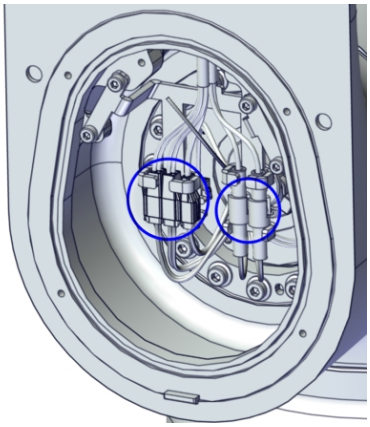
Disconnecting the cabling between the lower arm and the swing

	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936

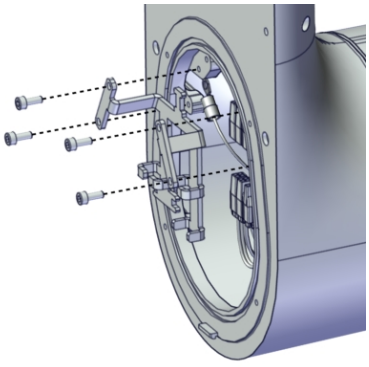
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5.3.2 Replacing the axis-1 cabling
Continued

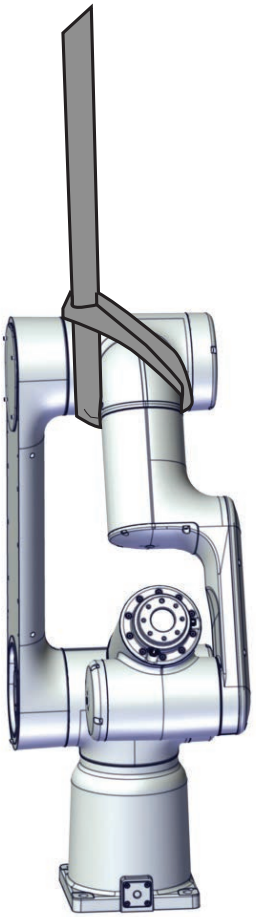
	Action	Note
2	Cut the cable ties.	 xx2000001937
3	Snap loose and disconnect all connectors.	 xx2000001938

Removing the lower and upper arm assembled

	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939

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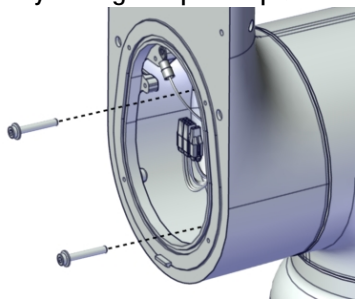
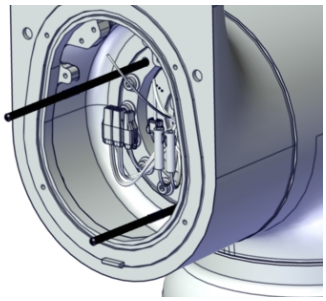
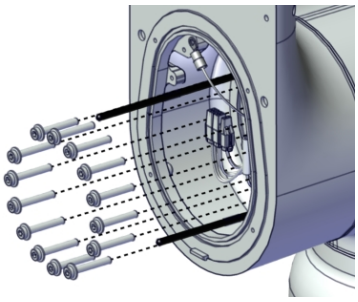
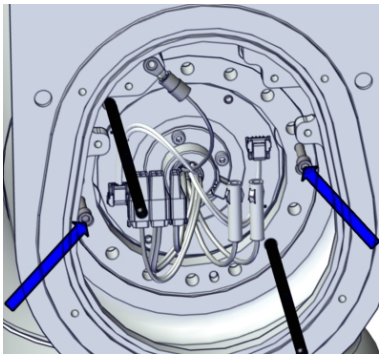
	Action	Note
2	Secure the weight of the upper and lower arm. **CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	Suggestion with lifting sling and an overhead crane. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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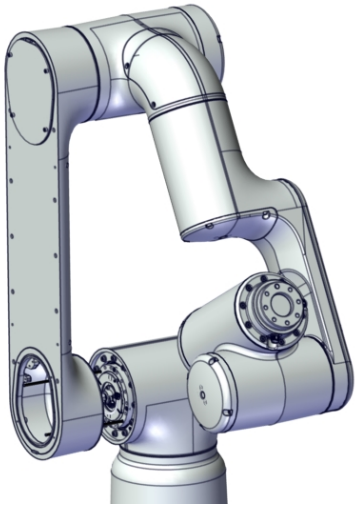
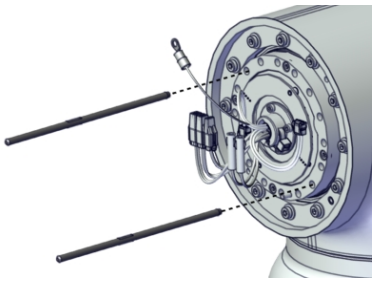
5.3.2 Replacing the axis-1 cabling

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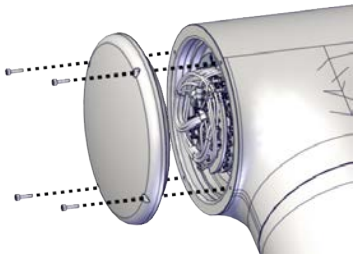
	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

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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 and insert (-10/1.52 and -12/1.27)

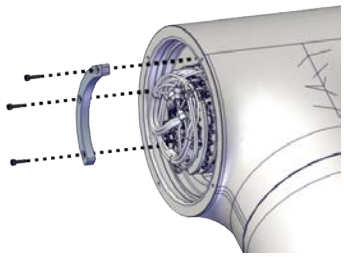
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000814

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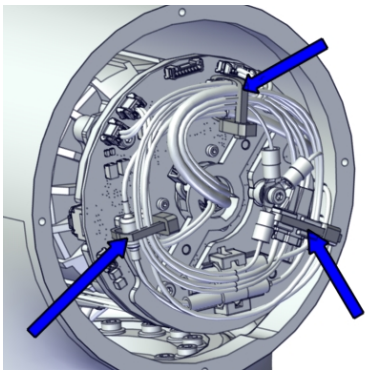
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5.3.2 Replacing the axis-1 cabling

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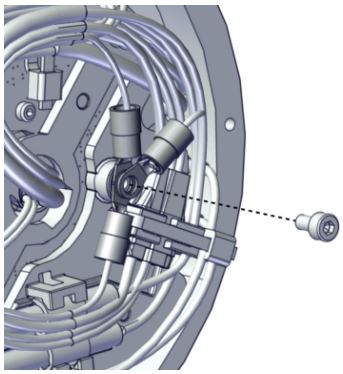
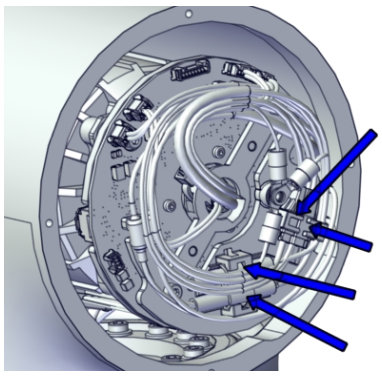
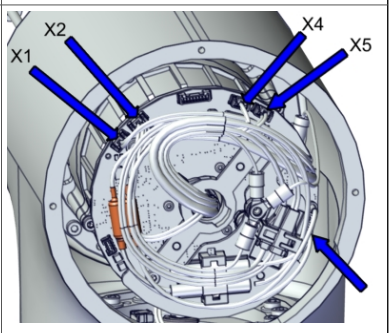
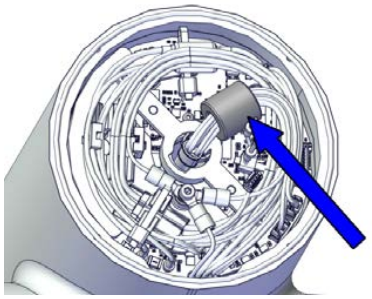
	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	Remove the insert.	 xx2300000815

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 53*.	
2	Cut the cable ties.	 xx2000001946

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	Action	Note
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: • J2.DC+ • J2.DC- • J2.CS • J2.CP	 xx2000001944
5	Disconnect the connectors from the drive board. • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002013
6	Remove the ferrite core by pulling the cables D2.X4 and D2.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

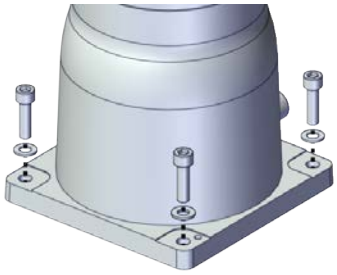
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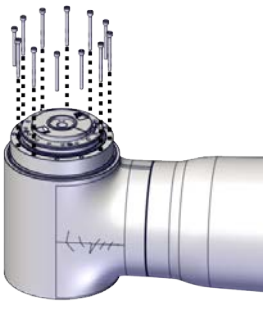
5.3.2 Replacing the axis-1 cabling

Continued

Removing the base from foundation (-10/1.52 and -12/1.27)

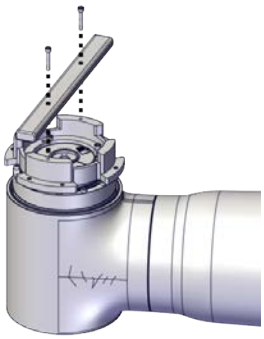
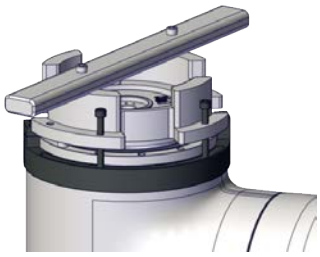
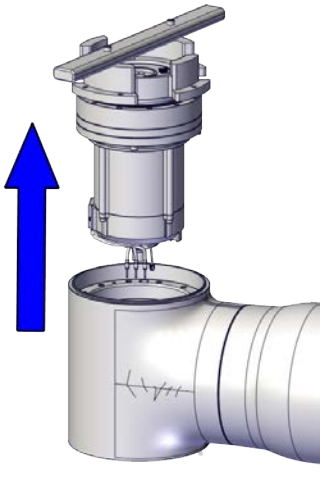
	Action	Note
1	**CAUTION** The weight of the complete swing and base together is up to 25 kg	
2	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
3	Loosen the robot base from the foundation by removing the foundation attachment screws.	 xx2300001060
4	Lay the robot down with the torque sensor side upwards on a working bench. Do not damage the base socket. Caution with the cabling. **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.	

Removing the axis-2 joint unit

	Action	Note
1	Removing the attachment screws.	 xx2300000786

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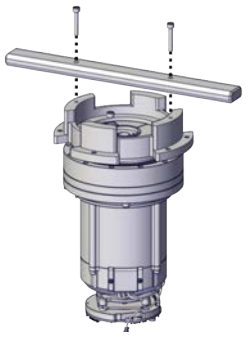
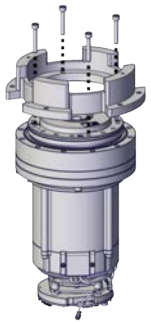
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	Action	Note
2	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000787  xx2300000788
3	Place the two semicircular blocks surrounding the joint unit, and use two fully threaded attachment screws as removal tools to press the joint unit out of position.	 xx2300000789
4	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.	 xx2300000790

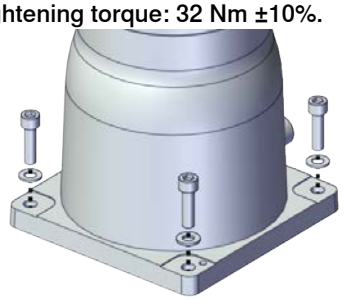
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5.3.2 Replacing the axis-1 cabling
Continued

	Action	Note
5	Remove the lifting aid.	 xx2300000778  xx2300000776

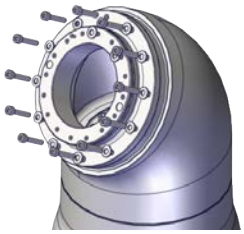
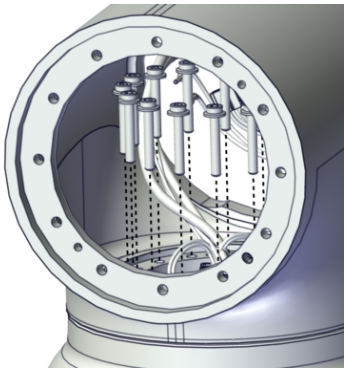
Securing the base (-10/1.52 and -12/1.27)

	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: 32 Nm ±10%.  xx2300001060

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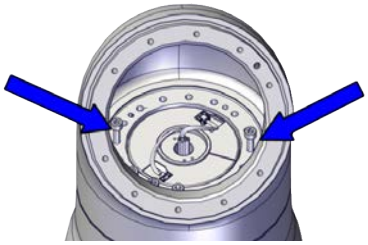
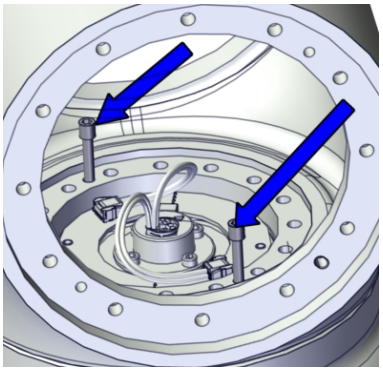
Removing the swing (-10/1.52 and -12/1.27)

	Action	Note
1	**Valid for CRB 15000-10/1.52** Remove the swing transition.	 xx2300000817
2	**Valid for CRB 15000-10/1.52** Remove the swing flange.	 xx2300000818
3	Remove the swing attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	**Valid for CRB 15000-10/1.52**  xx2300000819 **Valid for CRB 15000-12/1.27**  xx2000001987

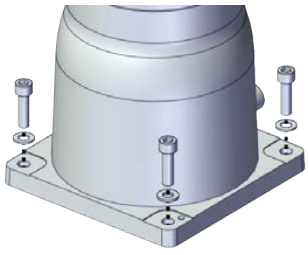
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5.3.2 Replacing the axis-1 cabling
Continued

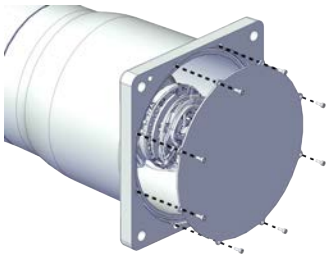
	Action	Note
4	Use two fully threaded attachment screws as removal tools to press the swing out of position. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	**Valid for CRB 15000-10/1.52**  xx2300000822 **Valid for CRB 15000-12/1.27**  xx2000002152
5	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

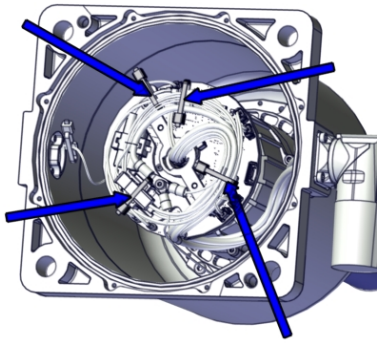
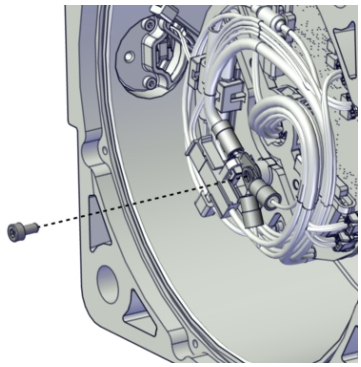
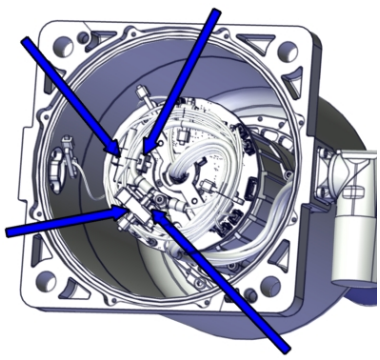
	Action	Note
1	Loosen the base from the foundation by removing the attachment screws and washers.	 xx2300001060

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	Action	Note
2	Tilt the base on to its side and remove the bottom cover by removing the attachment screws.	 xx2300000760

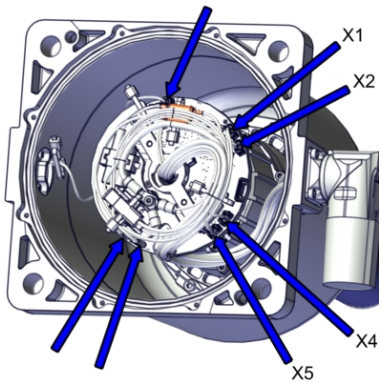
Disconnecting the axis-1 joint unit cabling

	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

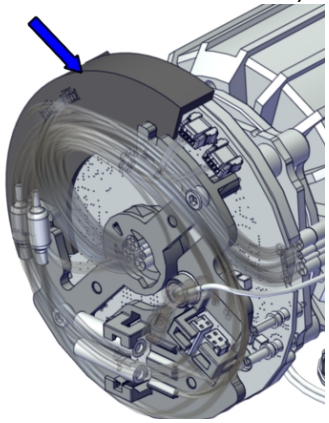
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5.3.2 Replacing the axis-1 cabling
Continued

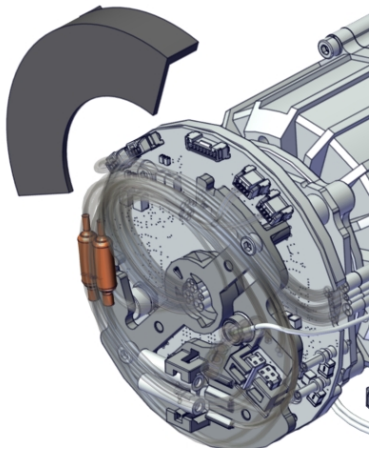
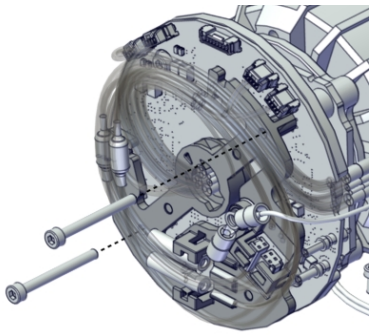
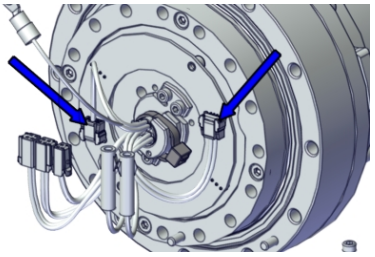
	Action	Note
4	Disconnect the connectors from the drive board. • D1.X1 from X1 • D1.DC+ from DC+ • D1.DC- from ground • D1.X4 from X4 • D1.X2 from X2 • D1.X5 from X5 • DR.X8 from X8 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002009
5	Remove the ferrite core by pulling the cables D1.X4 and D1.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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 53*.	
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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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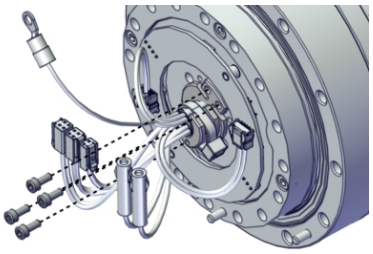
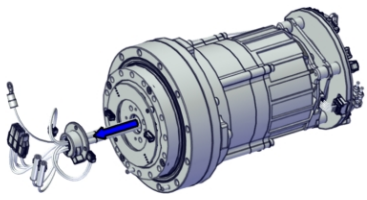
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	Action	Note
3	Cut the cable tie at the drive board.	 xx2000002058
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. • TQ.A • TQ.B	 xx2000002053

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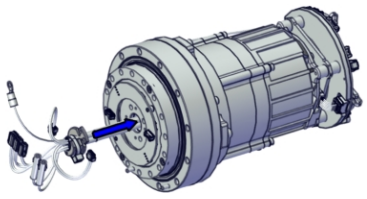
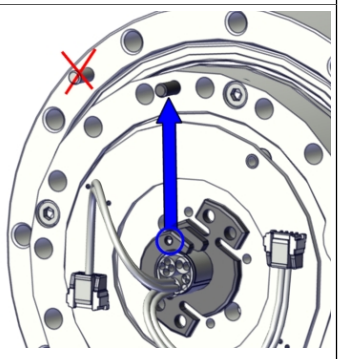
5.3.2 Replacing the axis-1 cabling
Continued

	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 (-5/0.95)

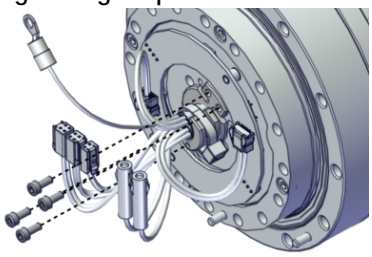
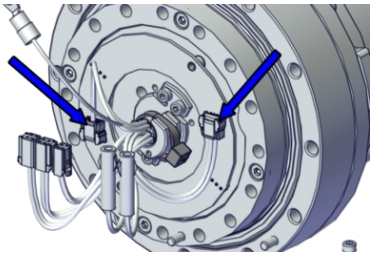
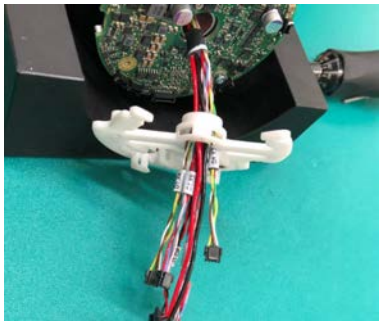
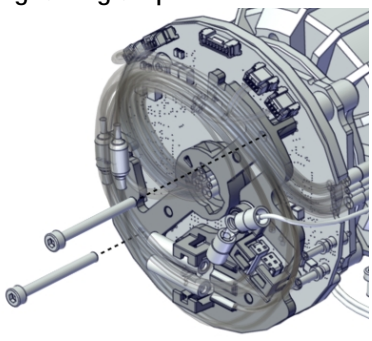
Use these procedures to refit the joint-1 cabling.

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 53*.	
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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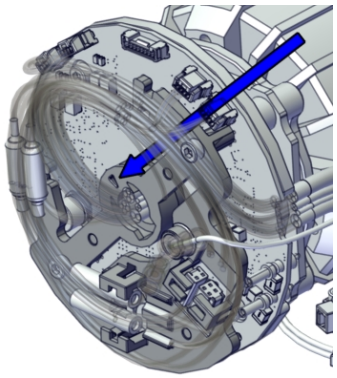
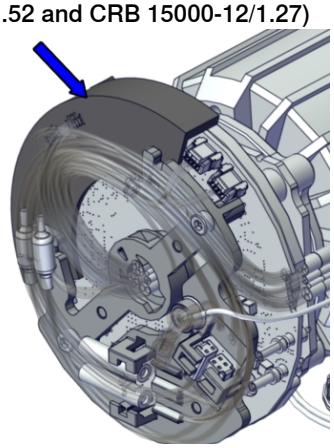
	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000002049
5	Connect the two connectors to the torque sensor board. • TQ.A to CH1/A • TQ.B to CH2/B	 xx2000002053
6	Insert 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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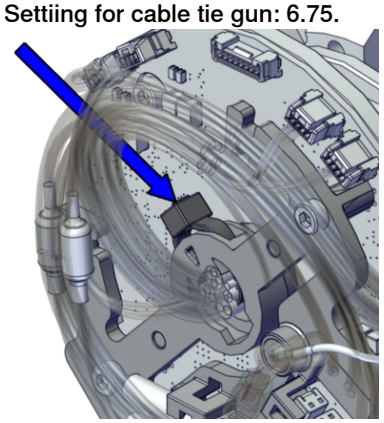
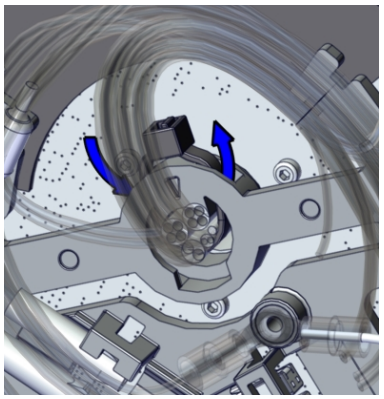
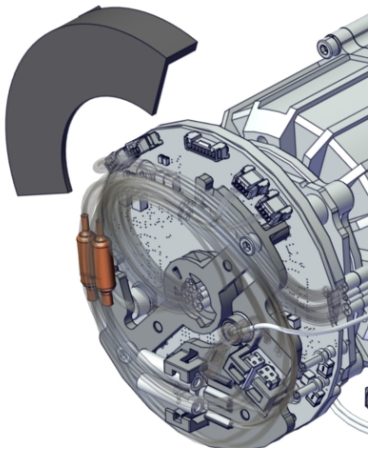
5.3.2 Replacing the axis-1 cabling

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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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	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 EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059
10	Remove the protection plate.	 xx2100000301

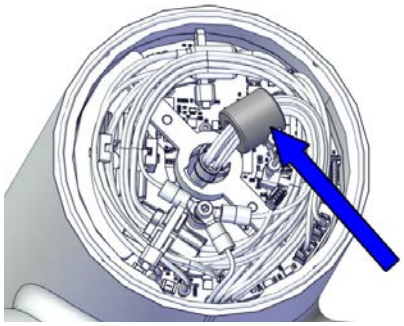
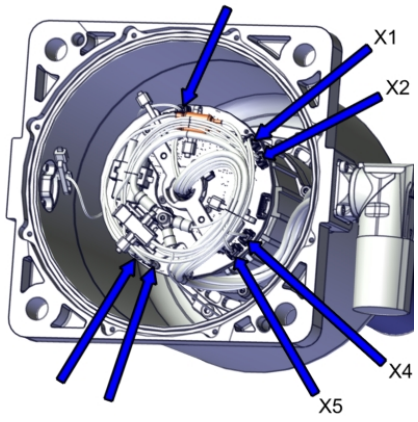
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5.3.2 Replacing the axis-1 cabling

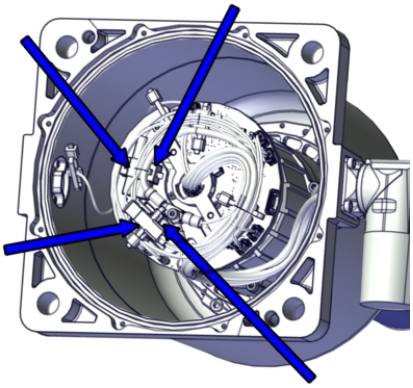
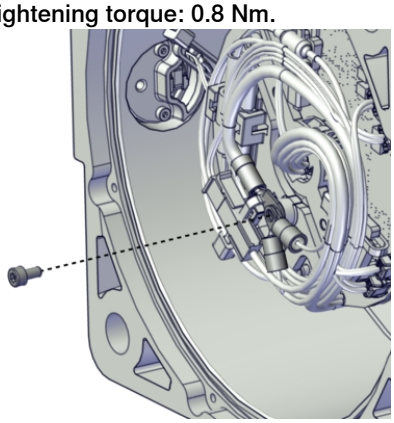
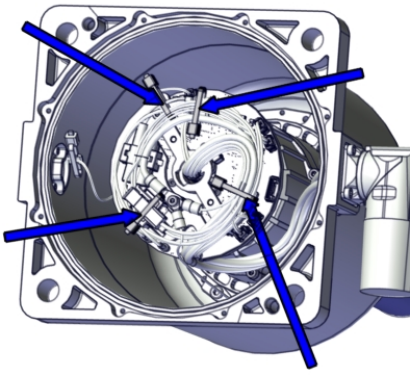
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Connecting the axis-1 joint unit cabling

	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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D1.X4 and D1.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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

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	Action	Note
5	Connect the connectors to each other and snap them to the cable holders. • J1.DC+ to J1.DC+ • J1.DC- to J1.DC- • J1.CS to J1.CS • J1.CP to J1.CP	 xx2000002010
6	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
7	Secure the cabling with cable ties.	Cable ties (4 pcs)  xx2000002012

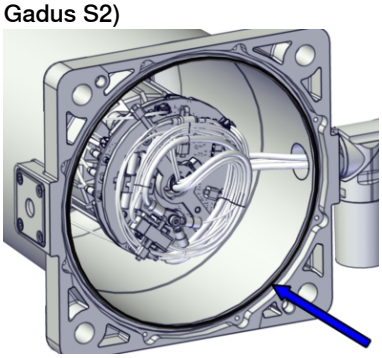
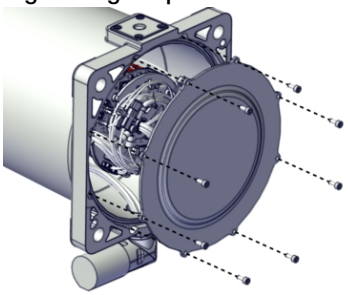
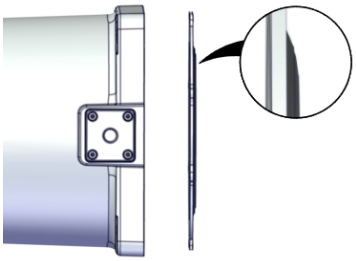
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5.3.2 Replacing the axis-1 cabling

Continued

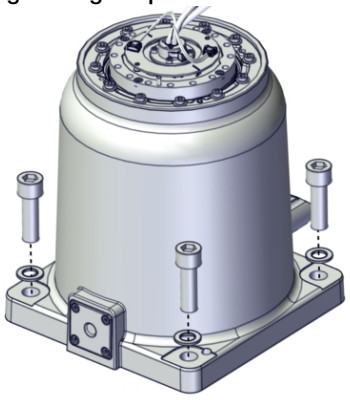
Refitting the base cover (-5/0.95)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAB3772-64 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016
2	Refit the bottom cover with the attachment screws. **Note** For CRB 15000-5/0.95, 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

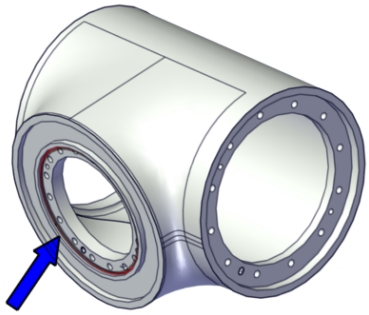
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Securing the base

	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: 32 Nm ±10%.  xx2000002006

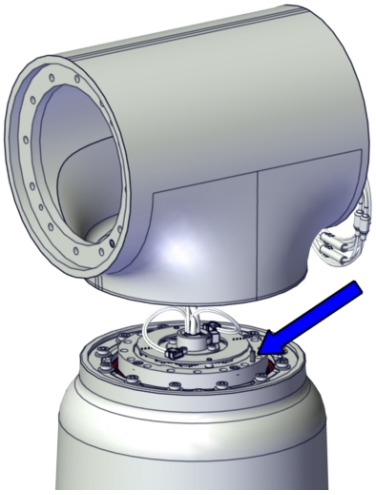
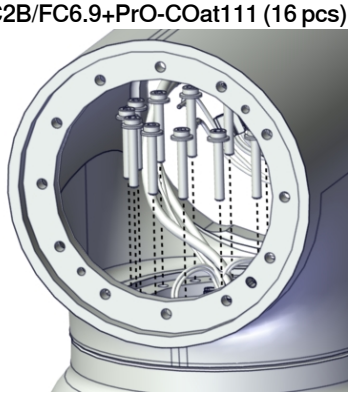
Refitting the swing(-5/0.95)

	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 (or equivalent)  xx2000001990
2	Separate the new swing parts by removing the pre-assembling screws.	

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5.3.2 Replacing the axis-1 cabling
Continued

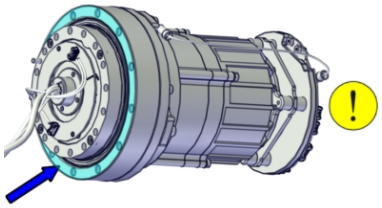
	Action	Note
3	Refit the swing to the base unit, aligning the pin with the pin hole. **CAUTION** The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	 xx2000001989
4	Secure the swing with the attachment screws. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001987
5	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm

Preparations before fitting the joint unit (-5/0.95)

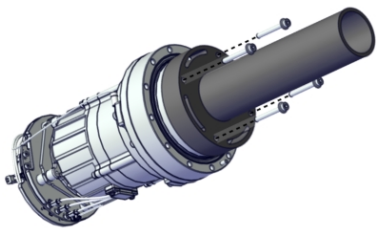
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	

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	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 (or equivalent)  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 53*.	

Refitting the axis-2 joint unit (-5/0.95)

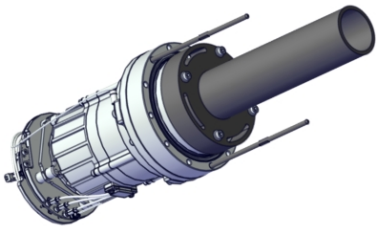
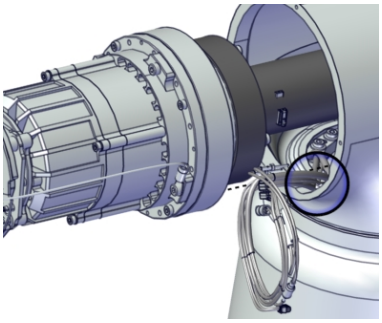
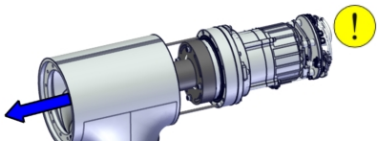
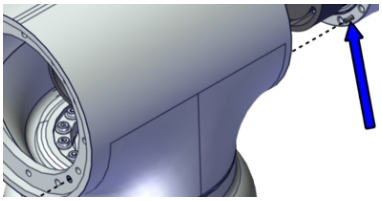
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Fit the lifting aid to the joint unit. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957

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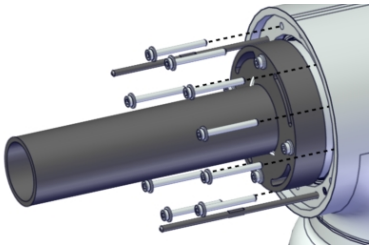
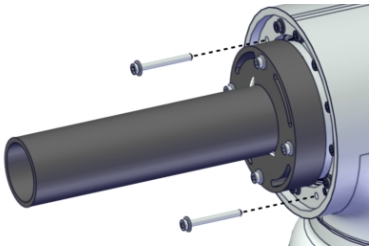
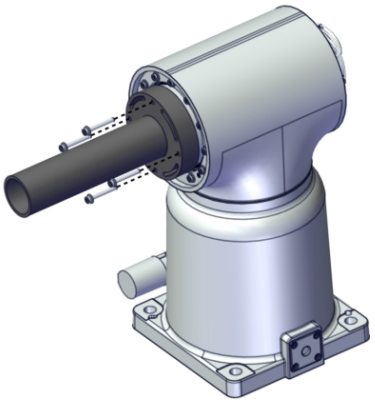
5.3.2 Replacing the axis-1 cabling

Continued

	Action	Note
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 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  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
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

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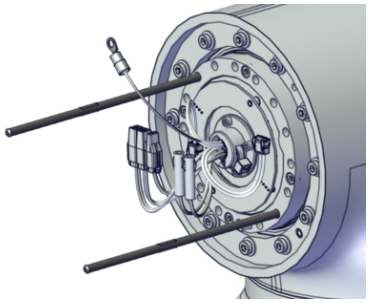
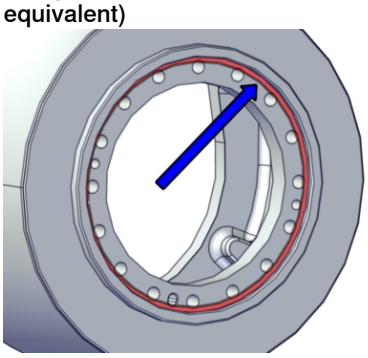
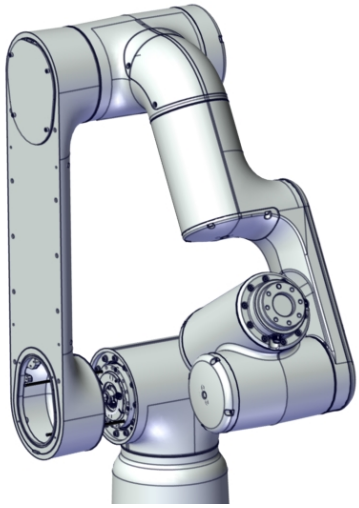
	Action	Note
6	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit 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.
10	Remove the lifting aid by removing the screws.	 xx2000001956
11	Clean pushed-out flange sealant, if any.	

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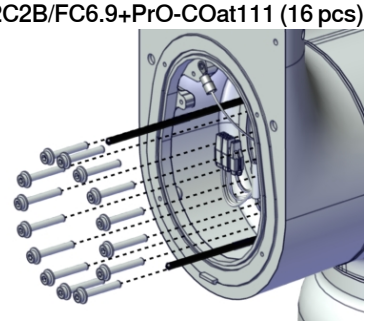
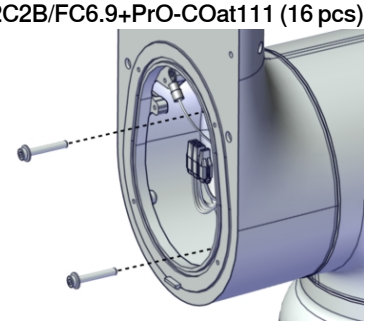
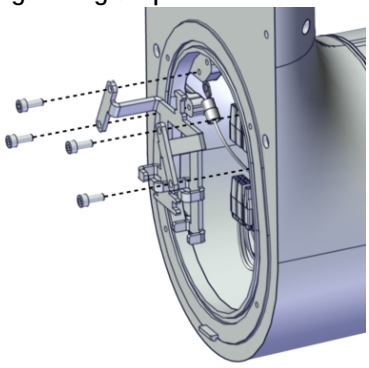
5.3.2 Replacing the axis-1 cabling
Continued

Refitting the lower and upper arm assembled (-5/0.95)

	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001  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 (or equivalent)  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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	Action	Note
5	Secure the lower arm to the swing with all attachment screws but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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

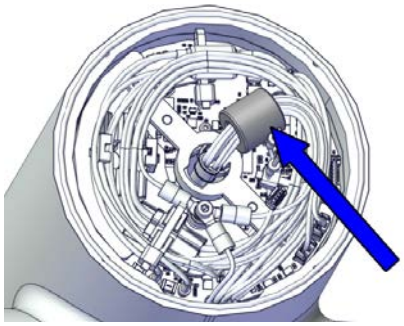
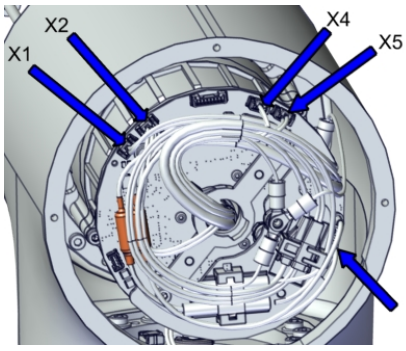
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5.3.2 Replacing the axis-1 cabling

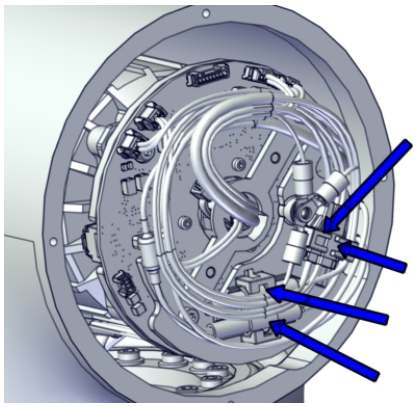
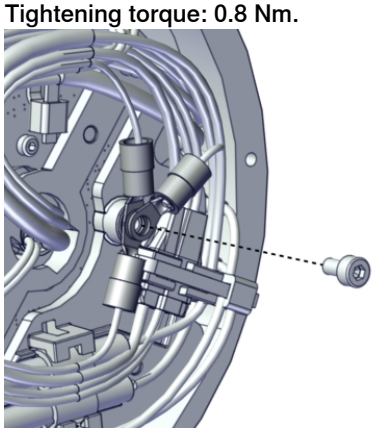
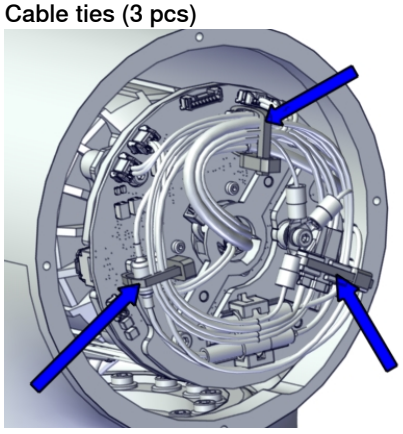
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Connecting the axis-2 joint unit cabling

	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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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

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	Action	Note
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944
6	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
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

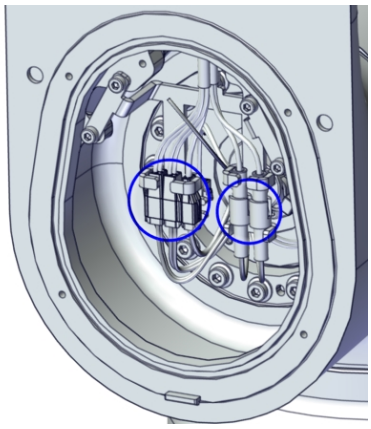
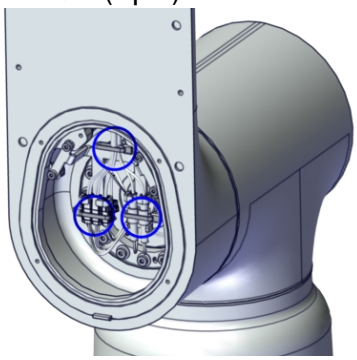
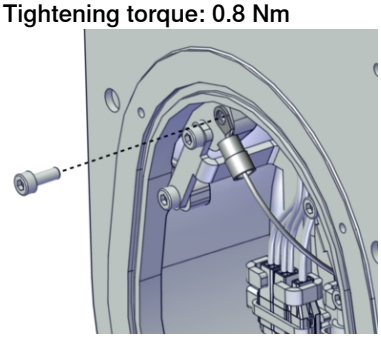
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5.3.2 Replacing the axis-1 cabling

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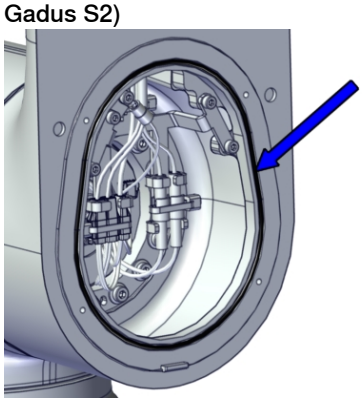
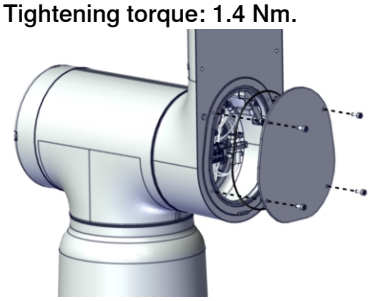
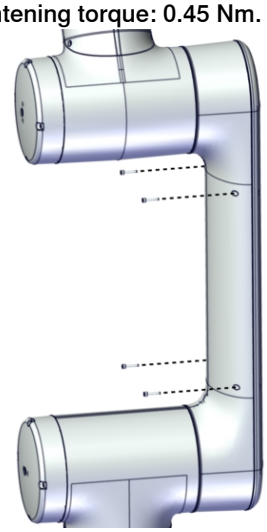
Connecting the cabling between the lower arm and swing

	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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Refitting the lower arm covers (-5/0.95)

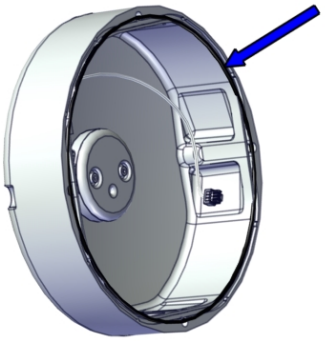
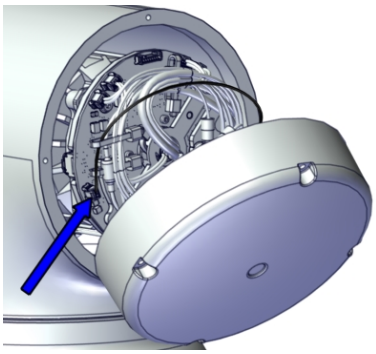
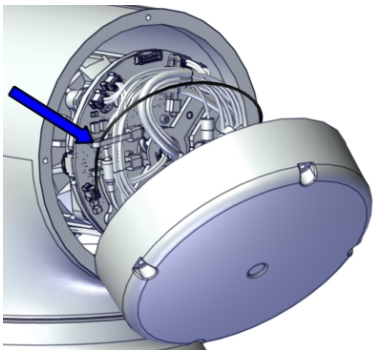
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001954
2	Refit the inner cover with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm.  xx2000001930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

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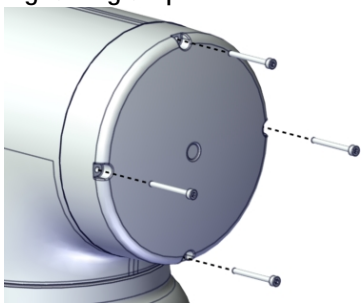
5.3.2 Replacing the axis-1 cabling
Continued

Refitting the swing cover(-5/0.95)

	Action	Note
1	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-047 (for CRB 15000-5/0.95)  xx2000001962
2	**For robots with RobotWare earlier than 7.10** 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	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000001931

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	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  xx2000001935

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

Refitting the joint cabling (-10/1.52 and -12/1.27)

Use these procedures to refit the joint-1 cabling.

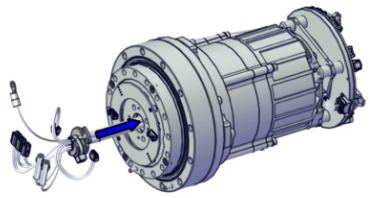
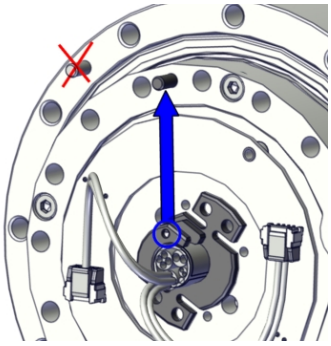
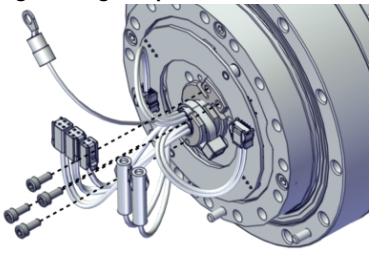
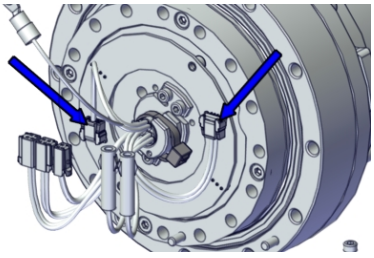
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5.3.2 Replacing the axis-1 cabling

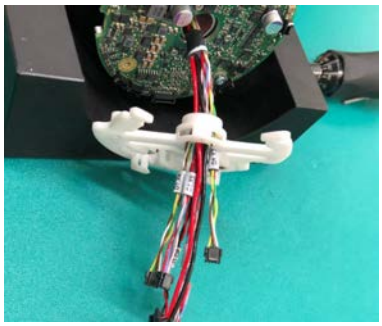
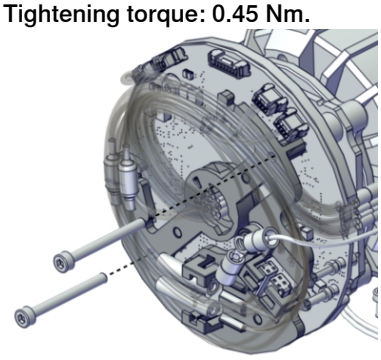
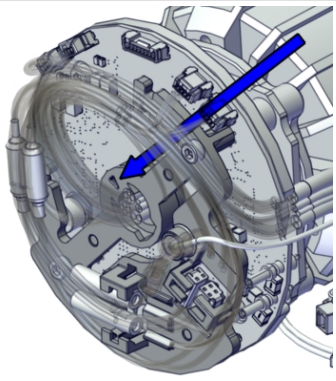
Continued

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 53*.	
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
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. • TQ.A to CH1/A • TQ.B to CH2/B	 xx2000002053

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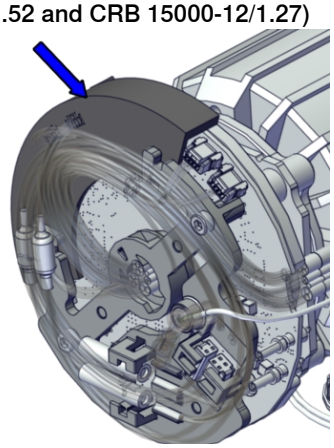
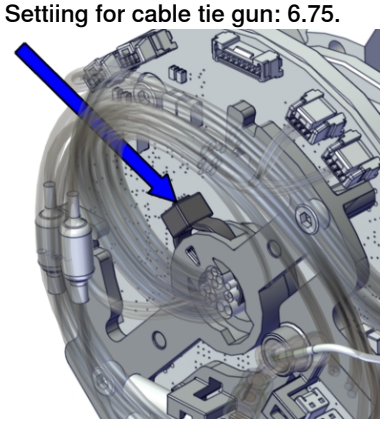
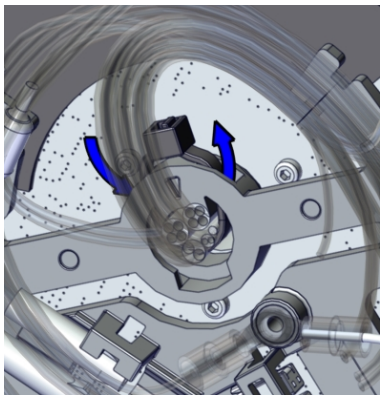
	Action	Note
6	Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 xx2000002056 Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.  xx2000002055
7	Keep the cabling loose, making sure not to twist or strain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

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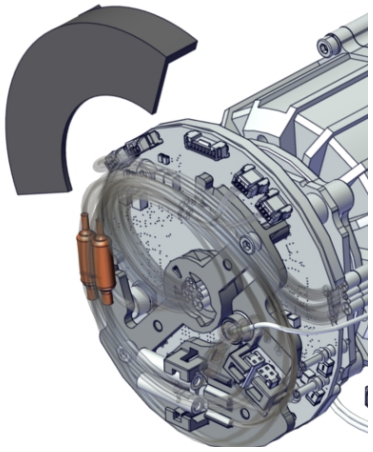
5.3.2 Replacing the axis-1 cabling

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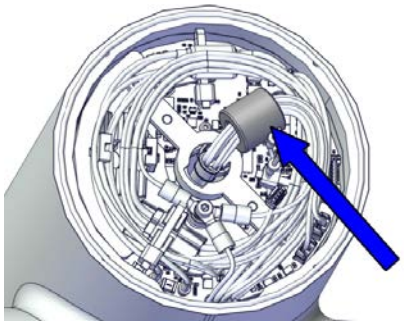
	Action	Note
8	Fit the protection plate to the drive board unit.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
9	Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.	Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059

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	Action	Note
10	Remove the protection plate.	 xx2100000301

Connecting the axis-1 joint unit cabling

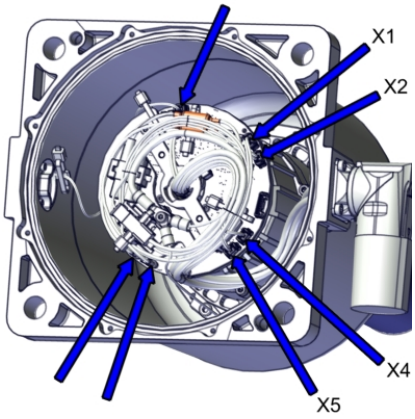
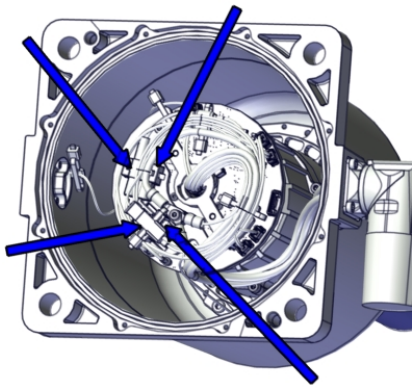
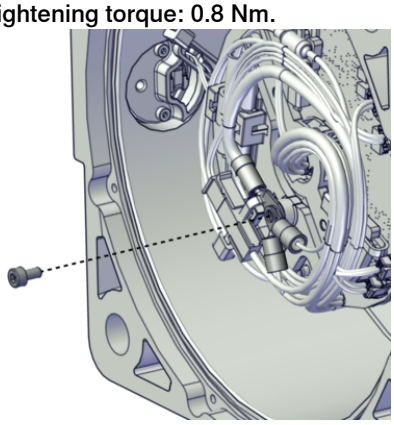
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D1.X4 and D1.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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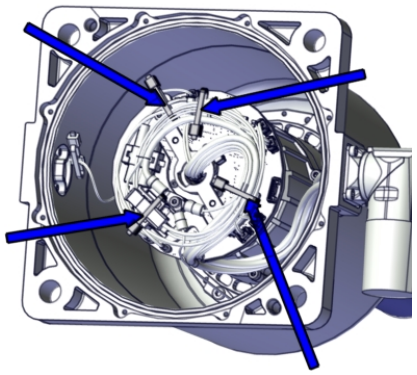
5.3.2 Replacing the axis-1 cabling

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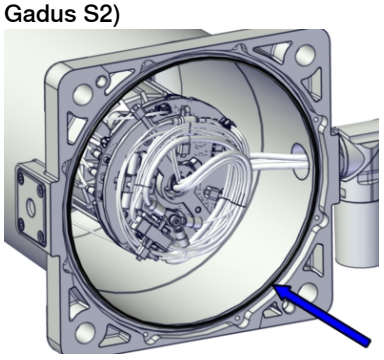
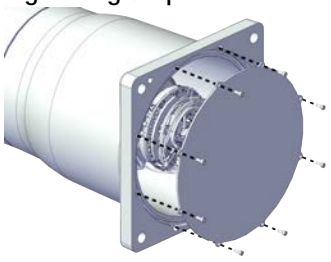
	Action	Note
4	Reconnect the connectors to the drive board. • D1.X1 to X1 • D1.DC+ to DC+ • D1.DC- to Ground • D1.X4 to X4 • D1.X2 to X2 • D1.X5 to X5 • DR.X8 to X8	 xx2000002009
5	Connect the connectors to each other and snap them to the cable holders. • J1.DC+ to J1.DC+ • J1.DC- to J1.DC- • J1.CS to J1.CS • J1.CP to J1.CP	 xx2000002010
6	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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	Action	Note
7	Secure the cabling with cable ties.	Cable ties (4 pcs)  xx2000002012

Refitting the base cover (-10/1.52 and -12/1.27)

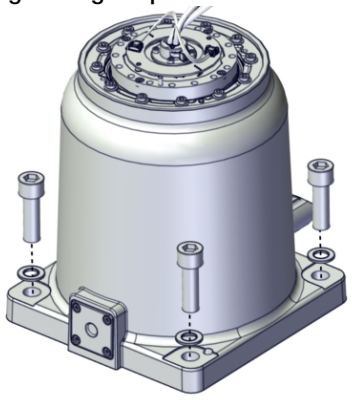
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	3HAC061327-072 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016
2	Refit the bottom cover with the attachment screws. **Note** For CRB 15000-5/0.95, fit the cover in correct direction, the protrusion of the cover must face outwards.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.4 Nm.  xx2300000760

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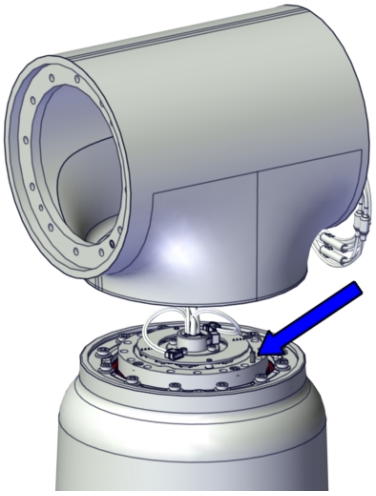
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5.3.2 Replacing the axis-1 cabling
Continued

Securing the base

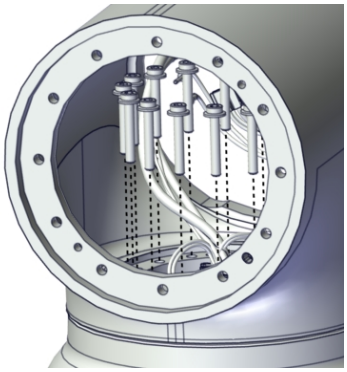
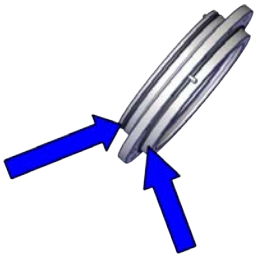
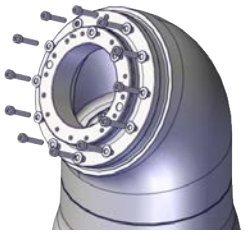
	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 32 Nm ±10%.  xx2000002006

Refitting the swing(-10/1.52 and -12/1.27)

	Action	Note
1	Fit two guide pins on the base unit for position guidance. Always use guide pins in pairs.	**Valid for CRB 15000-10/1.52** Guide pin, M5x75, 3HAC087786-002 **Valid for CRB 15000-12/1.27** Guide pin, M5x125: 3HAC087786-001
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.	Example of CRB 15000-12/1.27, similar to CRB 15000-10/1.52.  xx2000001989

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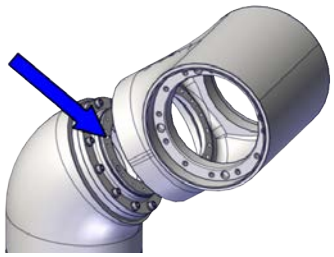
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	Action	Note
3	Secure the swing with the attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm **Valid for CRB 15000-12/1.27**  xx2000001987 **Valid for CRB 15000-10/1.52**  xx2300000819
4	**Valid for CRB 15000-10/1.52** Check the o-rings on both side of the swing flange. Replace if damaged.	O-ring: 3HAC061327-073 O-ring: 3HAC061327-044  xx2300000821
5	**Valid for CRB 15000-10/1.52** Refit the swing flange with the attachment screws. Always check the serial number printed on the swing parts and use the parts in the same number for refitting. **CAUTION** Do not use the pre-assembling screws of swing parts for securing.	Hex socket head cap screw: M5x25 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm  xx2300000818

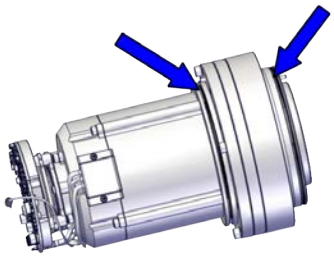
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5.3.2 Replacing the axis-1 cabling
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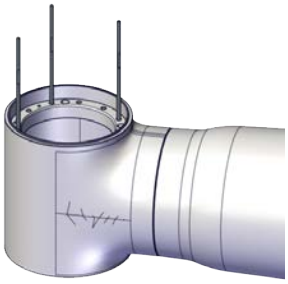
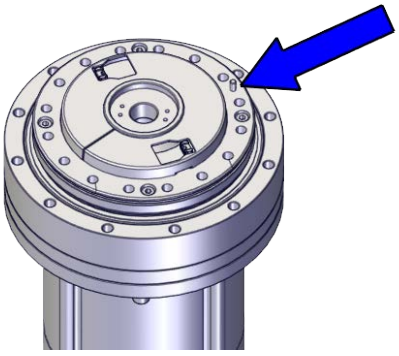
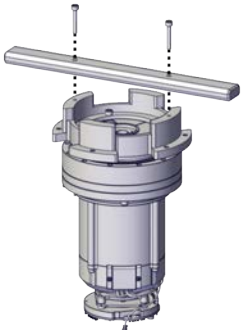
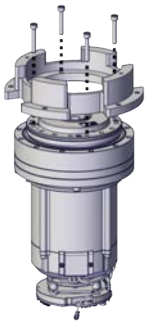
	Action	Note
6	**Valid for CRB 15000-10/1.52** Fit two guide pins on the swing flange for position guidance. Always use guide pins in pairs.	Guide pin, M5x75, 3HAC087786-002
7	**Valid for CRB 15000-10/1.52** Refit the swing transition to the swing flange, aligning the pin with the pin hole. Always check the serial number printed on the swing parts and use the parts in the same number for refitting.	 xx2300000820
8	**Valid for CRB 15000-10/1.52** Secure the swing transition with the attachment screws. **CAUTION** Do not use the pre-assembling screws of swing parts for securing.	Hex socket head cap screw: M5x25 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm  xx2300000817

Refitting the axis-2 joint unit (-10/1.52 and -12/1.27)

	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 53*.	
2	Check the o-rings. Replace if damaged.	O-ring: 3HAC061327-044  xx2300000823

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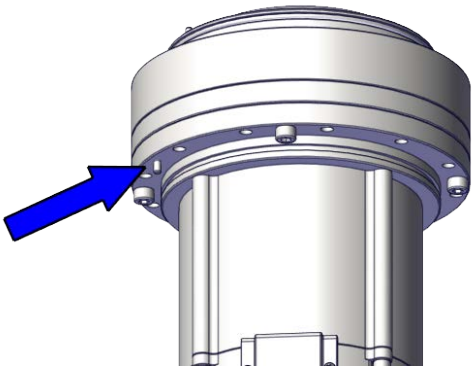
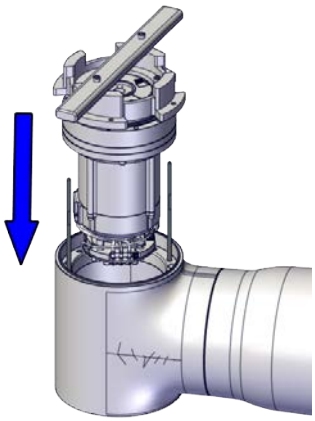
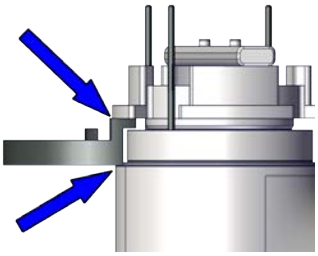
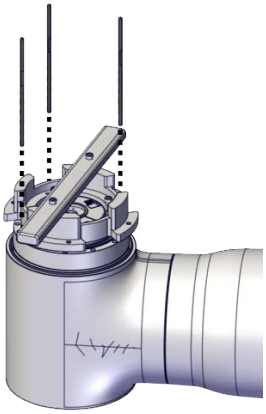
	Action	Note
3	Fit three guide pins to the swing.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins together.  xx2300000791
4	Fit the lifting aid to the joint unit, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  xx2300000777	Joint unit: 3HAC087472-001 Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000778  xx2300000776
5	Place the axis-1 cabling properly to avoid squeezing by the joint unit when putting the joint unit into 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.	

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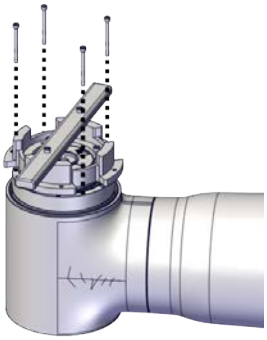
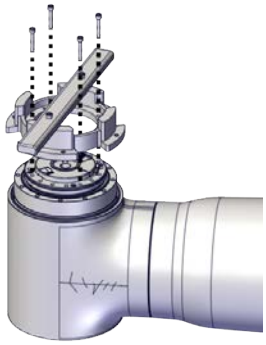
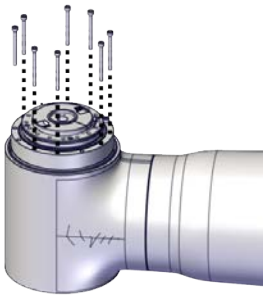
5.3.2 Replacing the axis-1 cabling

Continued

	Action	Note
6	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.  xx2300000780	 xx2300000792
7	Check the joint unit position by placing the higher boss of one semicircular block between the lifting aid and swing. The joint unit is properly placed when no gaps between the block and both lifting aid and swing.	 xx2300000794
8	Remove the guide pins.	 xx2300000795

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	Action	Note
9	Secure with four attachment screws and pre-tighten the screws crosswise.	 xx2300000796
10	Remove the lifting aid by removing the screws.	 xx2300000797
11	Secure the joint unit with the remaining attachment screws.	Hex socket head cap screw: 3HAB3409-20  xx2300000798
12	Torque tighten all screws crosswise.	M5x55 12.9 Lafre 2C2B/FC6.9, 12 pcs Tightening torque: 8.2 Nm.

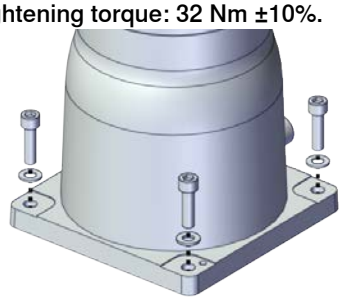
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5.3.2 Replacing the axis-1 cabling

Continued

Securing the base (-10/1.52 and -12/1.27)

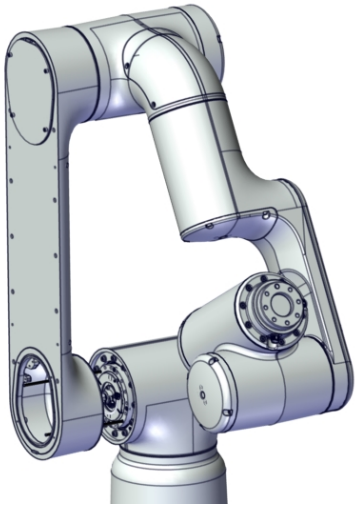
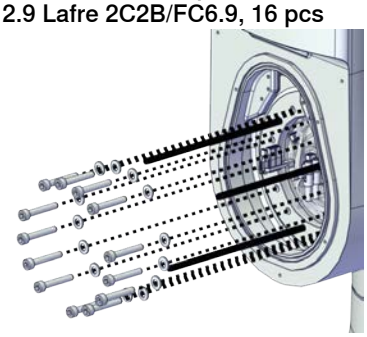
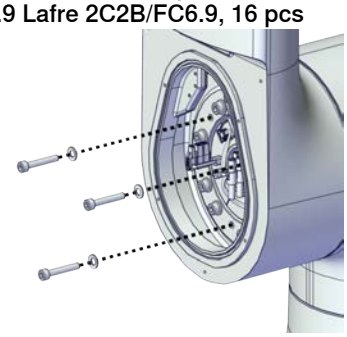
	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 32 Nm ±10%.  xx2300001060

Refitting the lower and upper arm assembled (-10/1.52 and -12/1.27)

	Action	Note
1	Fit three guide pins to the axis-2 joint unit.	Guide pin, M5x125: 3HAC087786-001  xx2300001021
2	**CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	

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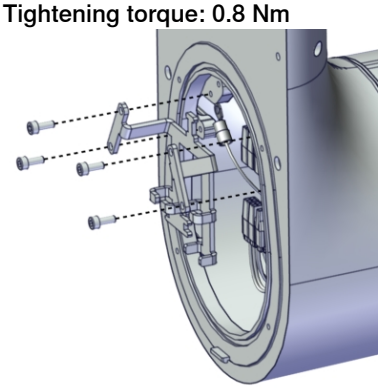
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	Action	Note
3	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000001941
4	Secure the lower arm to the swing with all screws and washers but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001022
5	Remove the guide pins and fasten the remaining two screws and washers. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001023
6	Torque tighten all screws crosswise.	Tightening torque: 8.2 Nm

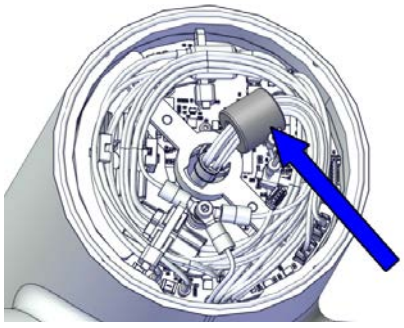
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5.3.2 Replacing the axis-1 cabling
Continued

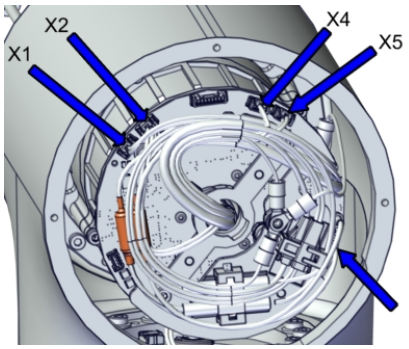
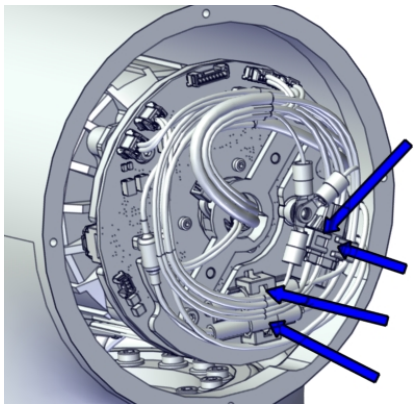
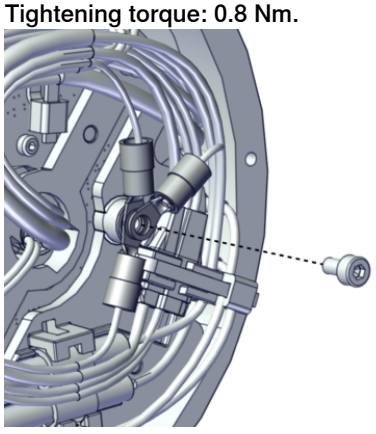
	Action	Note
7	Refit the cable bracket with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm  xx2000001939

Connecting the 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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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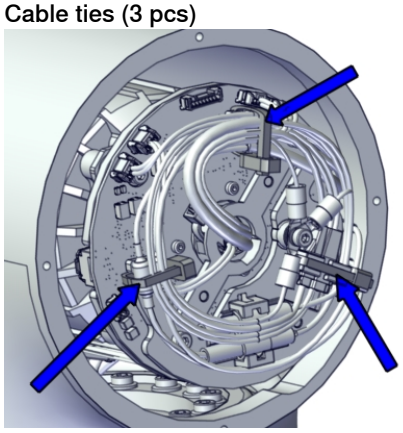
	Action	Note
4	Reconnect the connectors to the drive board. • D2.X1 to X1 • D2.DC+ to DC+ • D2.DC- to Ground • D2.X4 to X4 • D2.X2 to X2 • D2.X5 to X5	 xx2000002013
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944
6	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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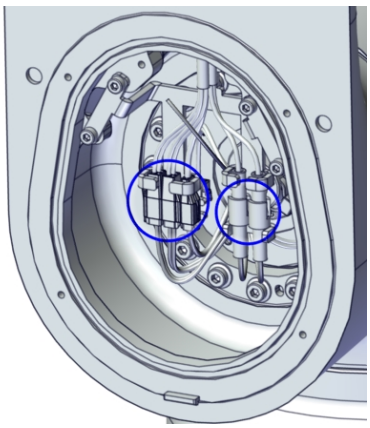
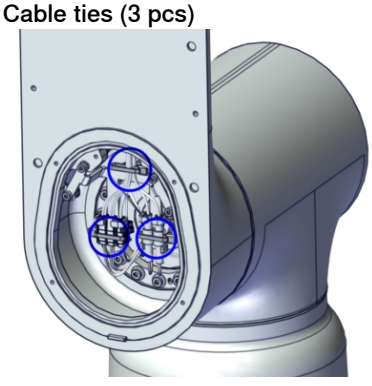
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5.3.2 Replacing the axis-1 cabling

Continued

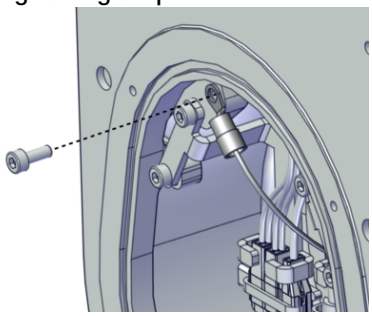
	Action	Note
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

Connecting the cabling between the lower arm and swing

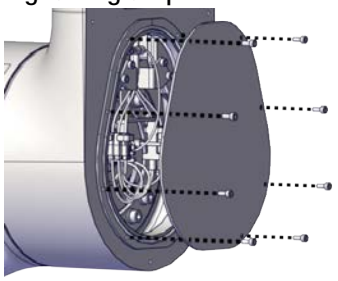
	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938
2	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937

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	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

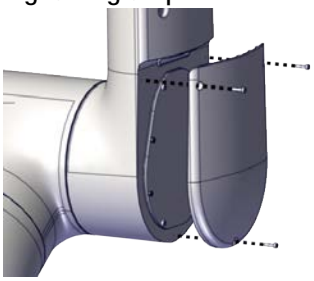
Refitting the lower arm covers (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-075 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.  xx2300000813

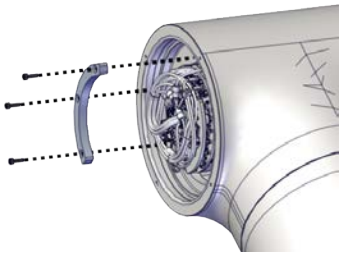
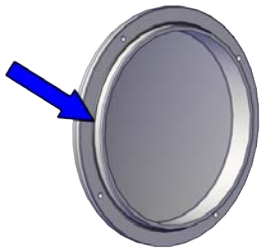
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5.3.2 Replacing the axis-1 cabling
Continued

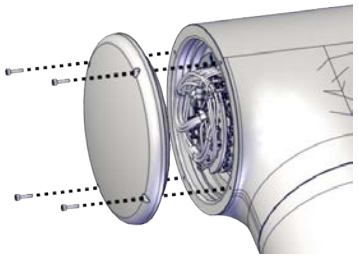
	Action	Note
3	Refit the lower cover of lower arm with three screws.	Lower arm cover, lower: Lower arm, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Tightening torque: 1.4 Nm.  xx2300000812

Refitting the swing cover and insert(-10/1.52 and -12/1.27)

	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000815
2	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-074 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2300000816

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	Action	Note
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000814

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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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*.

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Spare part	Article number	Note
Cable harness, joint 2	3HAC073205-001	Used for CRB 15000-5/0.95. Also order new Cable tie: 3HAC075545-001.
Cable harness, joint 2	3HAC080960-001	Used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Also order new Cable tie: 3HAC075545-001.
Cable tie	3HAC075545-001	For securing joint unit cable.
Ferrite core	3HAC092224-001	

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95. Attachment screws M4x35 (4 pcs) are enclosed.
Lifting aid	3HAC087787-001	For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27. A plate, a beam, a pair of semicircular blocks and attachment screws M5x30 (2 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M5x125	3HAC087786-001	Always use guide pins in pairs. For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint units of CRB 15000-5/0.95.
Protection plate	3HAC087789-001	For protection of drive board during cabling installation on joint units of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cable ties	-	

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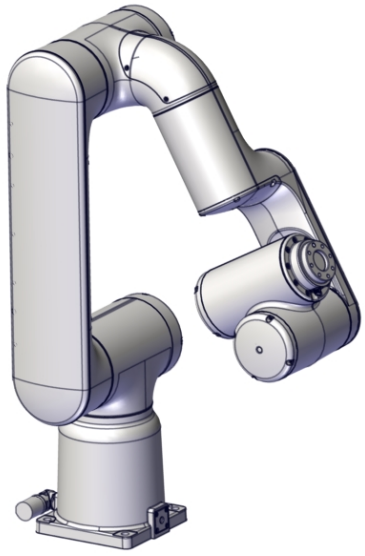
5.3.3 Replacing the axis-2 cabling
Continued

Consumable	Article number	Note
O-ring	3HAC061327-044	Lower arm, inner cover of CRB 15000-5/0.95. 1 pcs / cover. Replace if damaged.
O-ring	3HAC061327-075	Lower arm, lower inner cover of CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-074	Swing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAB3772-64	Base cover, used for CRB 15000-5/0.95.
O-ring	3HAC061327-072	Base cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27.
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Grease	3HAC042536-001	Shell Gadus S2

Removing the joint cabling (-5/0.95)

Use these procedures to remove the joint-2 cabling.

Preparations before removing the cabling

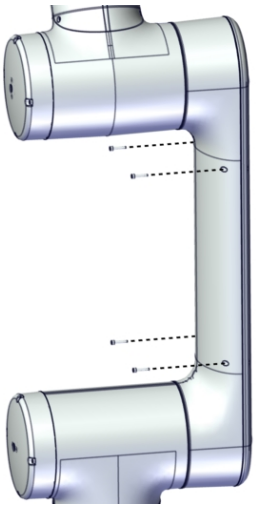
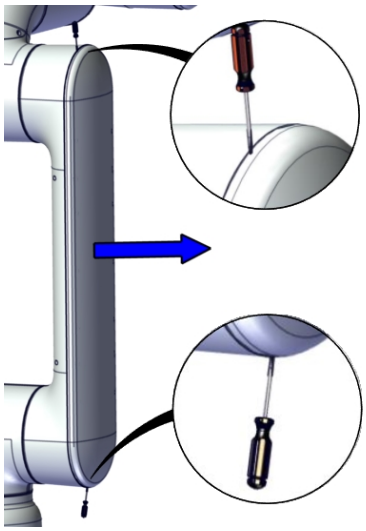
	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 0° (home position) • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. **CAUTION** Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.	 xx2100000044

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	Action	Note
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

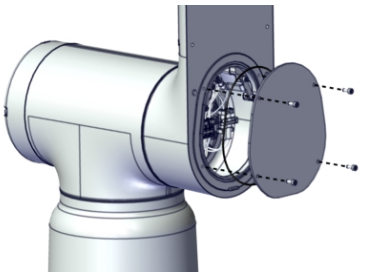
Removing the lower arm covers (-5/0.95)

	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

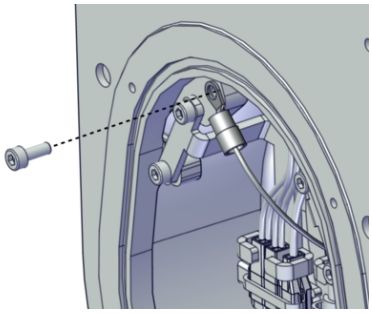
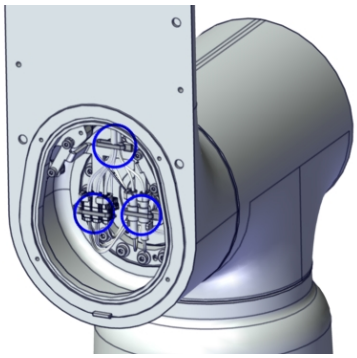
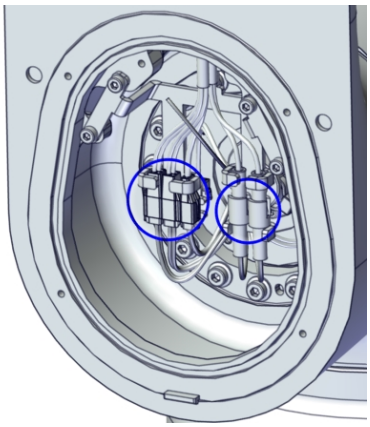
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5.3.3 Replacing the axis-2 cabling
Continued

	Action	Note
4	Remove the inner cover by removing the four screws.	 xx2000001930

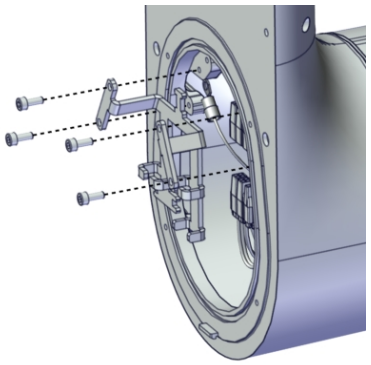
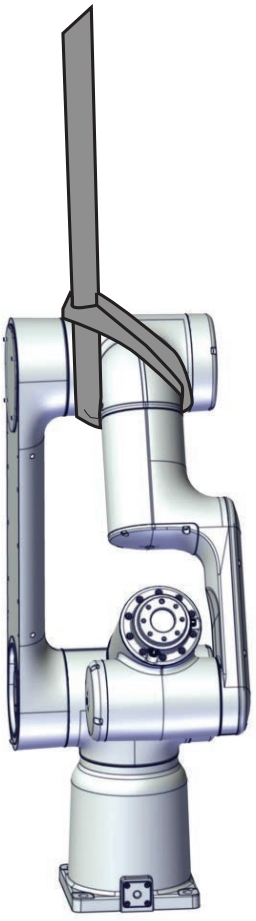
Disconnecting the cabling between the lower arm and the swing

	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

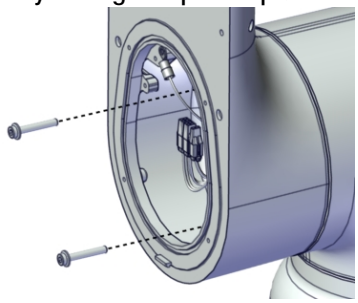
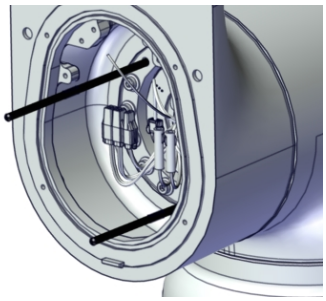
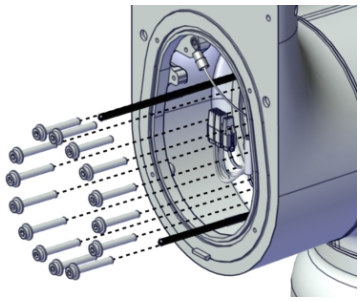
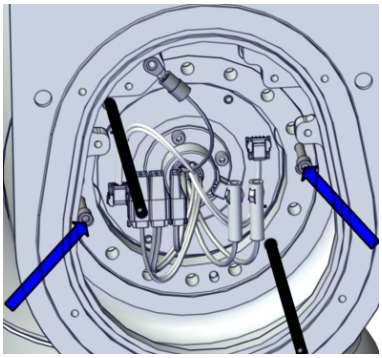
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939
2	Secure the weight of the upper and lower arm. **CAUTION** The weight of the complete upper and lower arm together is 18 kg	Suggestion with lifting sling and an overhead crane. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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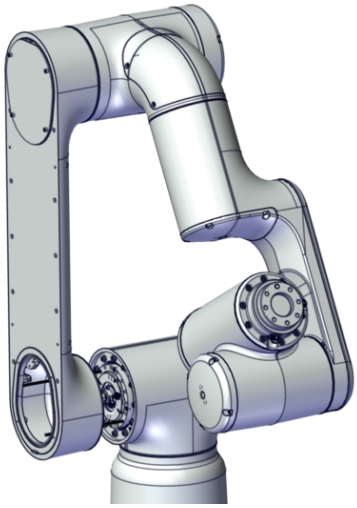
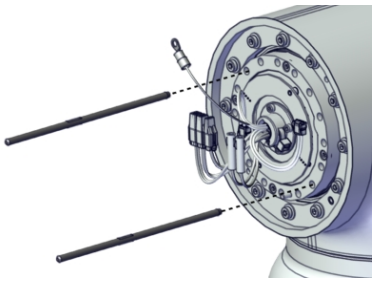
5.3.3 Replacing the axis-2 cabling

Continued

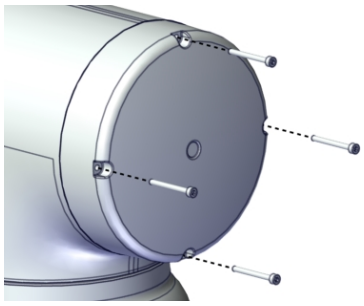
	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

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

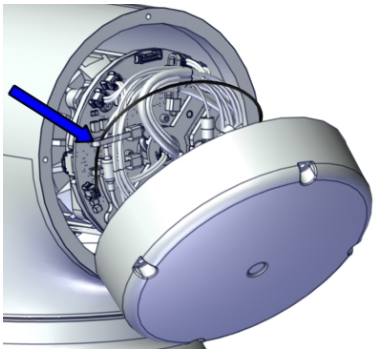
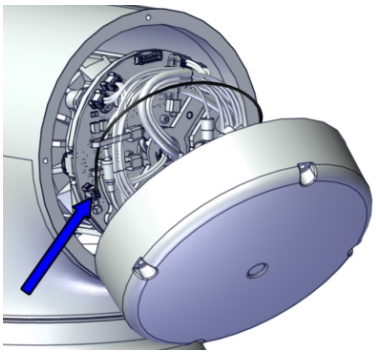
Removing the swing cover (-5/0.95)

	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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5.3.3 Replacing the axis-2 cabling
Continued

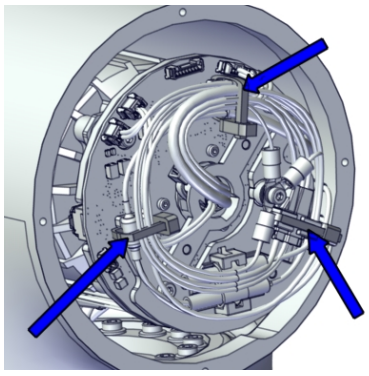
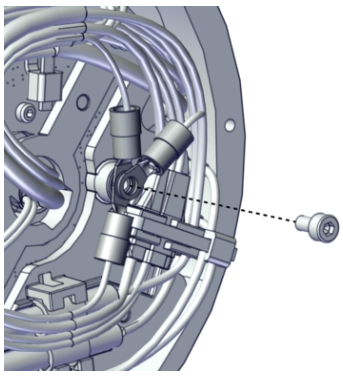
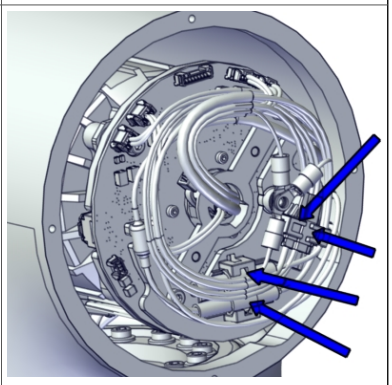
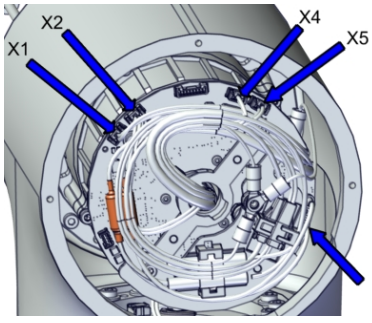
	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000001931
5	**For robots with RobotWare earlier than 7.10** 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 53*.	

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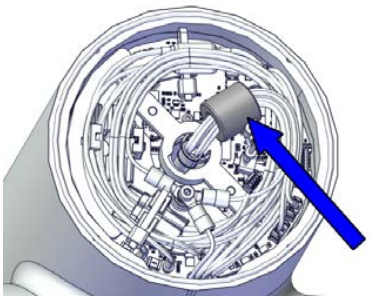
	Action	Note
2	Cut the cable ties.	 xx2000001946
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: • J2.DC+ • J2.DC- • J2.CS • J2.CP	 xx2000001944
5	Disconnect the connectors from the drive board. • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002013

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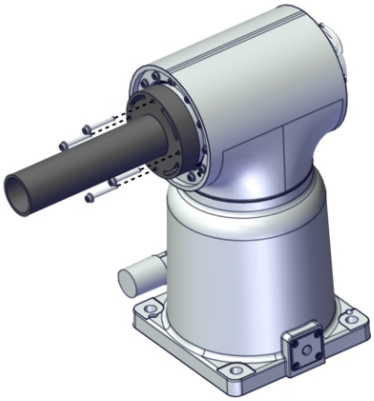
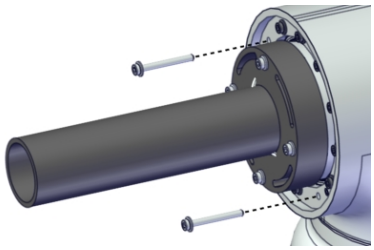
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5.3.3 Replacing the axis-2 cabling

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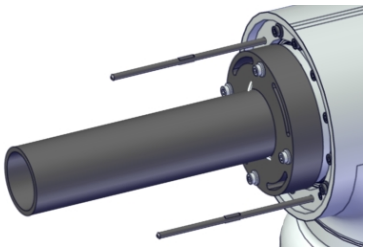
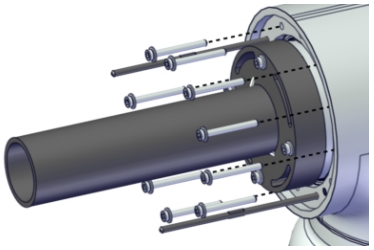
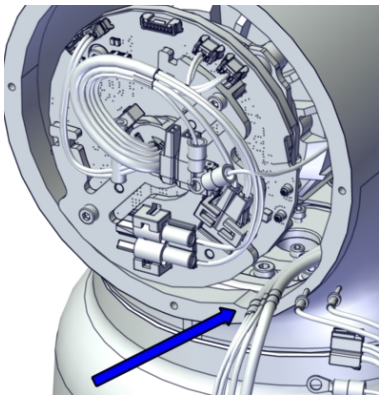
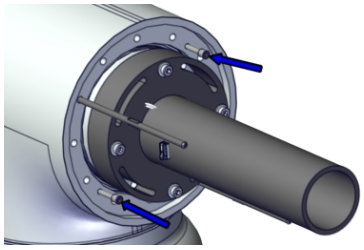
	Action	Note
6	Remove the ferrite core by pulling the cables D2.X4 and D2.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-2 joint unit (-5/0.95)

	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)  xx2000001956
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000295

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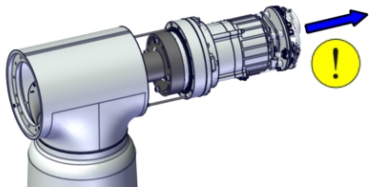
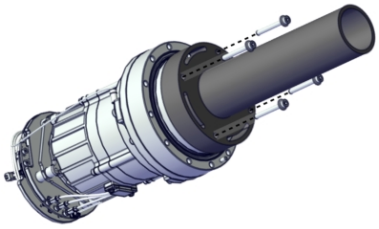
	Action	Note
3	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002433
4	Remove the remaining attachment screws. Use two screws 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.	 xx2000001943
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

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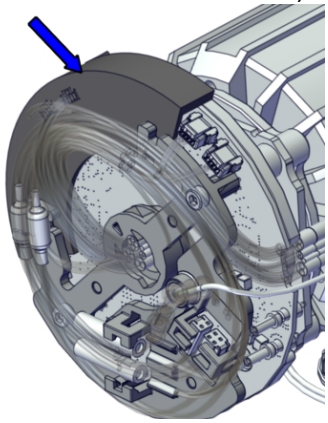
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5.3.3 Replacing the axis-2 cabling

Continued

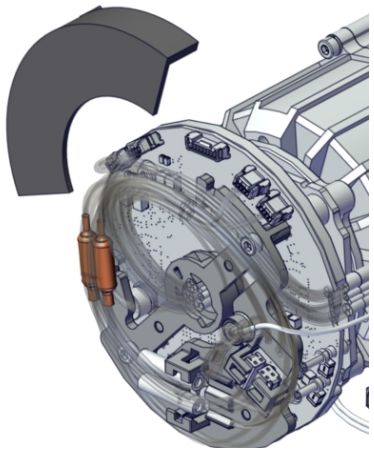
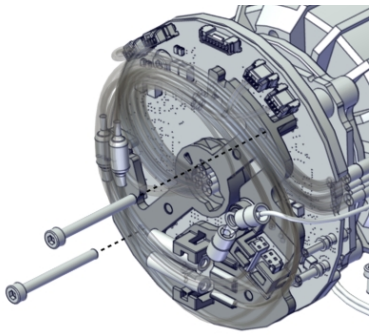
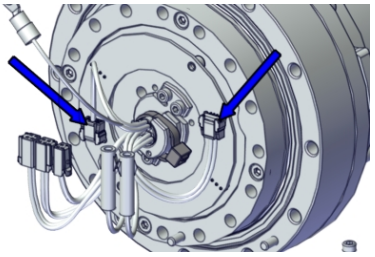
	Action	Note
7	Remove the joint unit from the swing. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000001958
8	Remove the lifting aid and guide pins.	 xx2000001957

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 53*.	
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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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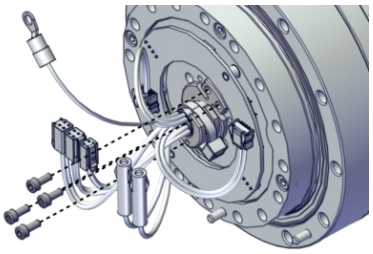
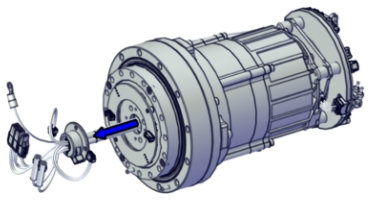
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	Action	Note
3	Cut the cable tie at the drive board.	 xx2000002058
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. • TQ.A • TQ.B	 xx2000002053

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5.3.3 Replacing the axis-2 cabling
Continued

	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

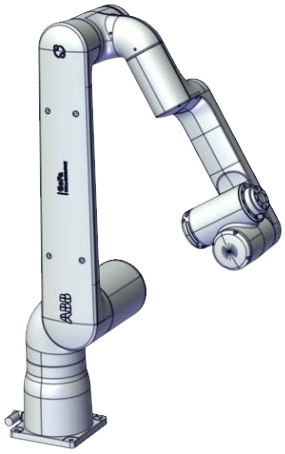
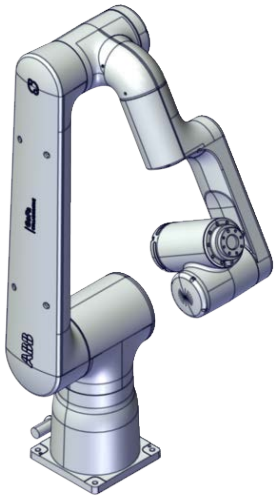
Removing the joint cabling (-10/1.52 and -12/1.27)

Use these procedures to remove the joint-2 cabling.

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Preparations before removing the cabling

	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 0° (home position) • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. **CAUTION** 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.	**Valid for CRB 15000-10/1.52**  xx2300001062 **Valid for CRB 15000-12/1.27**  xx2300001063
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

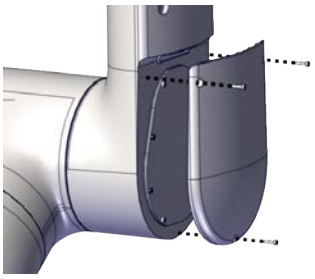
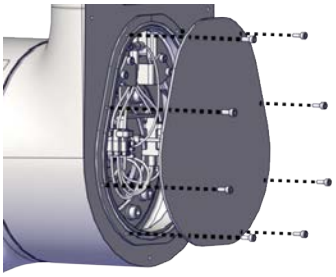
Removing the lower arm covers (-10/1.52 and -12/1.27)

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

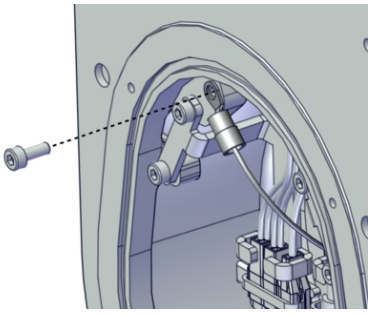
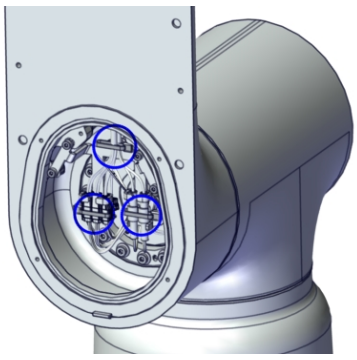
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5.3.3 Replacing the axis-2 cabling
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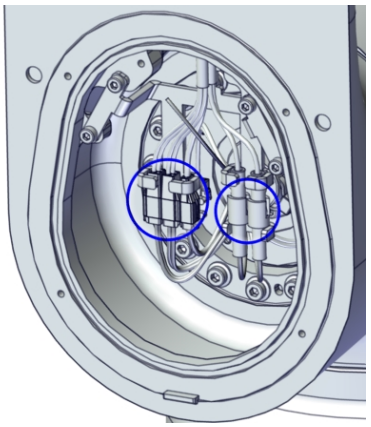
	Action	Note
2	Remove the lower cover of lower arm by removing the screws.	 xx2300000812
3	Remove the lower inner cover by removing the screws.	 xx2300000813

Disconnecting the cabling between the lower arm and the swing

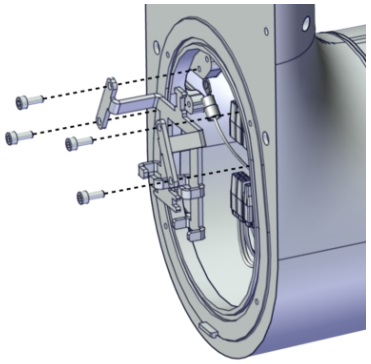
	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936
2	Cut the cable ties.	 xx2000001937

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	Action	Note
3	Snap loose and disconnect all connectors.	 xx2000001938

Removing the lower and upper arm assembled

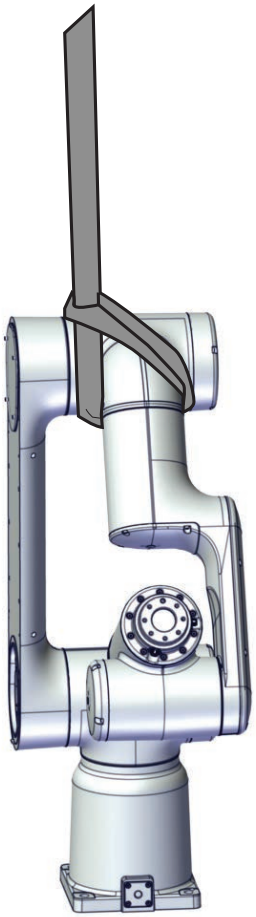
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939

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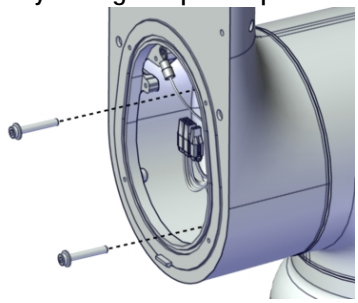
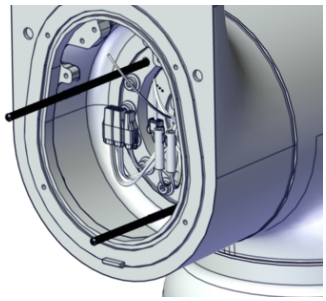
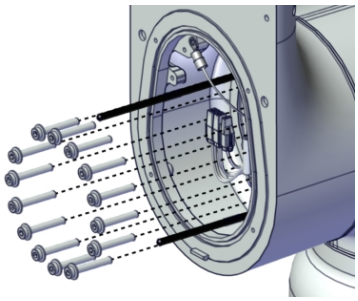
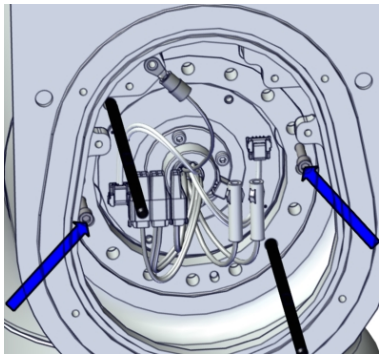
5.3.3 Replacing the axis-2 cabling

Continued

	Action	Note
2	Secure the weight of the upper and lower arm. **CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	Suggestion with lifting sling and an overhead crane. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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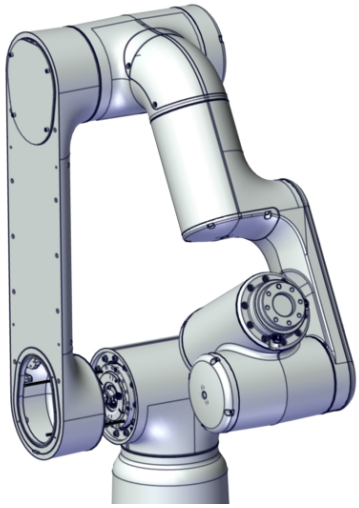
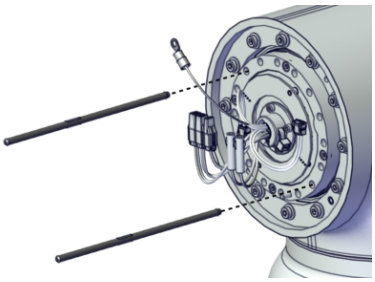
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	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

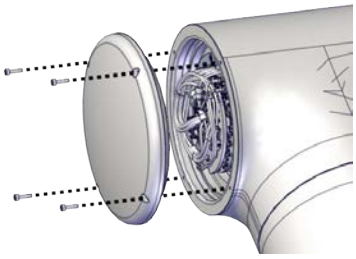
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5.3.3 Replacing the axis-2 cabling
Continued

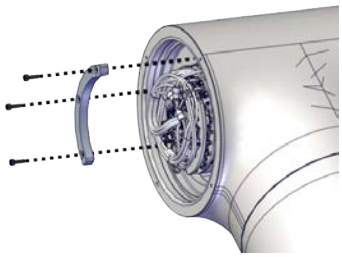
	Action	Note
6	Remove the complete arm system from the swing.	 xx2000001941
7	Remove the guide pins.	 xx2000002432

Removing the swing cover and insert (-10/1.52 and -12/1.27)

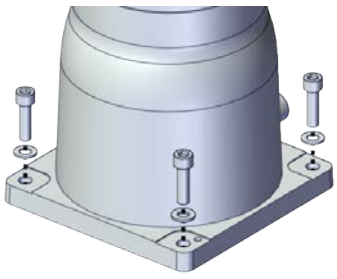
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000814

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	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	Remove the insert.	 xx2300000815

Removing the base from foundation (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** The weight of the complete swing and base together is up to 25 kg	
2	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
3	Loosen the robot base from the foundation by removing the foundation attachment screws.	 xx2300001060

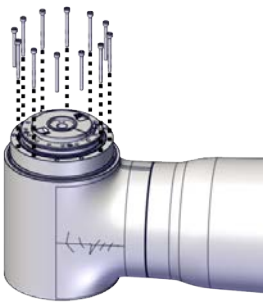
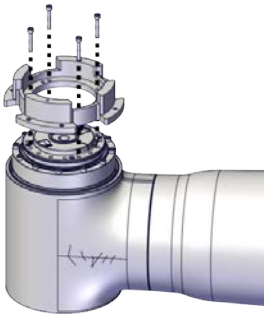
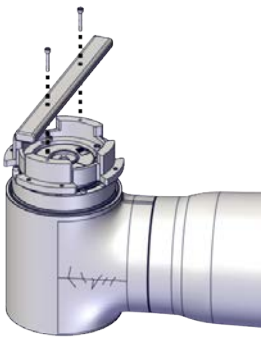
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5.3.3 Replacing the axis-2 cabling
Continued

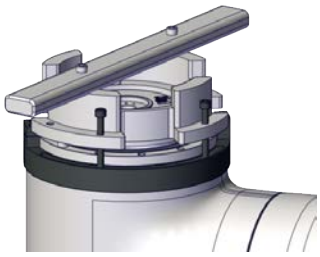
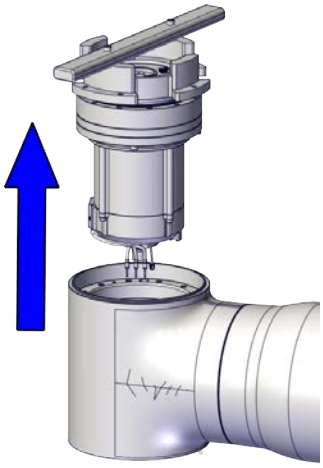
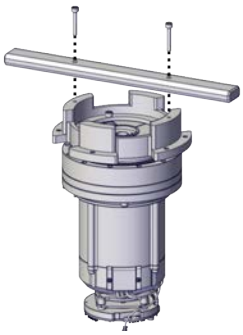
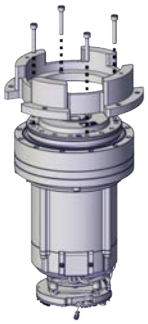
	Action	Note
4	Lay the robot down with the torque sensor side upwards on a working bench. Do not damage the base socket. Caution with the cabling. **CAUTION** The cabling is sensitive to mechanical damage. Handle it with care to avoid damage to the cabling or the connector, avoid any kind of tilt or skew.	

Removing the axis-2 joint unit

	Action	Note
1	Removing the attachment screws.	 xx2300000786
2	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: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000787  xx2300000788

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	Action	Note
3	Place the two semicircular blocks surrounding the joint unit, and use two fully threaded attachment screws as removal tools to press the joint unit out of position.	 xx2300000789
4	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.	 xx2300000790
5	Remove the lifting aid.	 xx2300000778  xx2300000776

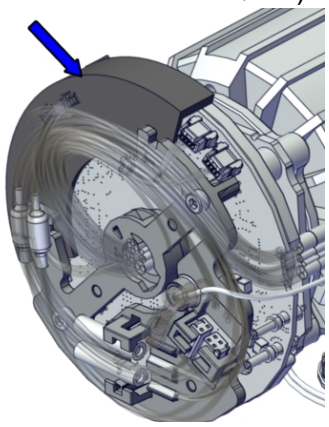
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5.3.3 Replacing the axis-2 cabling

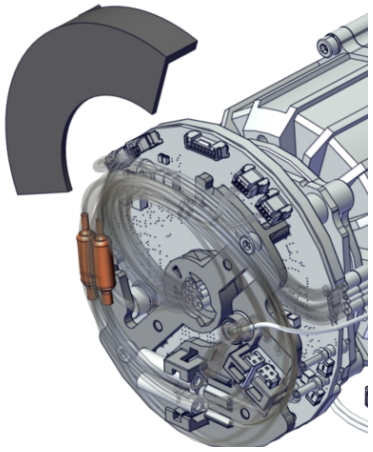
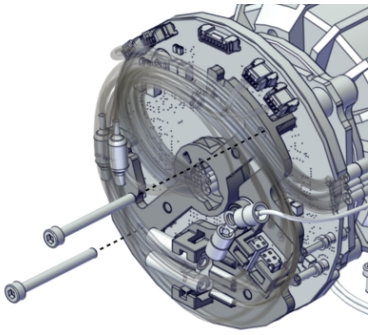
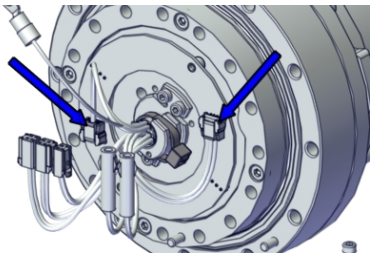
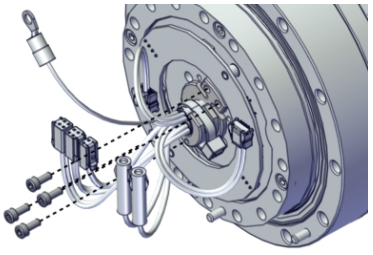
Continued

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 53*.	
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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
3	Cut the cable tie at the drive board.	 xx2000002058

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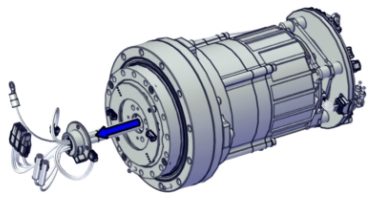
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	Action	Note
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. • TQ.A • TQ.B	 xx2000002053
7	Remove the cable plate by removing the attachment screws.	 xx2000002049

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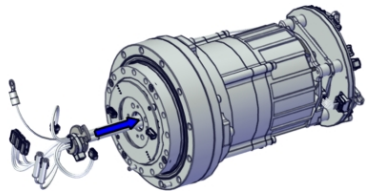
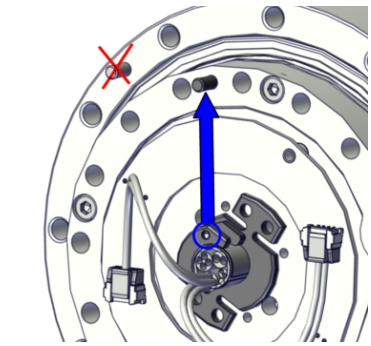
5.3.3 Replacing the axis-2 cabling
Continued

	Action	Note
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 (-5/0.95)

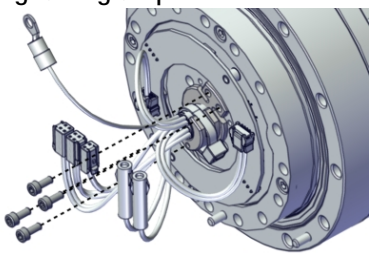
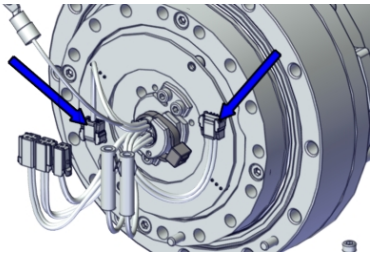
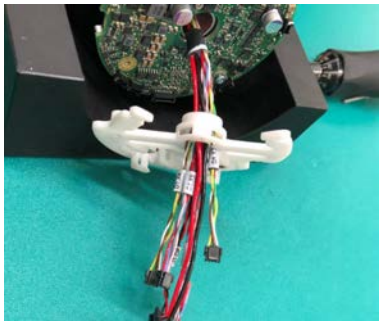
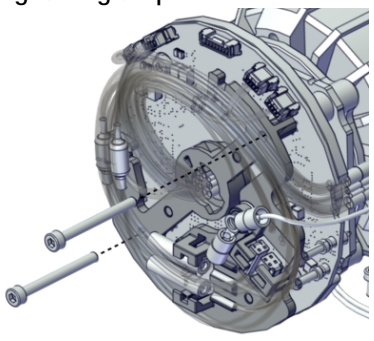
Use these procedures to refit the joint-2 cabling.

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 53*.	
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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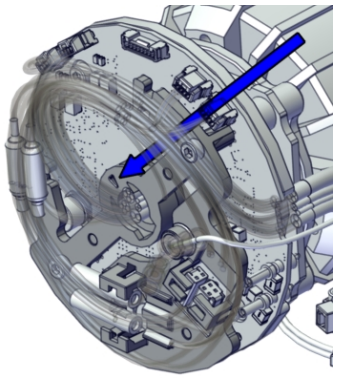
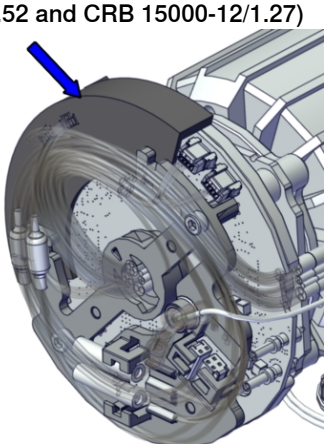
	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000002049
5	Connect the two connectors to the torque sensor board. • TQ.A to CH1/A • TQ.B to CH2/B	 xx2000002053
6	Insert 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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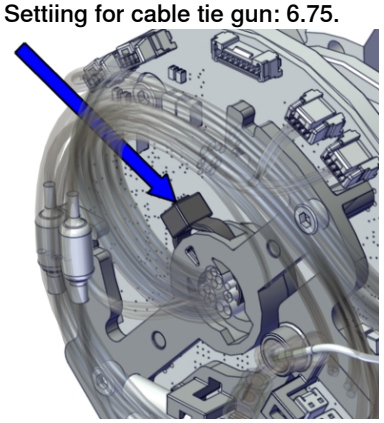
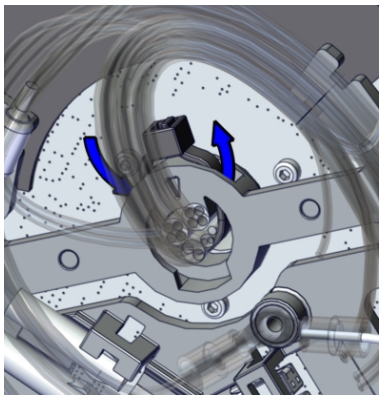
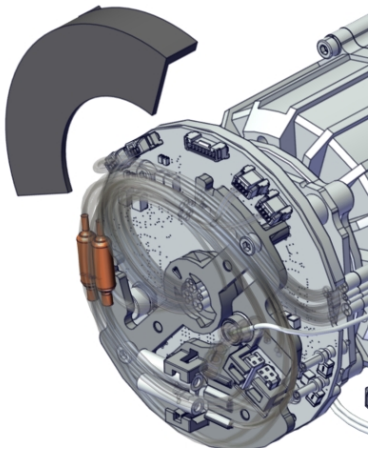
5.3.3 Replacing the axis-2 cabling

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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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	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 EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059
10	Remove the protection plate.	 xx2100000301

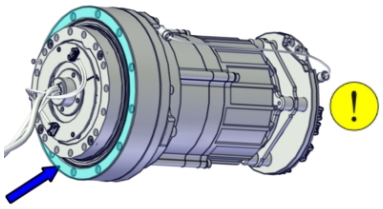
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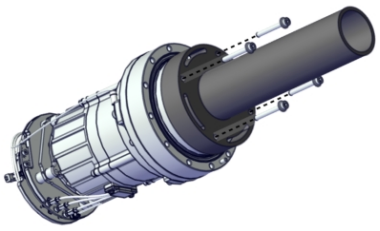
5.3.3 Replacing the axis-2 cabling

Continued

Preparations before fitting the joint unit (-5/0.95)

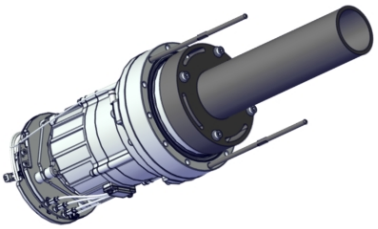
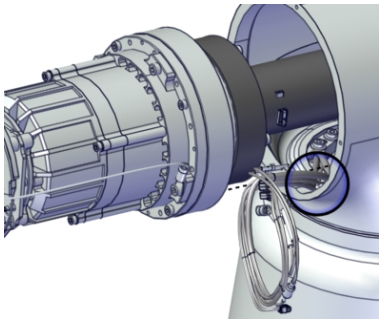
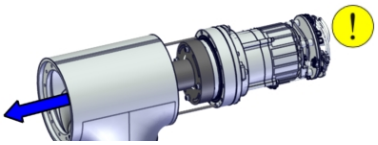
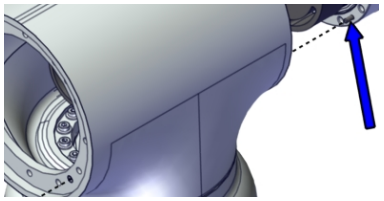
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  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 53*.	

Refitting the axis-2 joint unit (-5/0.95)

	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 53*.	
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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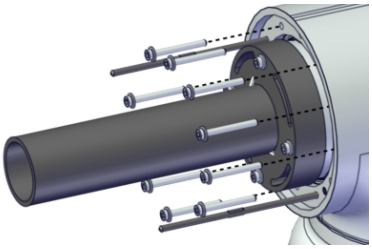
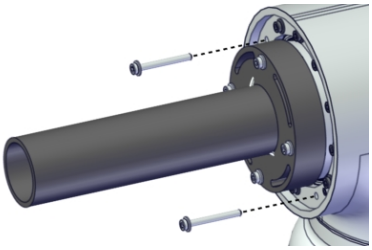
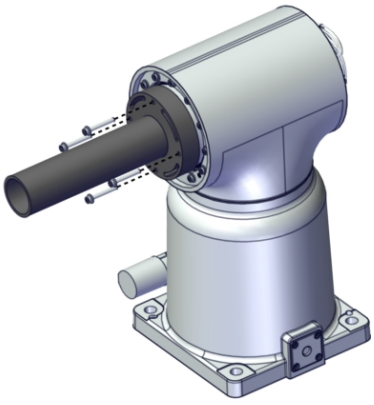
	Action	Note
3	Fit two guide pins to the joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002438
4	Place the axis-1 cabling at the notch in the swing. **CAUTION** 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
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

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5.3.3 Replacing the axis-2 cabling

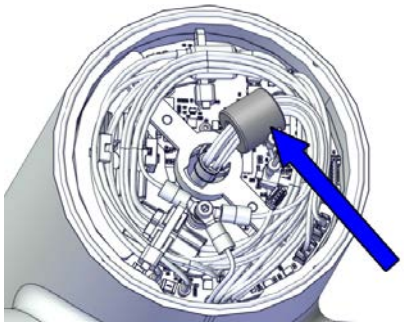
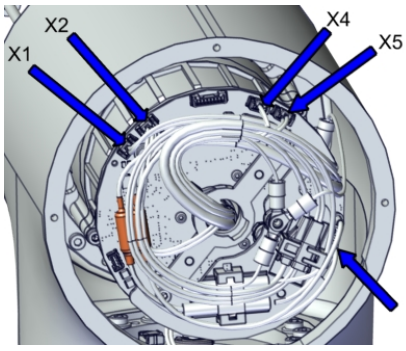
Continued

	Action	Note
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 Used for joint unit of CRB 15000-5/0.95. 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.
10	Remove the lifting aid by removing the screws.	 xx2000001956
11	Clean pushed-out flange sealant, if any.	

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Connecting the axis-2 joint unit cabling

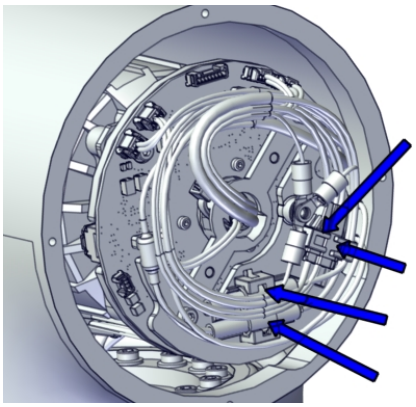
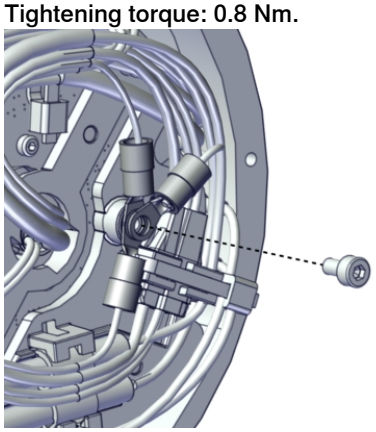
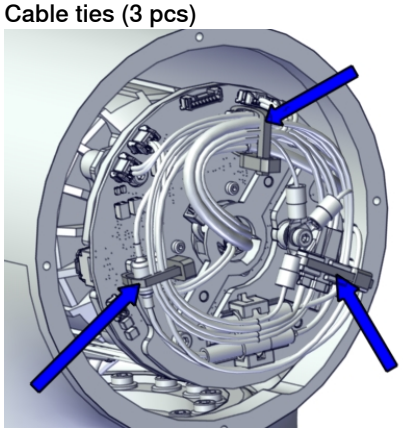
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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

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5.3.3 Replacing the axis-2 cabling

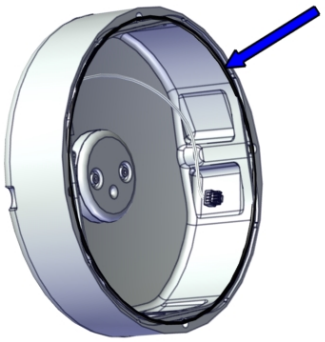
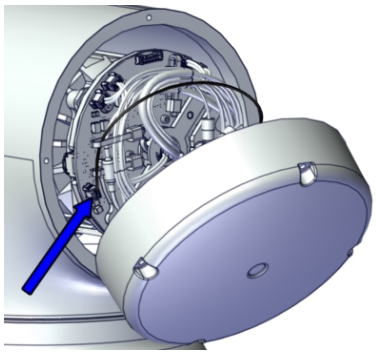
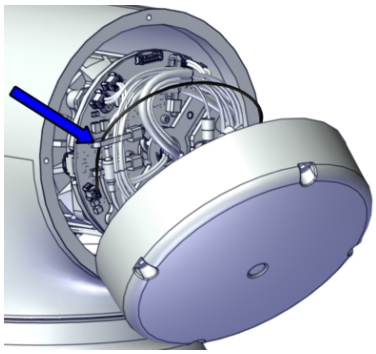
Continued

	Action	Note
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944
6	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
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

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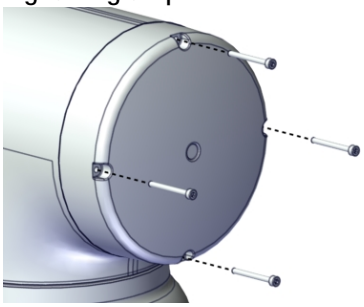
Refitting the swing cover(-5/0.95)

	Action	Note
1	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-047 (for CRB 15000-5/0.95)  xx2000001962
2	**For robots with RobotWare earlier than 7.10** 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	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000001931

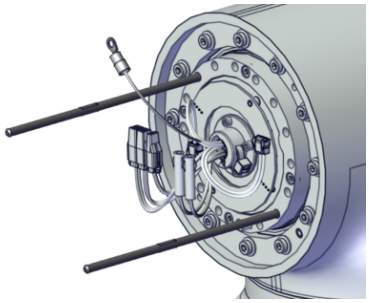
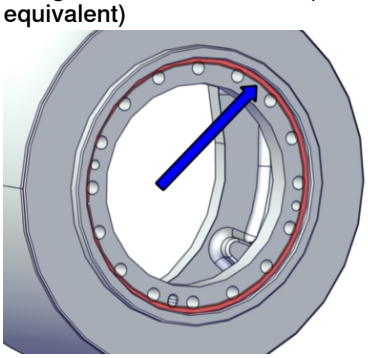
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5.3.3 Replacing the axis-2 cabling
Continued

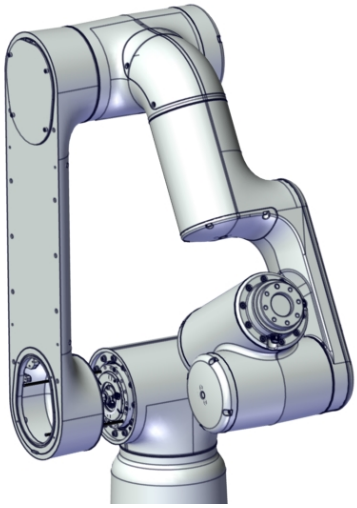
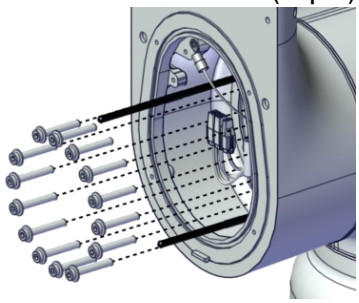
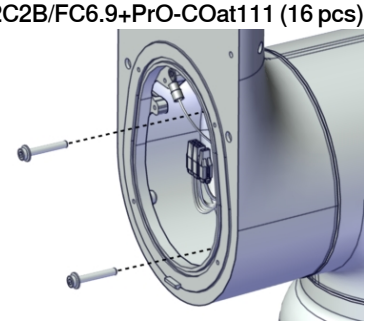
	Action	Note
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000001935

Refitting the lower and upper arm assembled (-5/0.95)

	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001  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 (or equivalent)  xx2000001963
3	**CAUTION** The weight of the complete upper and lower arm together is 18 kg	

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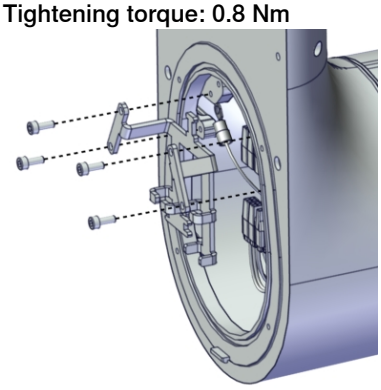
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	Action	Note
4	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	 xx2000001941
5	Secure the lower arm to the swing with all attachment screws but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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

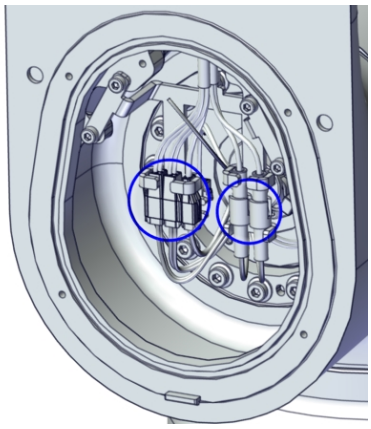
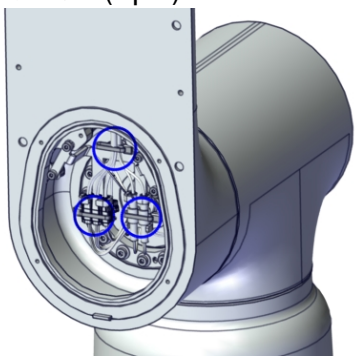
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5.3.3 Replacing the axis-2 cabling
Continued

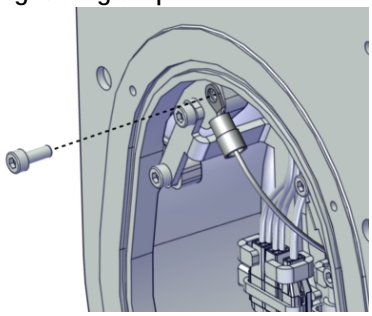
	Action	Note
8	Refit the cable bracket with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm  xx2000001939

Connecting the cabling between the lower arm and swing

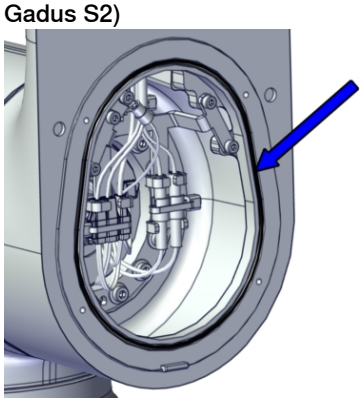
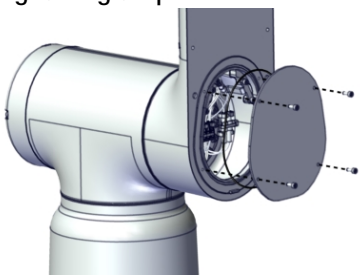
	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938
2	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937

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	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

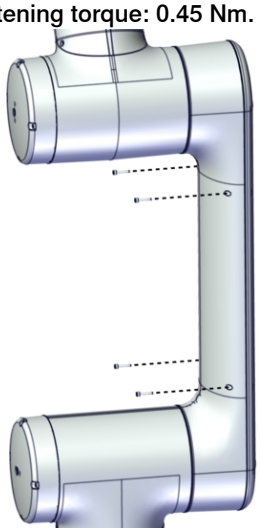
Refitting the lower arm covers (-5/0.95)

	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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5.3.3 Replacing the axis-2 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.  xx2000001929
4	Secure the cover with four screws.	

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.

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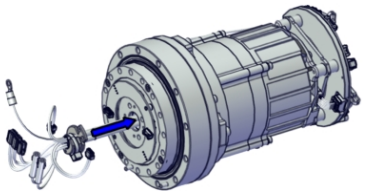
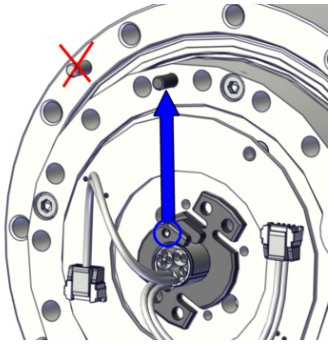
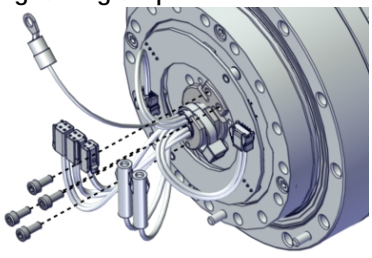
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	Action	Note
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

Refitting the joint cabling (-10/1.52 and -12/1.27)

Use these procedures to refit the joint-2 cabling.

Refitting the joint cable

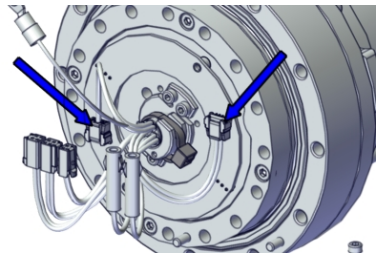
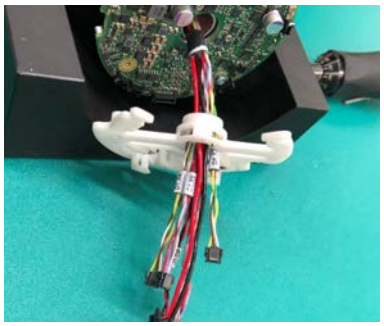
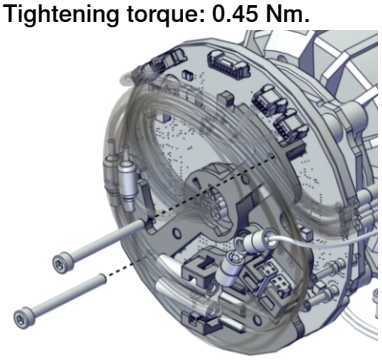
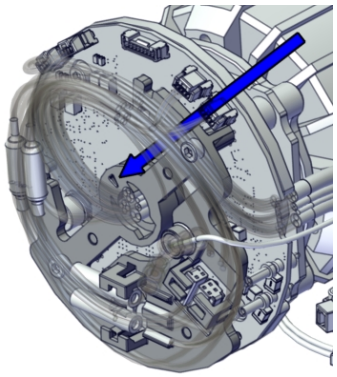
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Place the joint cable through the hollow shaft from the torque sensor side. **CAUTION** The connectors and the joint 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
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

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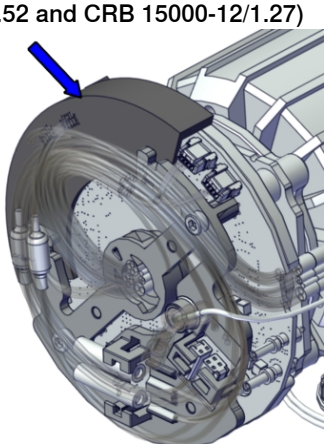
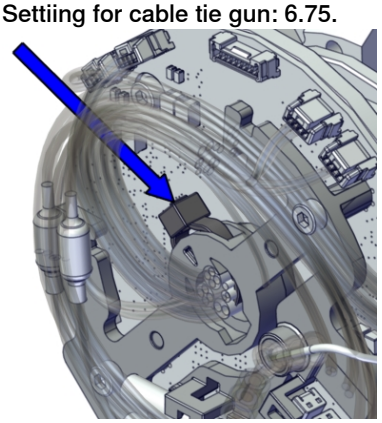
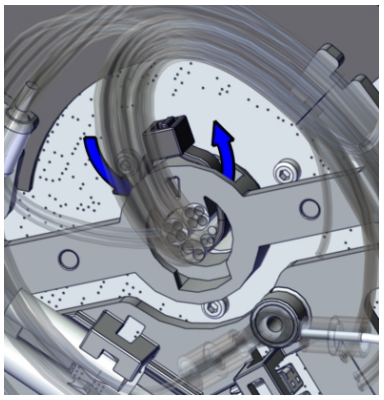
5.3.3 Replacing the axis-2 cabling

Continued

	Action	Note
5	Connect the two connectors to the torque sensor board. • 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
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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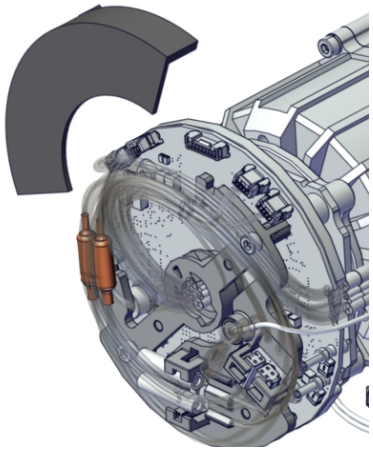
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	Action	Note
8	Fit the protection plate to the drive board unit.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
9	Secure the cables to the cable support with a cable 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 EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059

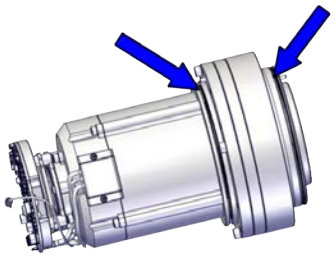
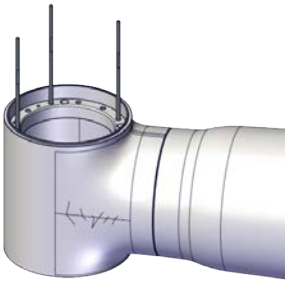
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5.3.3 Replacing the axis-2 cabling
Continued

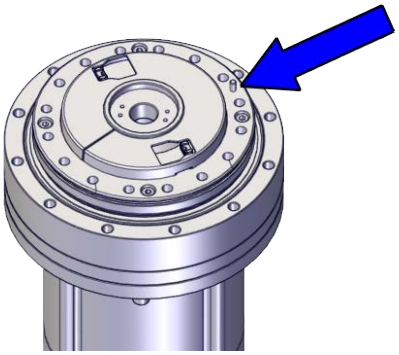
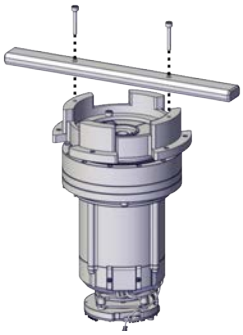
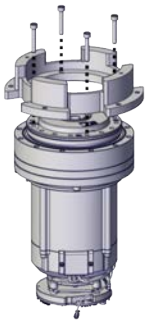
	Action	Note
10	Remove the protection plate.	 xx2100000301

Refitting the axis-2 joint unit (-10/1.52 and -12/1.27)

	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 53*.	
2	Check the o-rings. Replace if damaged.	O-ring: 3HAC061327-044  xx2300000823
3	Fit three guide pins to the swing.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins together.  xx2300000791

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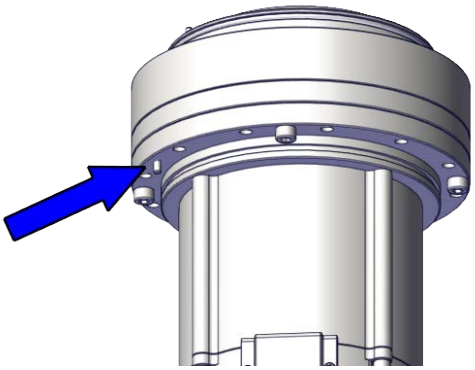
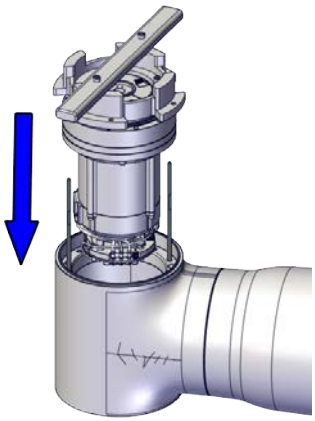
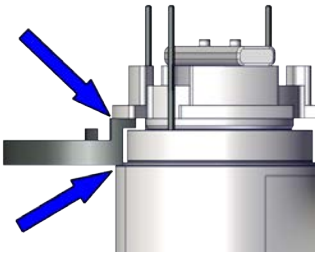
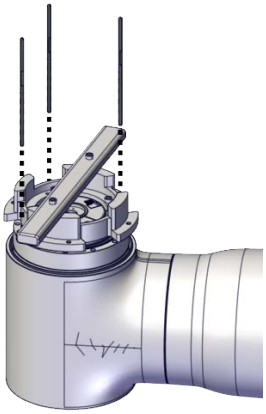
	Action	Note
4	Fit the lifting aid to the joint unit, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  xx2300000777	Joint unit: 3HAC087472-001 Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000778  xx2300000776
5	Place the axis-1 cabling properly to avoid squeezing by the joint unit when putting the joint unit into 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.	

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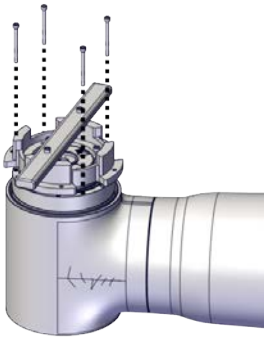
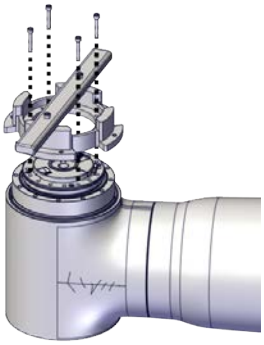
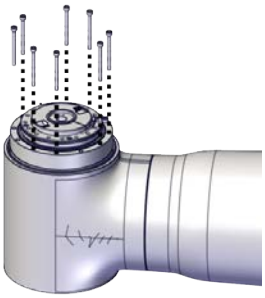
5.3.3 Replacing the axis-2 cabling

Continued

	Action	Note
6	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.  xx2300000780	 xx2300000792
7	Check the joint unit position by placing the higher boss of one semicircular block between the lifting aid and swing. The joint unit is properly placed when no gaps between the block and both lifting aid and swing.	 xx2300000794
8	Remove the guide pins.	 xx2300000795

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	Action	Note
9	Secure with four attachment screws and pre-tighten the screws crosswise.	 xx2300000796
10	Remove the lifting aid by removing the screws.	 xx2300000797
11	Secure the joint unit with the remaining attachment screws.	Hex socket head cap screw: 3HAB3409-20  xx2300000798
12	Torque tighten all screws crosswise.	M5x55 12.9 Lafre 2C2B/FC6.9, 12 pcs Tightening torque: 8.2 Nm.

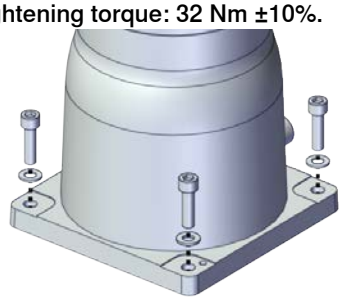
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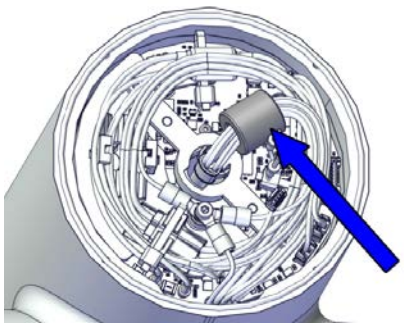
5.3.3 Replacing the axis-2 cabling

Continued

Securing the base (-10/1.52 and -12/1.27)

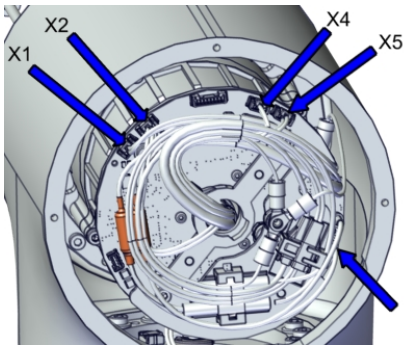
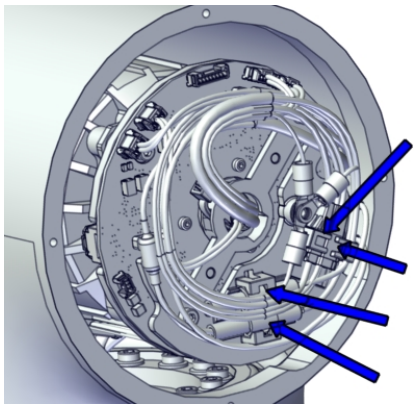
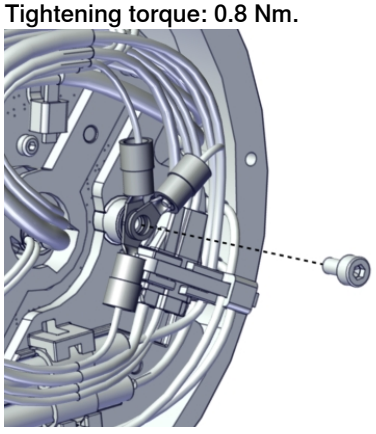
	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 32 Nm ±10%.  xx2300001060

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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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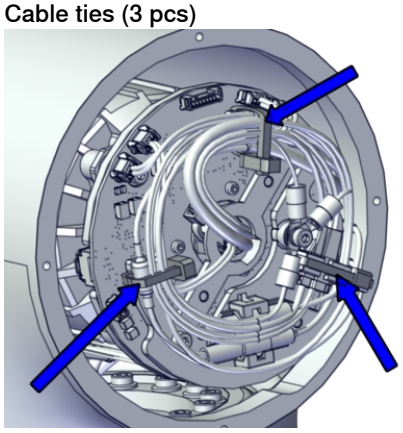
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	Action	Note
4	Reconnect the connectors to the drive board. • D2.X1 to X1 • D2.DC+ to DC+ • D2.DC- to Ground • D2.X4 to X4 • D2.X2 to X2 • D2.X5 to X5	 xx2000002013
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944
6	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

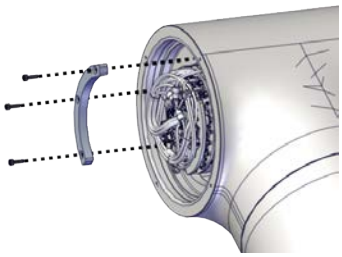
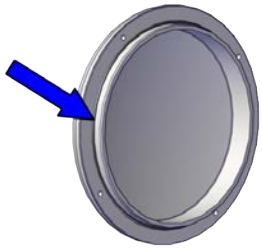
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5.3.3 Replacing the axis-2 cabling
Continued

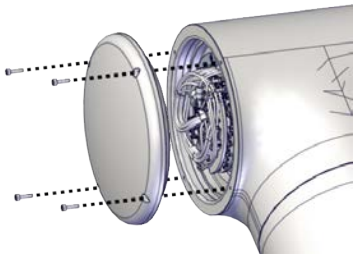
	Action	Note
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

Refitting the swing cover and insert(-10/1.52 and -12/1.27)

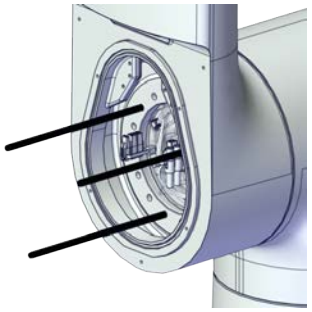
	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000815
2	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-074 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2300000816

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	Action	Note
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000814

Refitting the lower and upper arm assembled (-10/1.52 and -12/1.27)

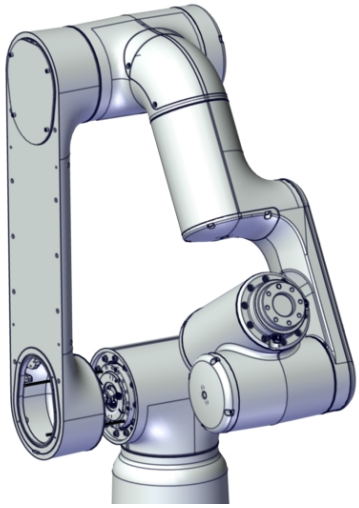
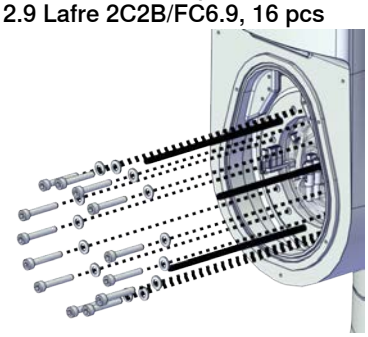
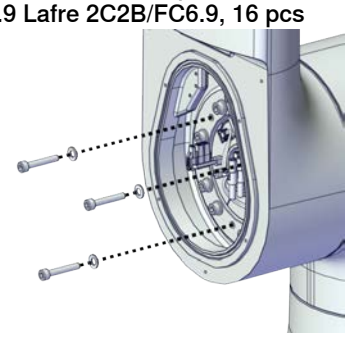
	Action	Note
1	Fit three guide pins to the axis-2 joint unit.	Guide pin, M5x125: 3HAC087786-001  xx2300001021
2	**CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	

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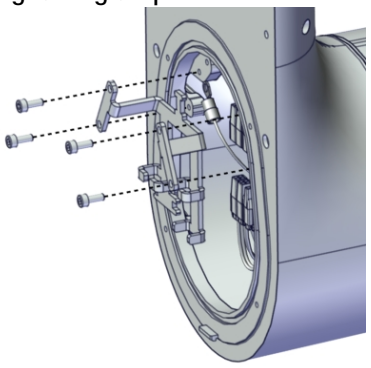
5.3.3 Replacing the axis-2 cabling

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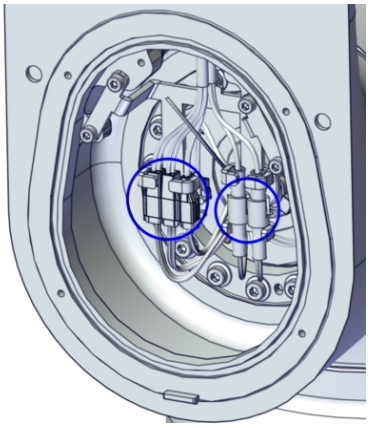
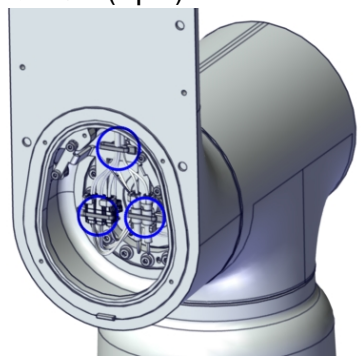
	Action	Note
3	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000001941
4	Secure the lower arm to the swing with all screws and washers but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001022
5	Remove the guide pins and fasten the remaining two screws and washers. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001023
6	Torque tighten all screws crosswise.	Tightening torque: 8.2 Nm

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	Action	Note
7	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

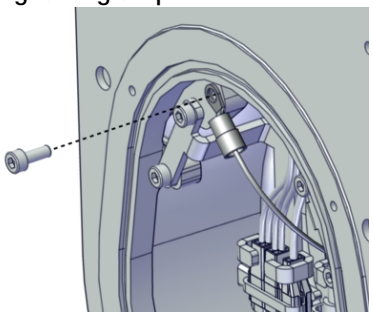
Connecting the cabling between the lower arm and swing

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

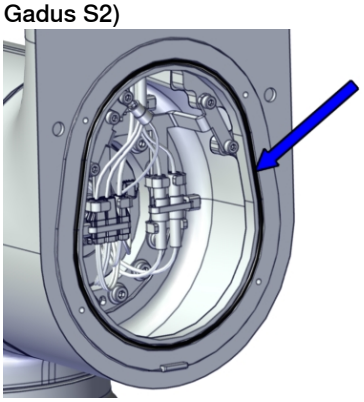
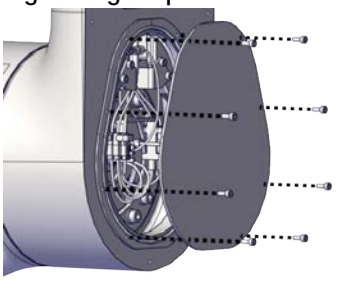
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5.3.3 Replacing the axis-2 cabling
Continued

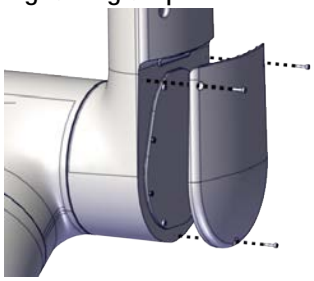
	Action	Note
3	Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

Refitting the lower arm covers (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-075 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.  xx2300000813

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	Action	Note
3	Refit the lower cover of lower arm with three screws.	Lower arm cover, lower: Lower arm, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Tightening torque: 1.4 Nm.  xx2300000812

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

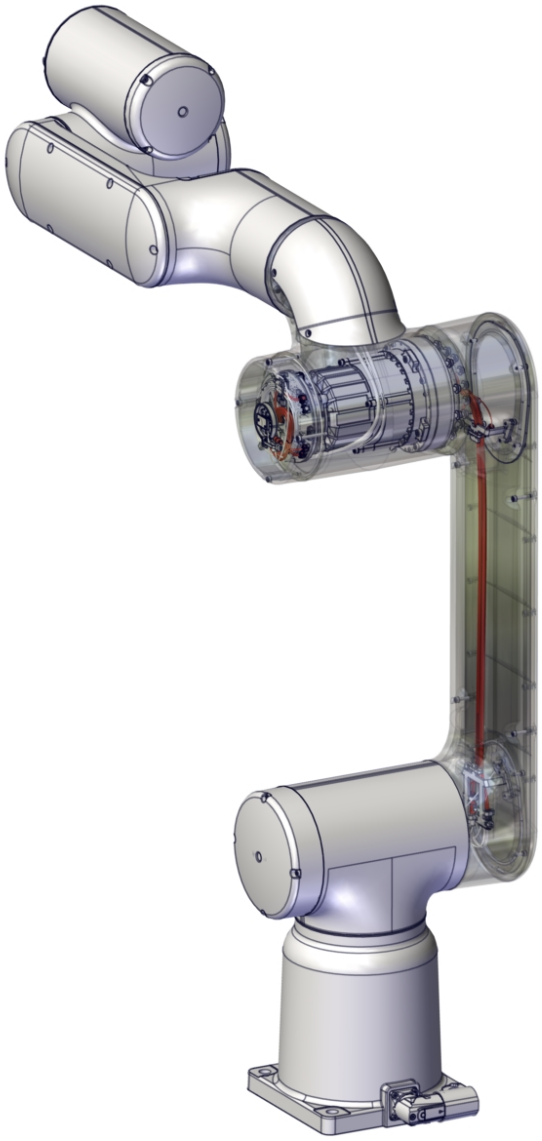
	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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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

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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Cable harness, joint 3	3HAC073207-001	Used for CRB 15000-5/0.95. Also order new Cable tie: 3HAC075545-001.
Cable harness, joint 3	3HAC080965-001	Used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Also order new Cable tie: 3HAC075545-001.
Cable tie	3HAC075545-001	For securing joint unit cable.
Ferrite core	3HAC092224-001	

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95. Attachment screws M4x35 (4 pcs) are enclosed.
Lifting aid	3HAC087788-001	For joint unit on axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint units of CRB 15000-5/0.95.
Protection plate	3HAC087789-001	For protection of drive board during cabling installation on joint units of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cable ties	-	

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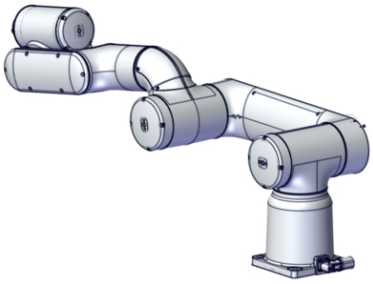
5.3.4 Replacing the axis-3 cabling
Continued

Consumable	Article number	Note
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-047	Housing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-044	Lower arm, inner cover of CRB 15000-5/0.95. 1 pcs / cover. Replace if damaged.
O-ring	3HAC061327-044	Lower arm, upper inner cover of CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
Grease	3HAC042536-001	Shell Gadus S2
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)

Removing the joint cabling

Use these procedures to remove the joint-3 cabling.

Preparations before removing the cabling

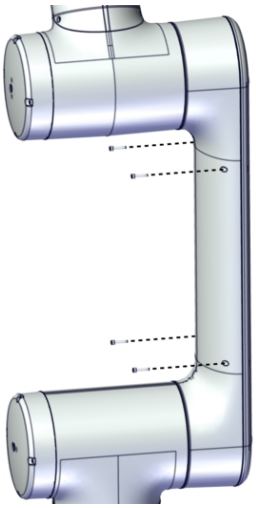
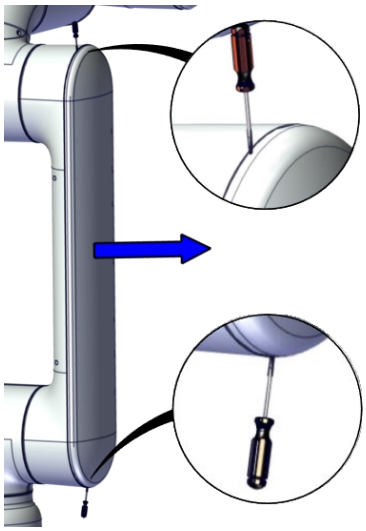
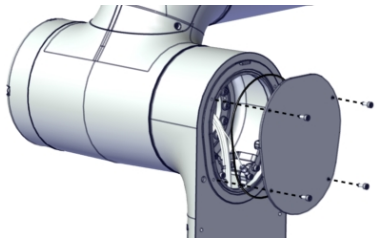
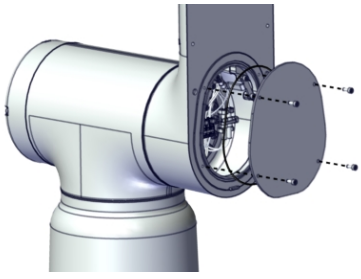
	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: +90° (suggested position for convenient working position) • Axis 3: -80° (home position) • Axis 4: 0° • Axis 5: 0° • Axis 6: 0° **CAUTION** Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000002
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the lower arm covers (-5/0.95)

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

Continues on next page

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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 covers by removing the screws.	 xx2000001947  xx2000001930

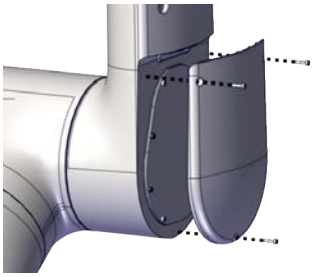
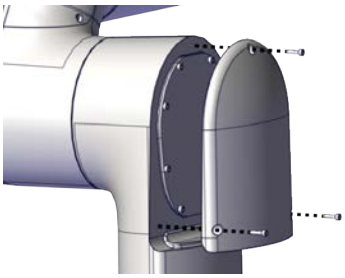
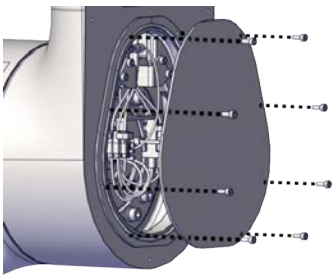
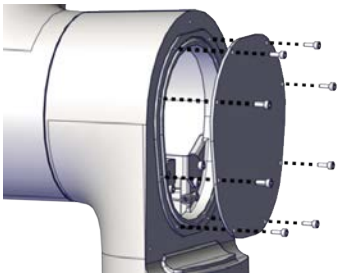
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5.3.4 Replacing the axis-3 cabling

Continued

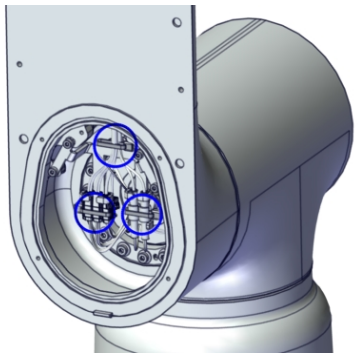
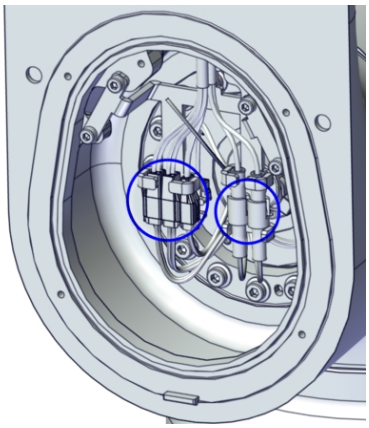
Removing the lower arm covers (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the lower arm covers by removing the screws.	 xx2300000812  xx2300000829
3	Remove the inner covers by removing the screws.	 xx2300000813  xx2300000830

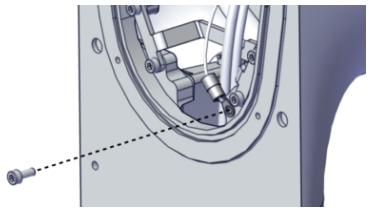
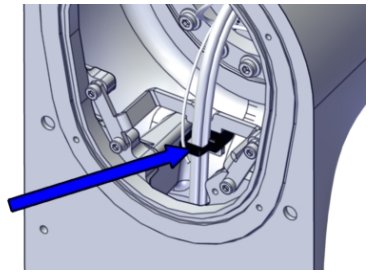
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Disconnecting the upper arm cabling

	Action	Note
1	Cut the cable ties.	 xx2000001937
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

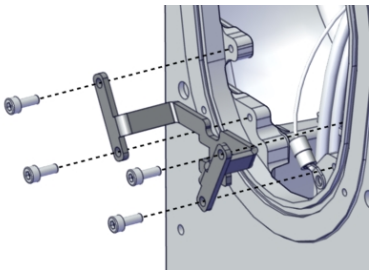
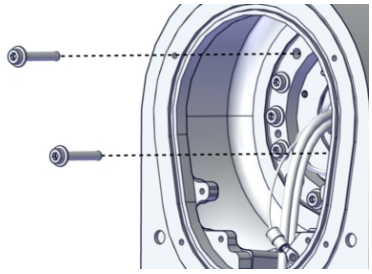
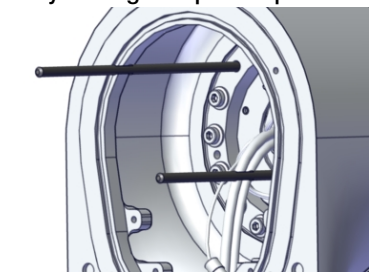
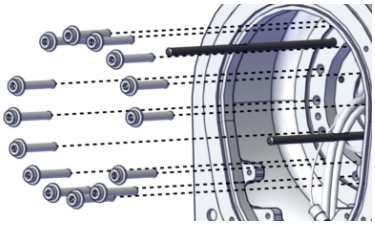
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5.3.4 Replacing the axis-3 cabling

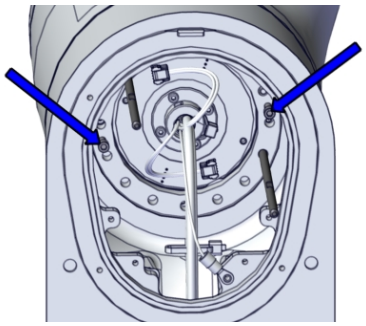
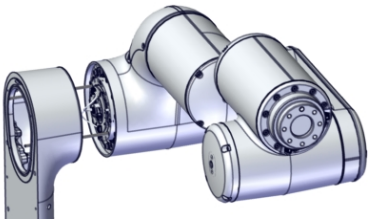
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Removing the upper arm

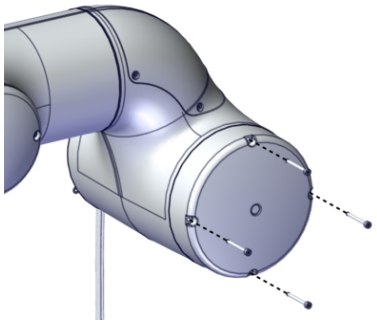
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001966
2	Secure the weight of the upper arm. **CAUTION** The weight of the complete upper arm is 14 kg.	
3	Remove two attachment screws.	 xx2000001967
4	Fit two guide pins to the axis-3 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001968
5	Remove the remaining attachment screws.	 xx2000001969

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	Action	Note
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

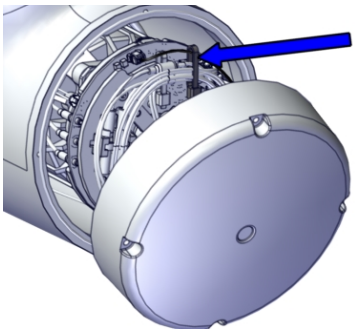
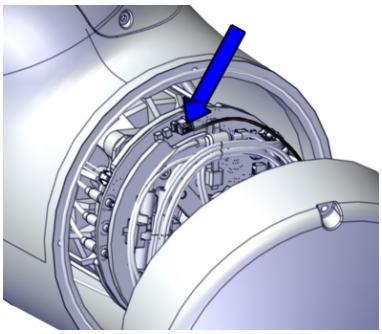
Removing the housing cover (-5/0.95)

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover screws.	 xx2000002021
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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.	

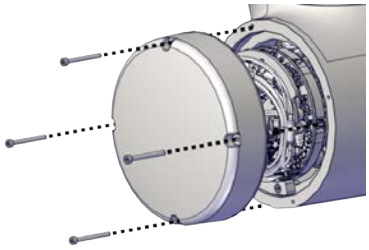
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5.3.4 Replacing the axis-3 cabling
Continued

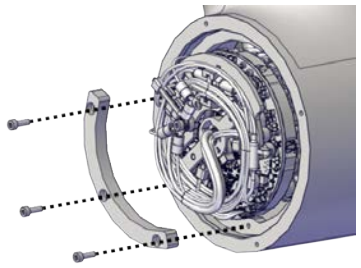
	Action	Note
4	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002022
5	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002023

Removing the housing cover and insert (-10/1.52 and -12/1.27)

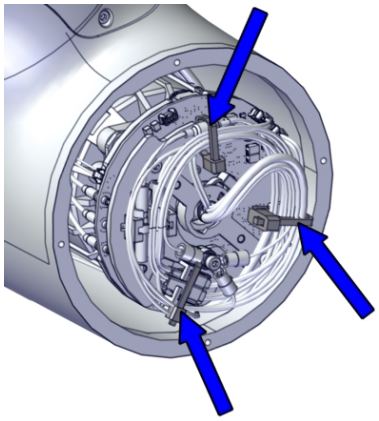
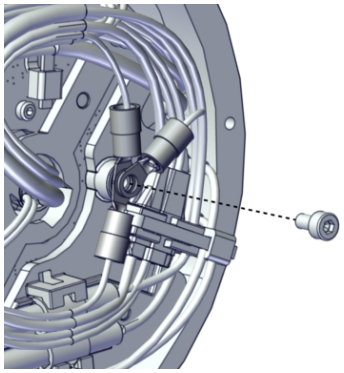
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000833
3	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid 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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	Action	Note
4	Remove the insert.	 xx2300000834

Disconnecting the axis-3 joint unit cabling

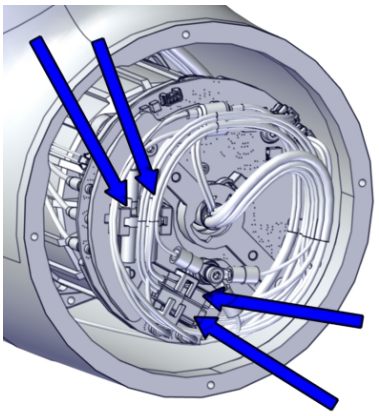
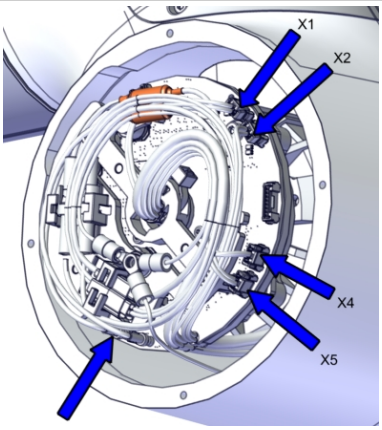
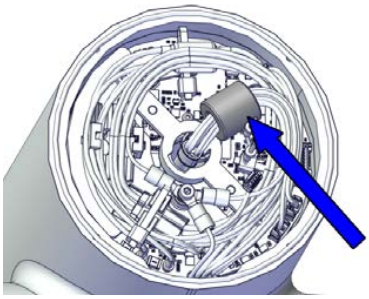
	Action	Note
1	Cut the cable ties.	 xx2000002066
2	Remove the functional and protective earth cables by removing the screw.	 xx2000001945

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5.3.4 Replacing the axis-3 cabling

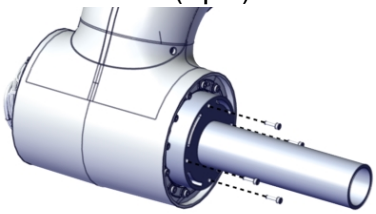
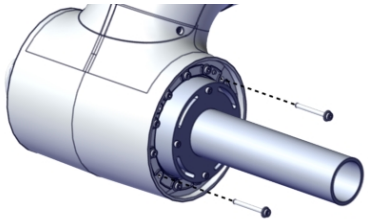
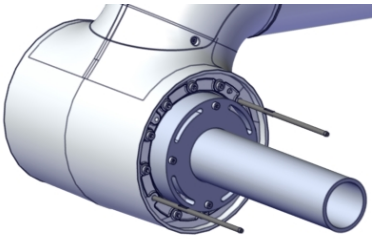
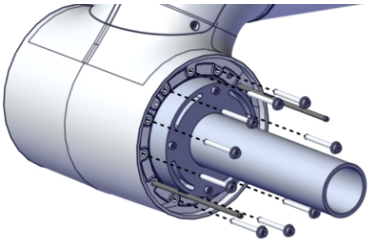
Continued

	Action	Note
3	Snap loose and disconnect the connectors: • J4.DC+ • J4.DC- • J4.CS • J4.CP	 xx2000002067
4	Disconnect the connectors from the drive board. • D3.X1 • D3/4.DC+ • D3/4.DC- • D3.X4 • D3/4.X2 • D3.X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002068
5	Remove the ferrite core by pulling the cables D3.X4 and D3.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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Removing the axis-3 joint unit (-5/0.95)

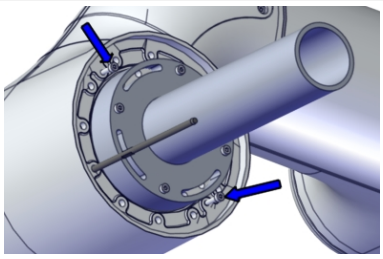
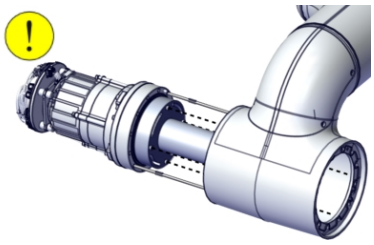
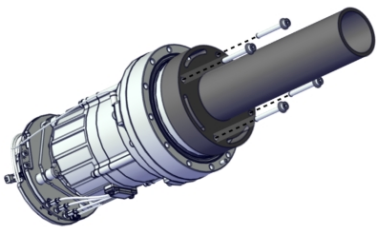
	Action	Note
1	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000002069
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2000002070
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 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  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

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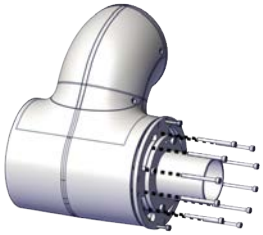
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5.3.4 Replacing the axis-3 cabling

Continued

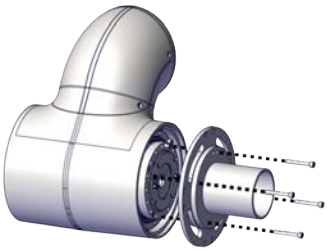
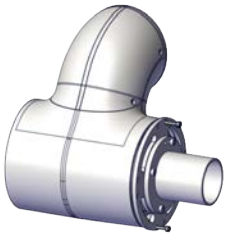
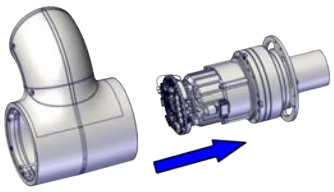
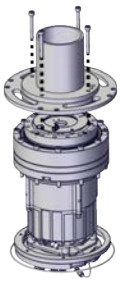
	Action	Note
5	Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 xx2100000003
6	Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2000002577
7	Remove the joint unit from the housing. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002071
8	Remove the lifting aid and guide pins.	 xx2000001957

Removing the axis-3 joint unit (-10/1.52 and -12/1.27)

	Action	Note
1	Remove the attachment screws.	 xx2300000799

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	Action	Note
2	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: 3HAC087788-001 Screws: M4x30 (4 pcs)  xx2300000800
3	Use two fully attachment screws as removal tools to press the joint unit out of position.	 xx2300000801
4	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.	 xx2300000802
5	Remove the lifting aid.	 xx2300000804

Removing the joint cable

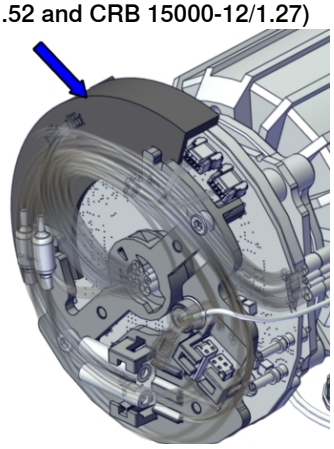
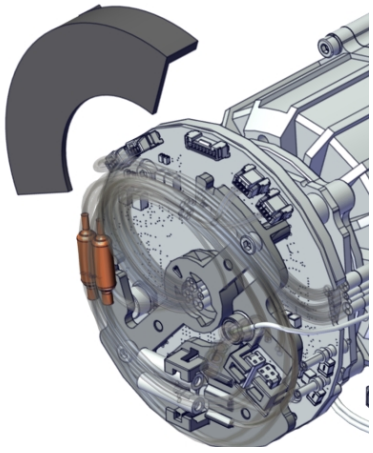
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	

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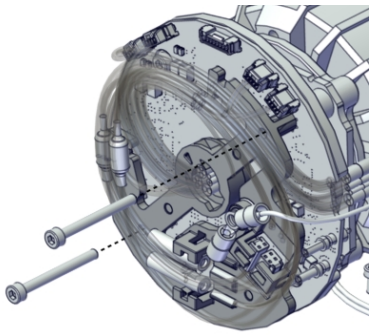
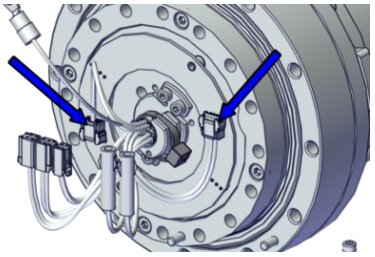
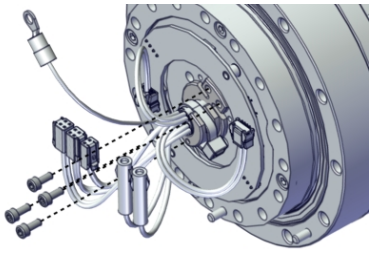
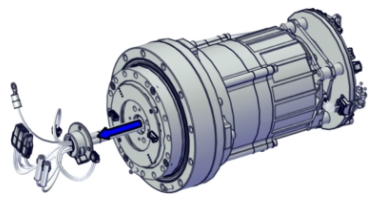
5.3.4 Replacing the axis-3 cabling

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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
3	Cut the cable tie at the drive board.	 xx2000002058
4	Remove the protection plate.	 xx2100000301

Continues on next page

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	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. • 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-3 cabling.

Refitting the joint cable

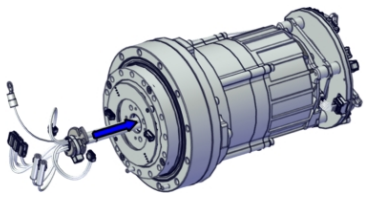
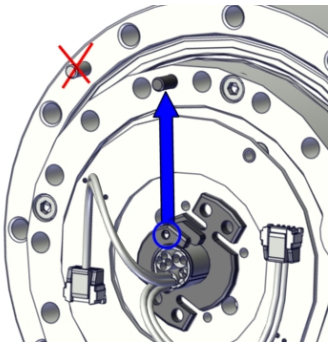
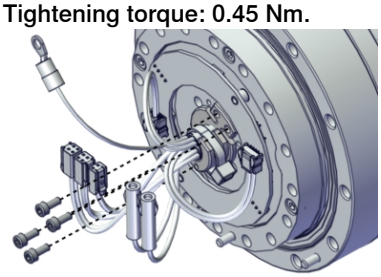
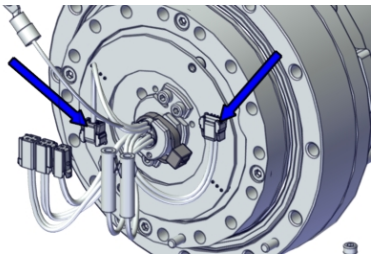
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	

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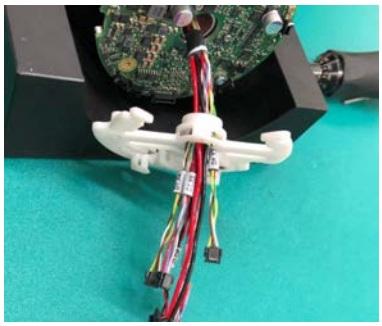
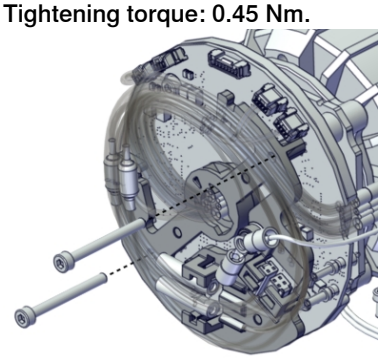
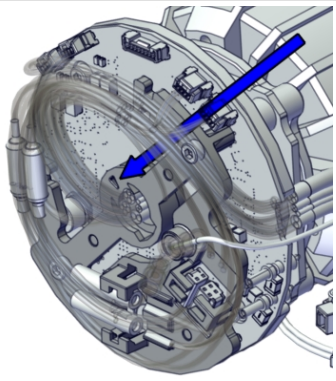
5.3.4 Replacing the axis-3 cabling

Continued

	Action	Note
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
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. • TQ.A to CH1/A • TQ.B to CH2/B	 xx2000002053

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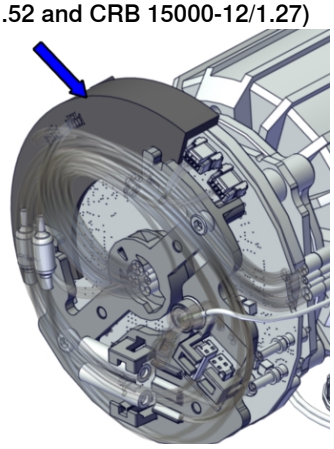
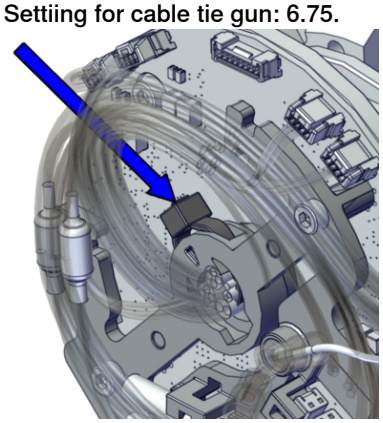
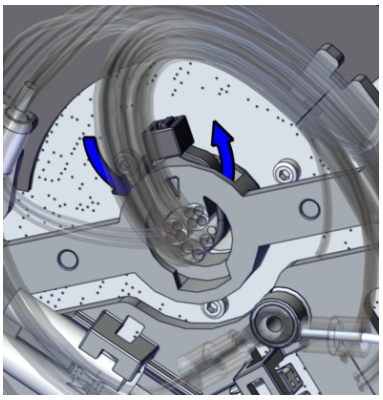
	Action	Note
6	Insert the cabling through the cable support and fit the support to the drive board with the attachment screws.	 xx2000002056 Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.45 Nm.  xx2000002055
7	Keep the cabling loose, making sure not to twist or strain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

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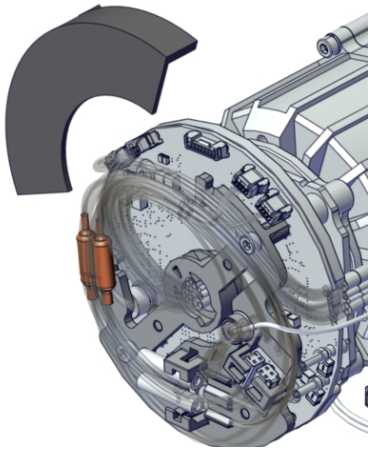
5.3.4 Replacing the axis-3 cabling

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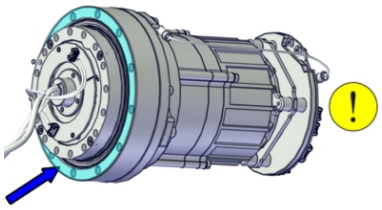
	Action	Note
8	Fit the protection plate to the drive board unit.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
9	Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.	Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059

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	Action	Note
10	Remove the protection plate.	 xx2100000301

Preparations before fitting the joint unit (-5/0.95)

	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 53*.	
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 (or equivalent)  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 53*.	

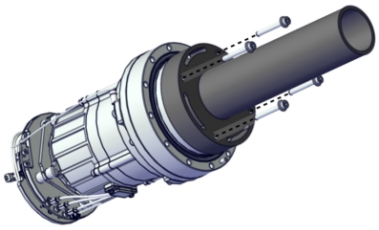
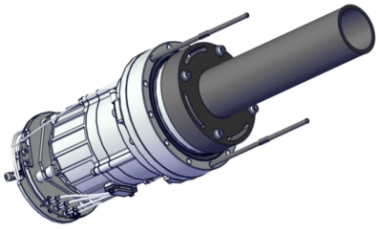
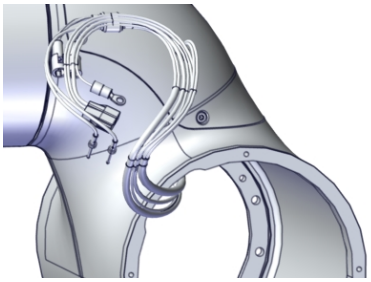
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5.3.4 Replacing the axis-3 cabling

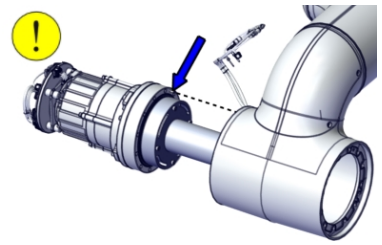
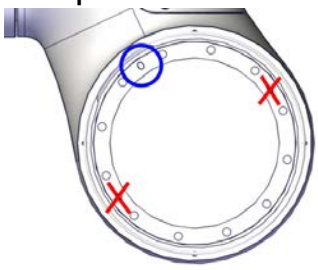
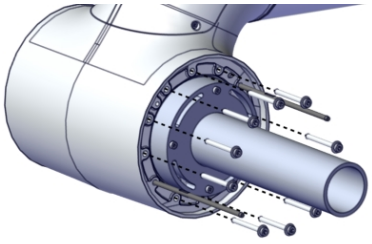
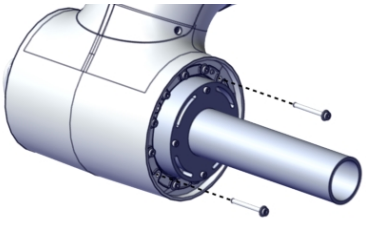
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Refitting the axis-3 joint unit (-5/0.95)

	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
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 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002438
3	Place the cabling at the slot before refitting the joint unit.	 xx2100000004

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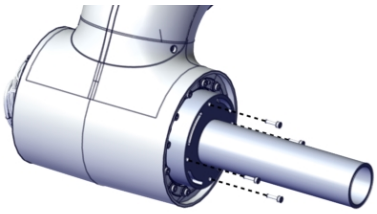
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	Action	Note
4	Fit the joint unit to the housing, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002072 **Pay attention to the right position of the pin hole.**  xx2400001485
5	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 Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000320
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.

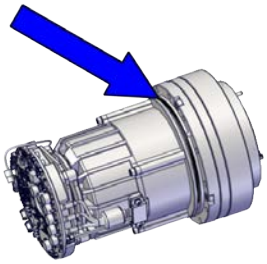
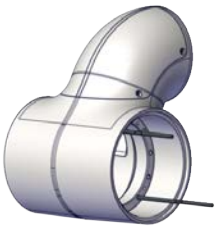
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5.3.4 Replacing the axis-3 cabling
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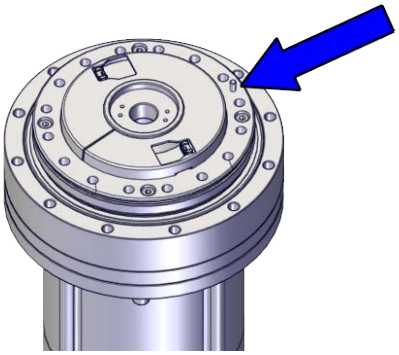
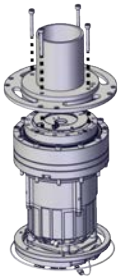
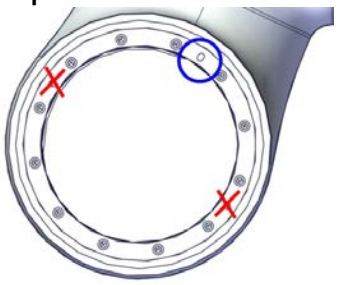
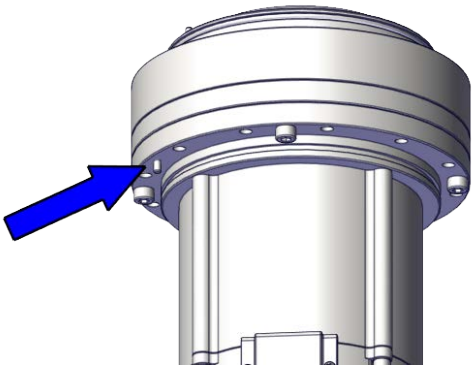
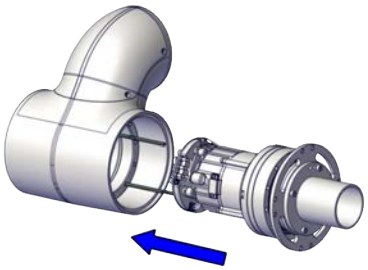
	Action	Note
9	Remove the lifting aid by removing the screws.	 xx2000002069
10	Clean pushed-out flange sealant, if any.	

Refitting the axis-3 joint unit (-10/1.52 and -12/1.27)

	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 53*.	
2	Check the o-ring. Replace if damaged.	O-ring: 3HAC061327-036  xx2300000836
3	Fit two guide pins to the housing.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2300000803

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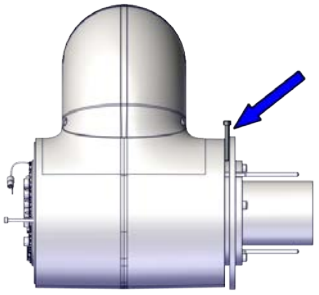
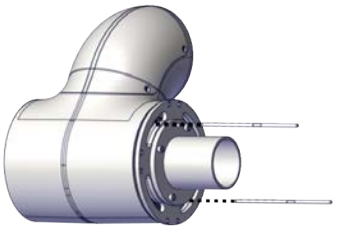
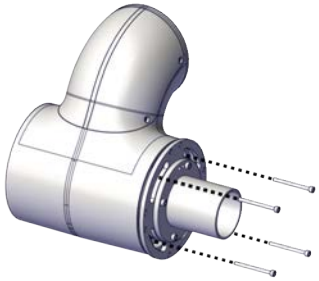
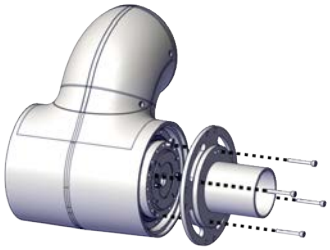
	Action	Note
4	Fit the lifting aid to the joint unit, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  xx2300000777	Joint unit: 3HAC087474-001 Lifting aid: 3HAC087788-001 Screws: M4x30 (4 pcs)  xx2300000804 **Pay attention to the right position of the pin hole.**  xx2400001486
5	Fit the joint unit to the housing, 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.  xx2300000780	 xx2300000806

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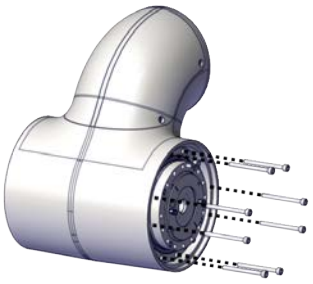
5.3.4 Replacing the axis-3 cabling

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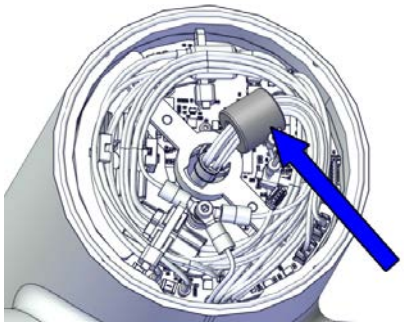
	Action	Note
6	Check the joint unit position by placing an M4 screw between the lifting aid and housing. The joint unit is properly placed when no gaps between the lifting aid and housing.	 xx2300000808
7	Remove the guide pins.	 xx2300000809
8	Secure with four attachment screws and pre-tighten the screws crosswise.	 xx2300000810
9	Remove the lifting aid by removing the screws.	 xx2300000800

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	Action	Note
10	Secure the joint unit with the remaining attachment screws.	Hex socket head cap screw: 3HAB3409-262  xx2300000811
11	Torque tighten all screws crosswise.	M4x45 12.9 Lafre 2C2B/FC6.9, 12 pcs Tightening torque: 4.3 Nm.

Connecting the axis-3 joint unit cabling

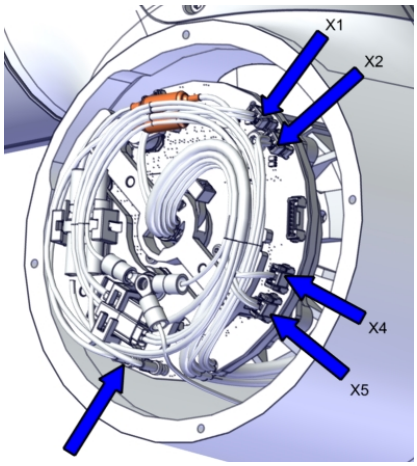
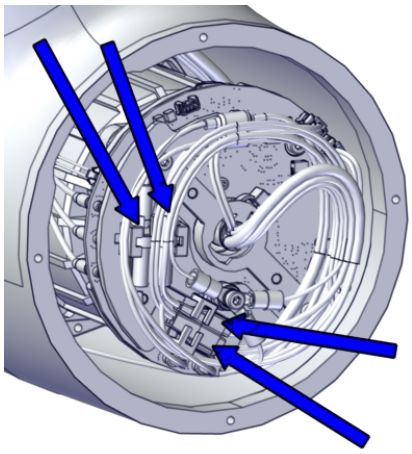
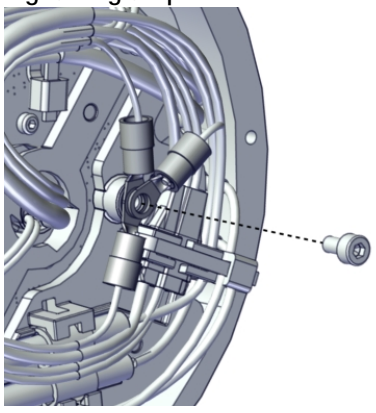
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D3.X4 and D3.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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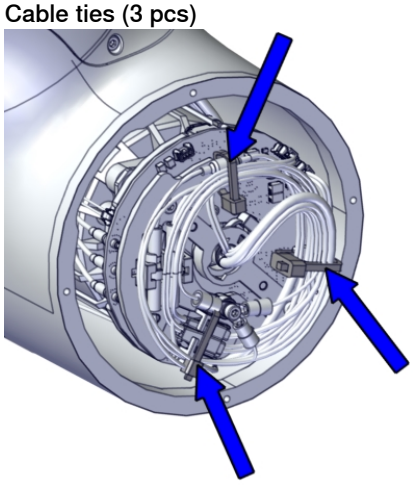
5.3.4 Replacing the axis-3 cabling

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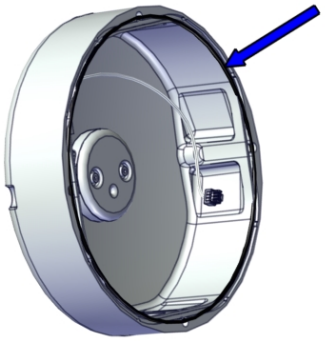
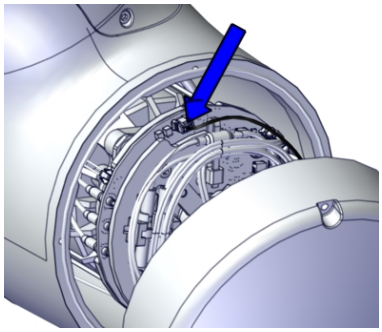
	Action	Note
4	Reconnect the connectors to the drive board. • D3.X1 to X1 • D3/4.DC+ to DC+ • D3/4.DC- to Ground • D3.X4 to X4 • D3/4.X2 to X2 • D3.X5 to X5	 xx2000002068
5	Connect the connectors to each other and snap them to the cable holders. • J4.DC+ to J4/5.DC+ • J4.DC- to J4/5.DC- • J4.CS to J4/5.CS • J4.CP to J4/5.CP	 xx2000002067
6	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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	Action	Note
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002066

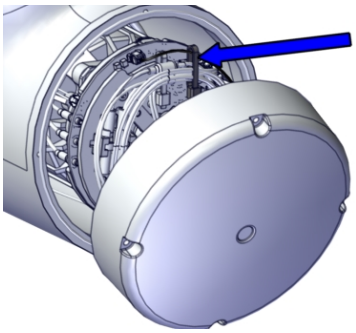
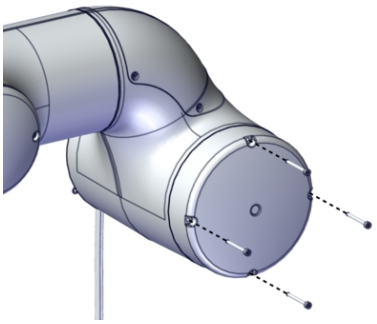
Refitting the housing cover (-5/0.95)

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2	**For robots with RobotWare earlier than 7.10** 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

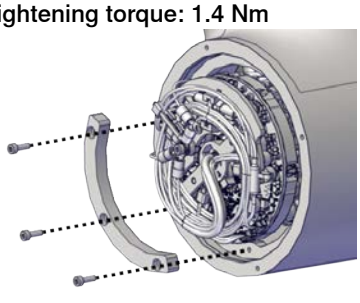
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5.3.4 Replacing the axis-3 cabling
Continued

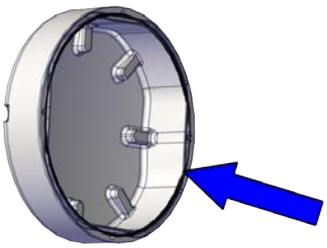
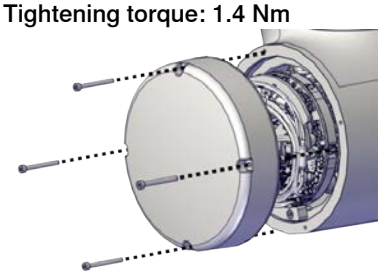
	Action	Note
3	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000002022
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002021

Refitting the housing cover and insert (-10/1.52 and -12/1.27)

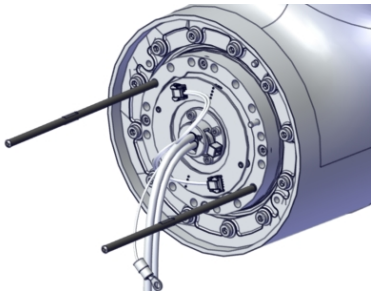
	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000834

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	Action	Note
2	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2300000835
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000833

Refitting the upper arm

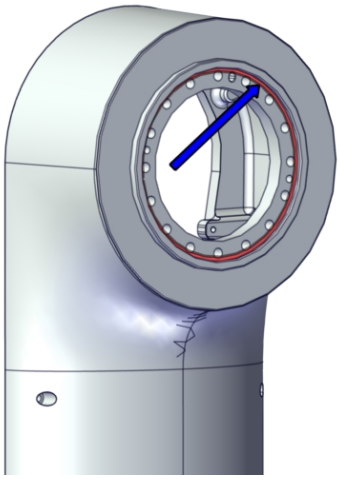
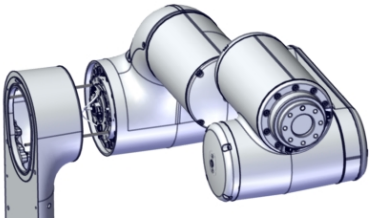
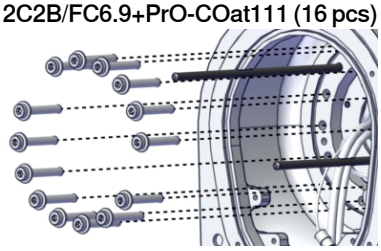
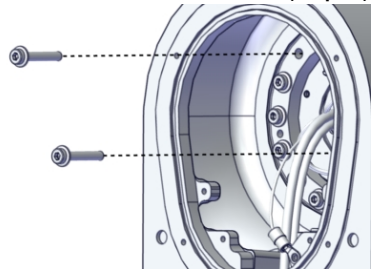
	Action	Note
1	Fit two guide pins to the axis-3 joint.	Guide pin, M4x120: 3HAC077786-001  xx2000001971

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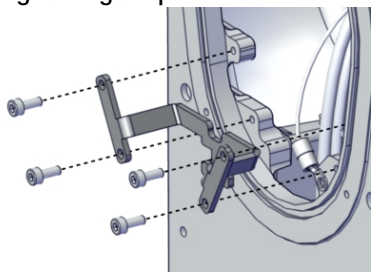
5.3.4 Replacing the axis-3 cabling

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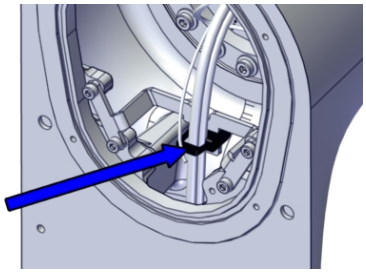
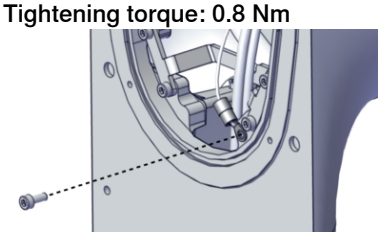
	Action	Note
2	**Valid for CRB 15000-5/0.95** Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000001973
3	Lift the upper arm into 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

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	Action	Note
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

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

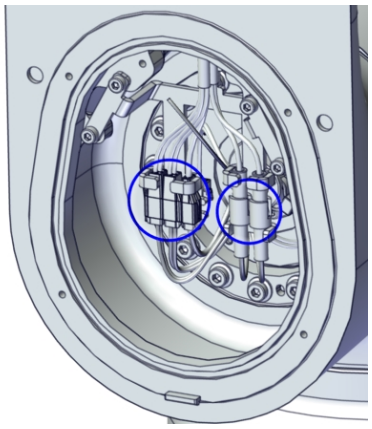
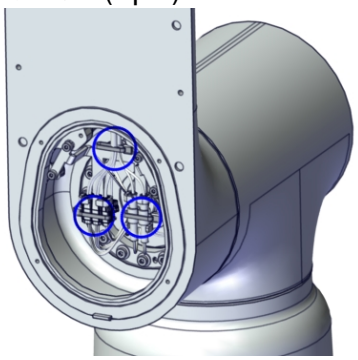
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5.3.4 Replacing the axis-3 cabling

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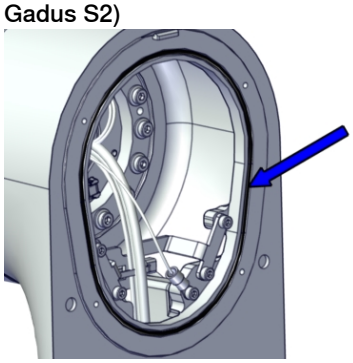
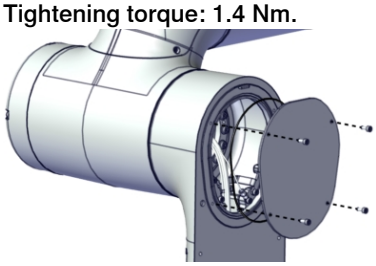
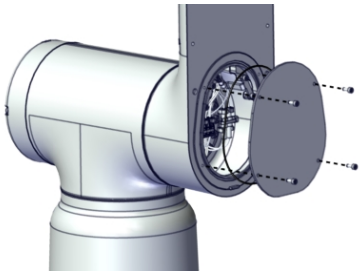
Connecting the upper arm cabling

	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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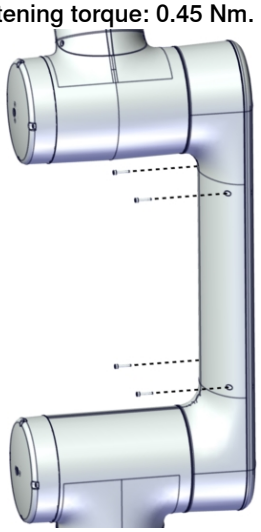
Refitting the lower arm covers (-5/0.95)

	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

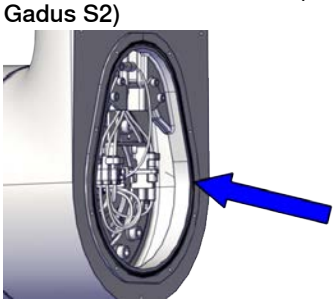
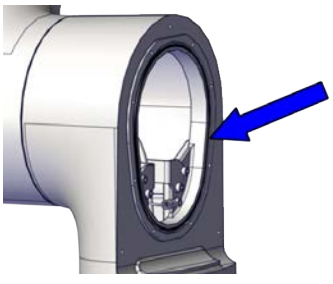
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5.3.4 Replacing the axis-3 cabling
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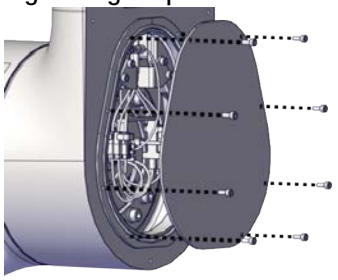
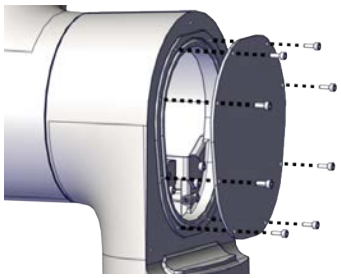
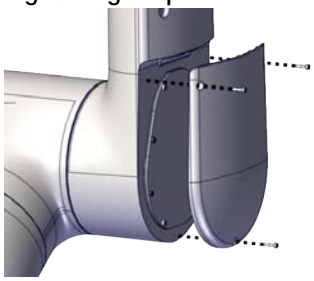
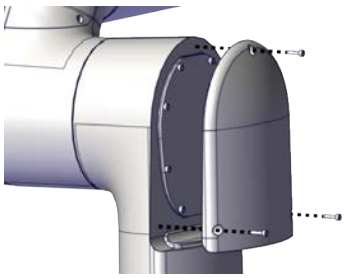
	Action	Note
3	Snap the lower arm cover into place.	Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000001929
4	Secure the cover with four screws.	

Refitting the lower arm covers (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-075 O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2300000832  xx2300000831

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	Action	Note
2	Refit the inner covers with eight screws each.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) x 2 Tightening torque: 1.4 Nm.  xx2300000813  xx2300000830
3	Snap the lower arm cover into place.	Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) x 2 Tightening torque: 1.4 Nm.  xx2300000812  xx2300000829
4	Secure the cover with three screws.	

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5.3.4 Replacing the axis-3 cabling
Continued

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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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*.

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5.3.5 Replacing the axis-4 cabling
Continued

Spare part	Article number	Note
Cable harness, joint 4	3HAC073206-001	Used for CRB 15000-5/0.95. Also order new Cable tie: 3HAC075545-001.
Cable harness, joint 4	3HAC080961-001	Used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Also order new Cable tie: 3HAC075545-001.
Cable tie	3HAC075545-001	For securing joint unit cable.
Ferrite core	3HAC092224-001	

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 units of CRB 15000-5/0.95.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cable ties	-	
O-ring	3HAC061327-051	Axis-4 cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-051	Axis-4 cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
Gasket	3HAC075056-001	Cover inside housing Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-047	Housing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.

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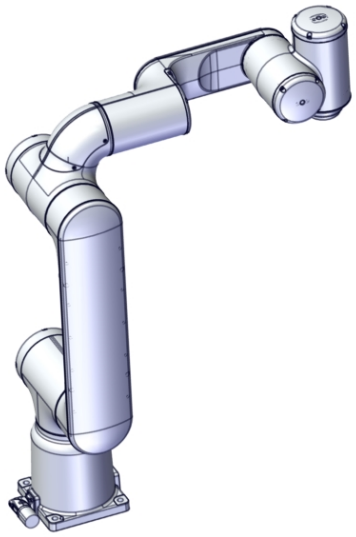
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Consumable	Article number	Note
O-ring	3HAC061327-043	Tubular cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAB3772-166	Tubular cover, upper, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-076	Tubular cover, lower, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. 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 of CRB 15000-5/0.95. 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 (or equivalent)

Removing the joint cabling

Use these procedures to remove the joint-4 cabling.

Preparations before removing the cabling

	Action	Note
1	Jog the robot to the specified position: • Axis 1: No significance. • Axis 2: 0° • Axis 3: 0° • Axis 4: 0° (home position) • Axis 5: +90° • Axis 6: No significance. **CAUTION** 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.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000005

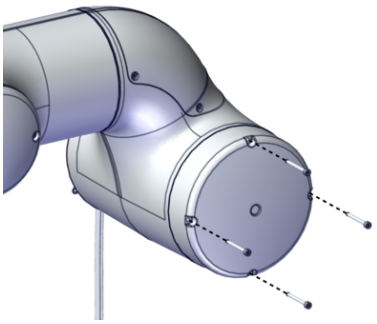
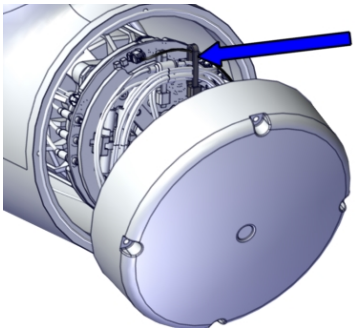
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5.3.5 Replacing the axis-4 cabling
Continued

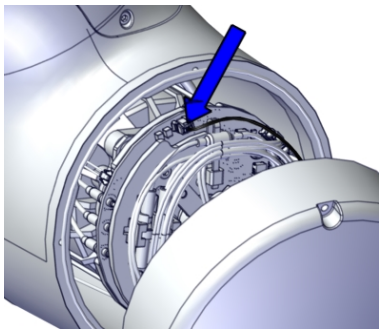
	Action	Note
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the housing cover (-5/0.95)

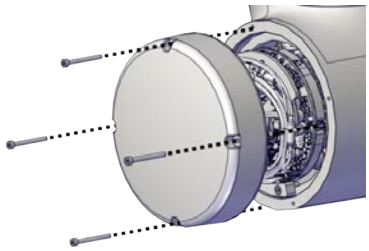
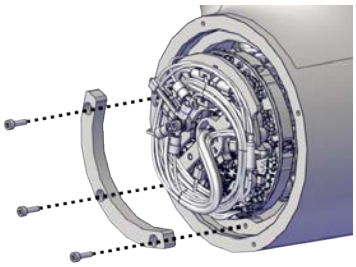
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover screws.	 xx2000002021
3	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002022

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	Action	Note
5	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002023

Removing the housing cover and insert (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000833
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	Remove the insert.	 xx2300000834

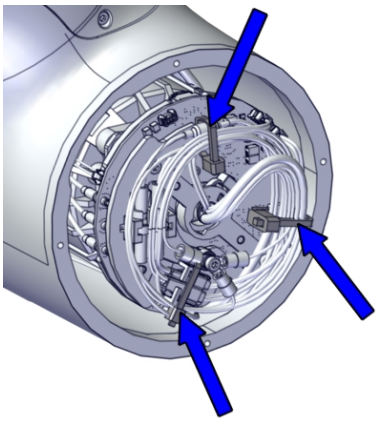
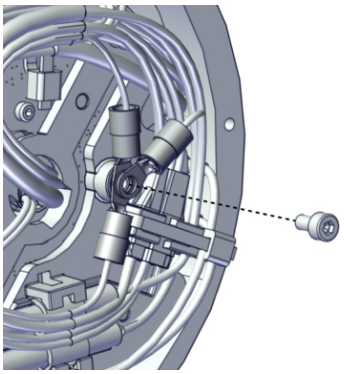
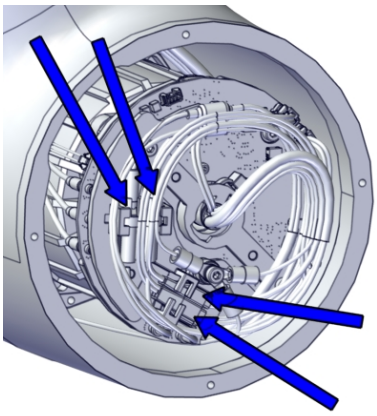
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5.3.5 Replacing the axis-4 cabling

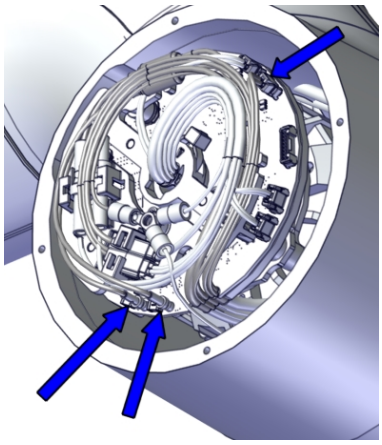
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Separating the cabling between the housing and the tubular

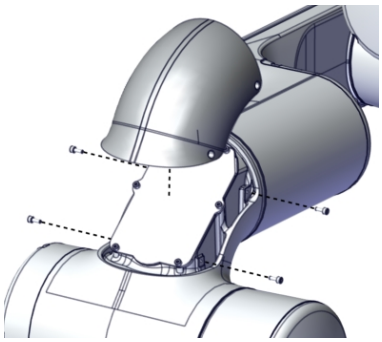
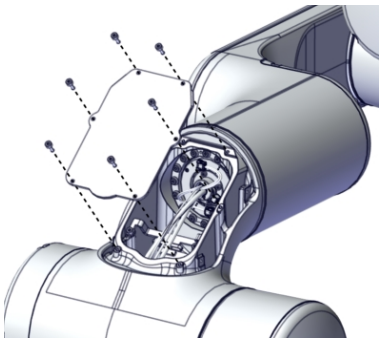
	Action	Note
1	Cut the cable ties.	 xx2000002066
2	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
3	Snap loose and disconnect the connectors: • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP	 xx2000002067

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	Action	Note
4	Disconnect the connectors from the drive board. • 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

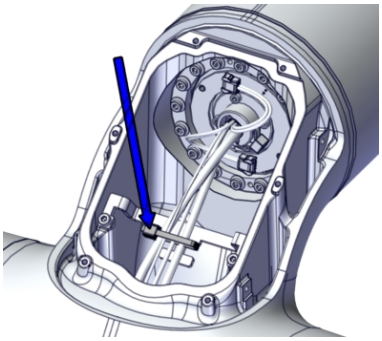
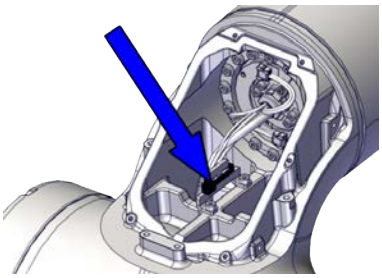
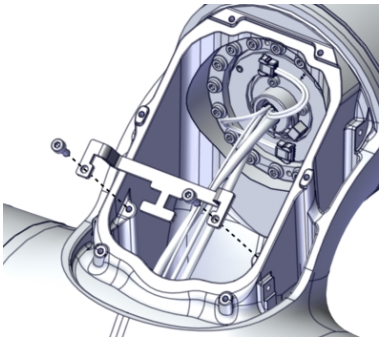
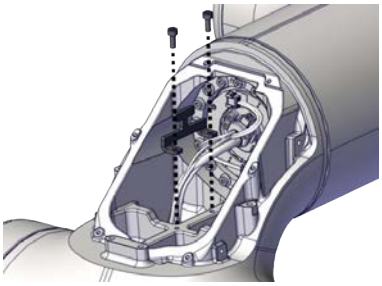
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5.3.5 Replacing the axis-4 cabling

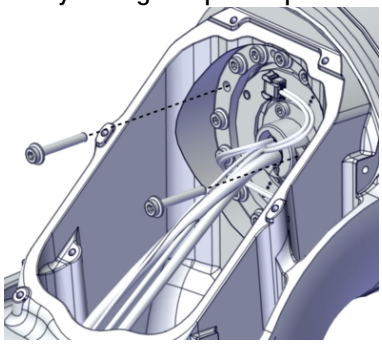
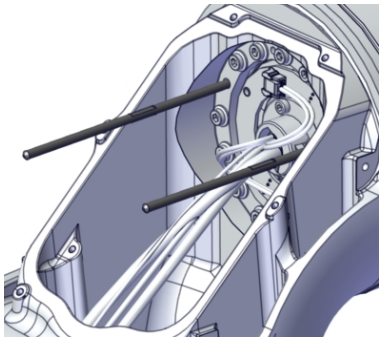
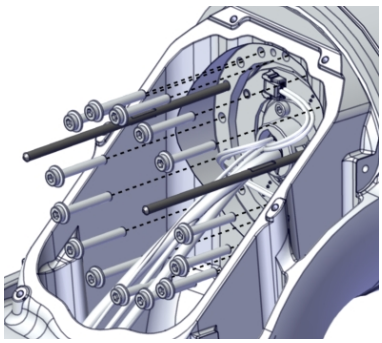
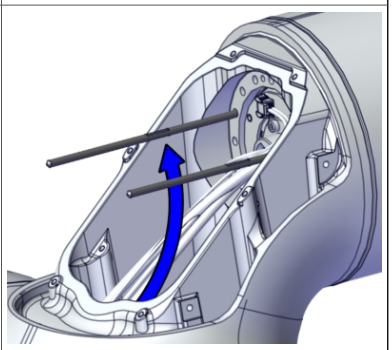
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Removing the tubular

	Action	Note
1	Cut the cable tie.	**Valid for CRB 15000-5/0.95**  xx2000002077 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000839
2	Remove the cable bracket by removing the two screws.	**Valid for CRB 15000-5/0.95**  xx2000002078 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000840

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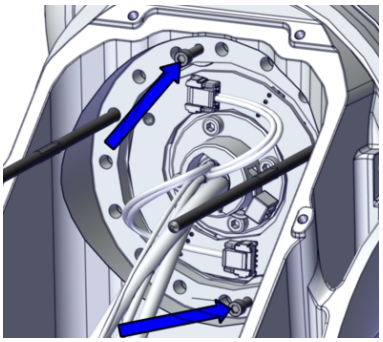
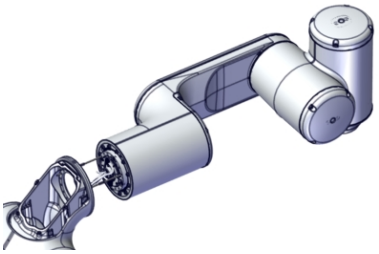
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	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-4 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002079  xx2000002080
4	Remove the remaining attachment screws.	 xx2000002081
5	Pull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

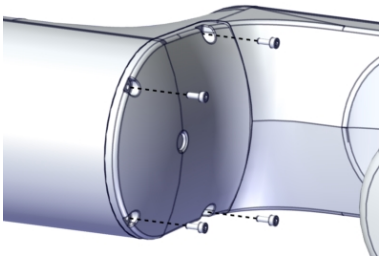
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5.3.5 Replacing the axis-4 cabling
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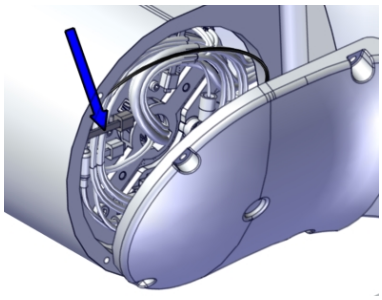
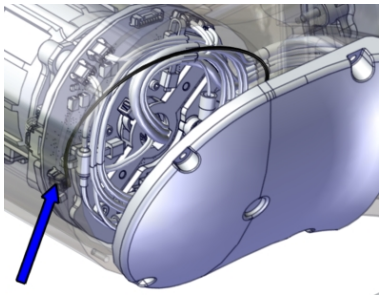
	Action	Note
6	Use two fully threaded attachment screws as removal tools to press the housing out of position.	 xx2100000006
7	Remove the tubular from the housing. Assist the cabling to be removed from the housing while lifting away the complete tubular. Place the tubular on a workbench.	 xx2000002082

Removing the axis-4 cover

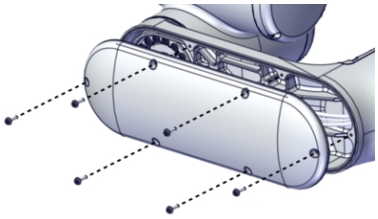
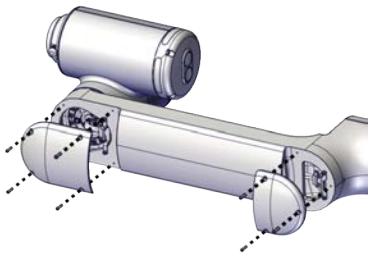
	Action	Note
1	Remove the cover screws.	 xx2000002083
2	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	

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	Action	Note
3	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002084
4	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	Tweezers  xx2000002085

Removing the tubular cover

	Action	Note
1	**Valid for CRB 15000-5/0.95** 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
2	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the covers by removing the screws.	 xx2300000841

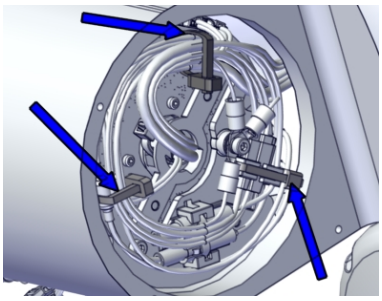
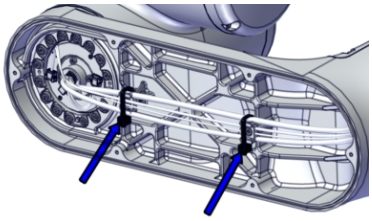
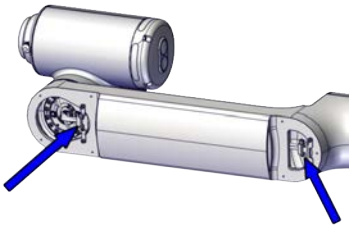
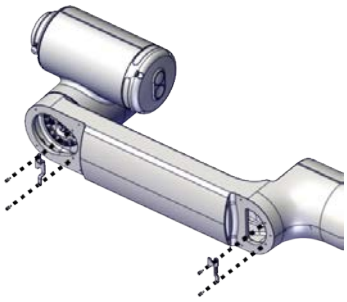
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5.3.5 Replacing the axis-4 cabling

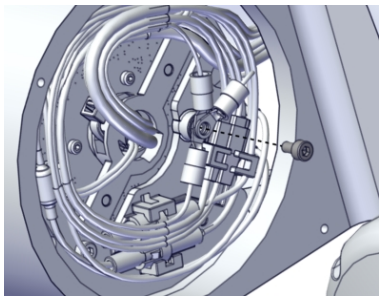
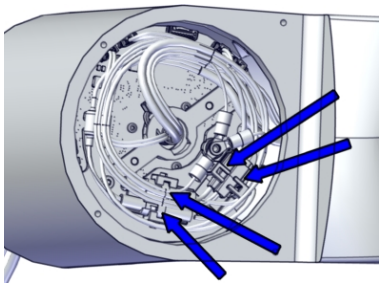
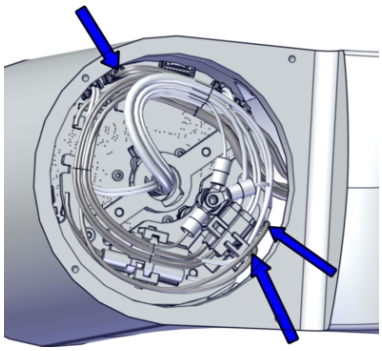
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Separating the cabling between the tubular and the tilt

	Action	Note
1	Cut the cable ties on joint unit.	 xx2000002086
2	Cut the cable ties on tubular, if needed.	**Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842
3	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the cable brackets.	 xx2300000843

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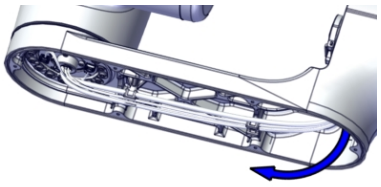
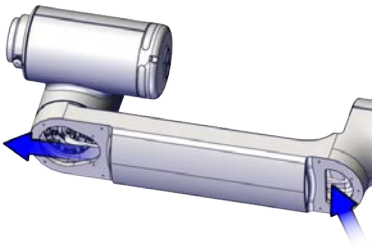
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	Action	Note
4	Remove the functional and protective earth cables by removing the screw.	 xx2000002087
5	Snap loose and disconnect the connectors: • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP	 xx2000002089
6	Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board: • D3/4.X2 • D3/4.DC- • D3/4.DC+ Use tweezers, if needed.	Tweezers  xx2000002125

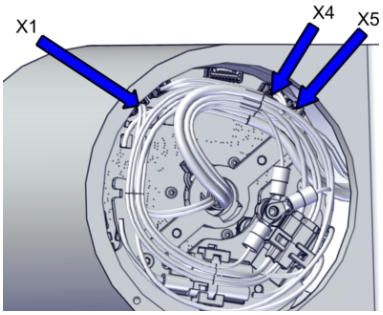
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5.3.5 Replacing the axis-4 cabling
Continued

	Action	Note
7	Pull out the cabling carefully from the tubular.	**Valid for CRB 15000-5/0.95**  xx2000002126 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000844

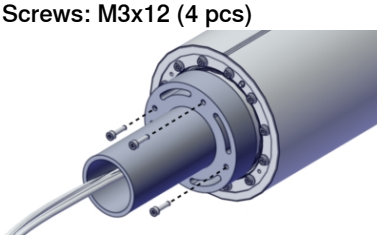
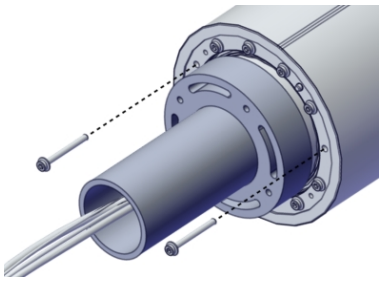
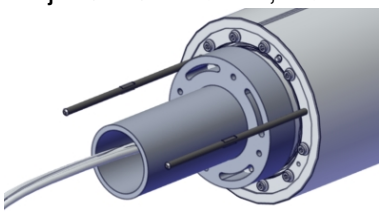
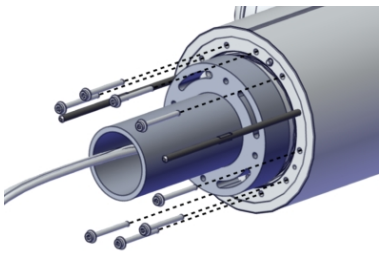
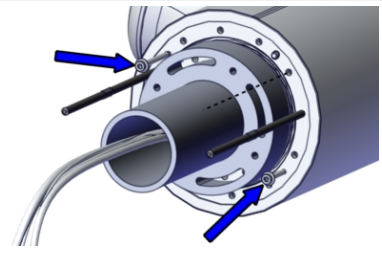
Disconnecting the axis-4 joint unit cabling

	Action	Note
1	Disconnect the connectors from the drive board. **CAUTION** Use tweezers to unlock connectors and pull them off. • D4/5.X1 • D4/5.X4 • D4/5.X5	Tweezers  xx2000002088
2	Remove the ferrite core by pulling the cables D4/5.X4 and D4/5.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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Removing the axis-4 joint unit

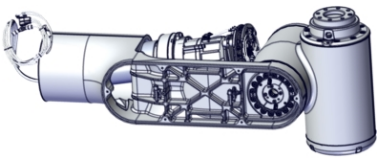
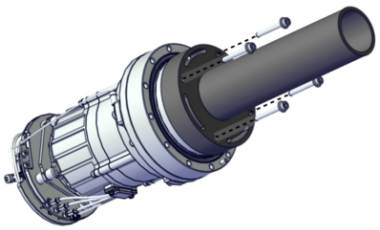
	Action	Note
1	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002090
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2000002091
3	Fit two guide pins to the axis-4 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2000002578
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.	 xx2100000326
5	Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2100000327

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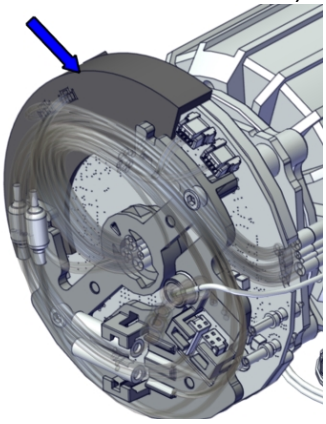
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5.3.5 Replacing the axis-4 cabling

Continued

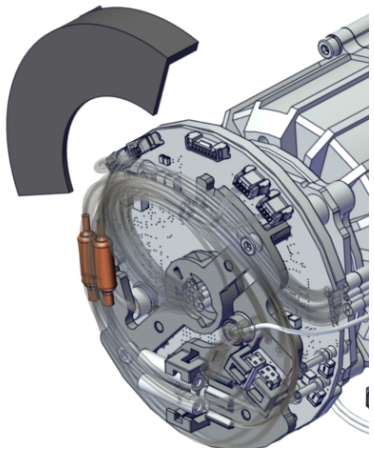
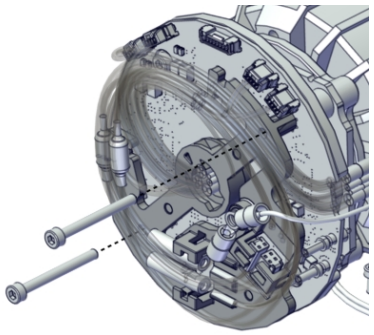
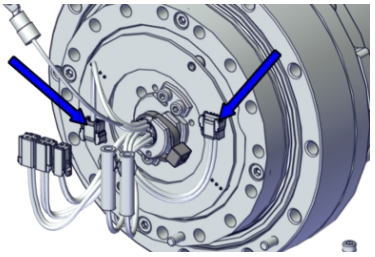
	Action	Note
6	Remove the joint unit from the tubular. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002116
7	Remove the lifting aid and guide pins.	 xx2000001957

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 53*.	
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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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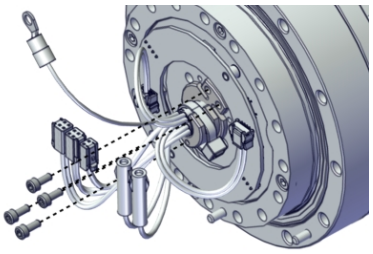
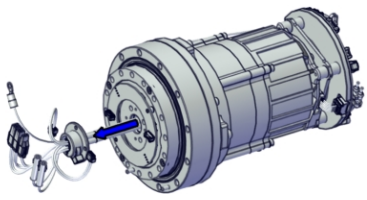
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	Action	Note
3	Cut the cable tie at the drive board.	 xx2000002058
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. • TQ.A • TQ.B	 xx2000002053

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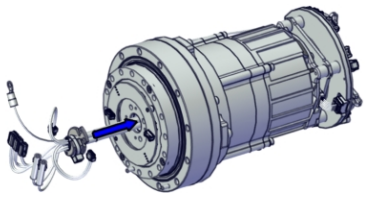
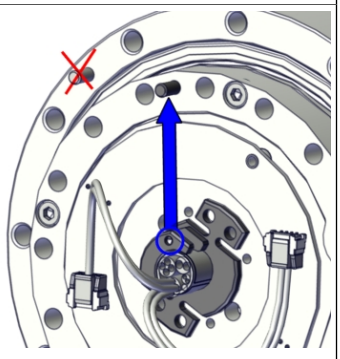
5.3.5 Replacing the axis-4 cabling
Continued

	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

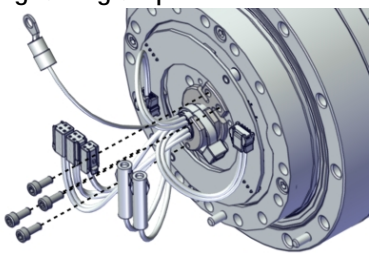
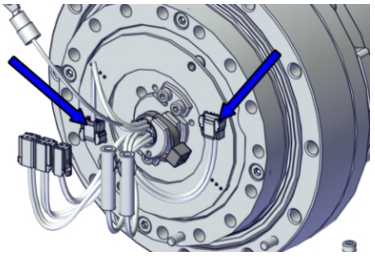
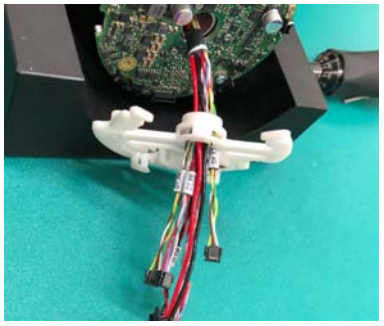
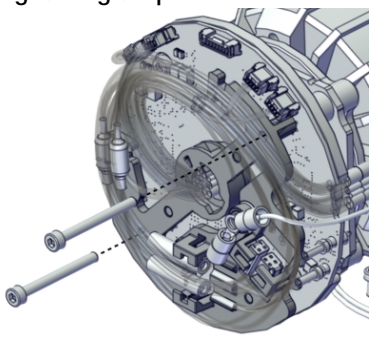
Use these procedures to refit the joint-4 cabling.

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 53*.	
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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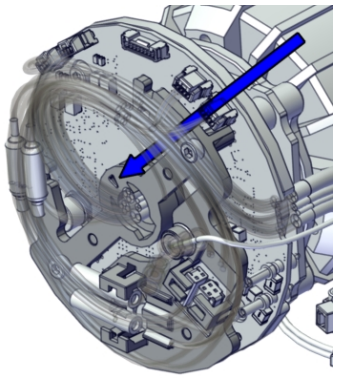
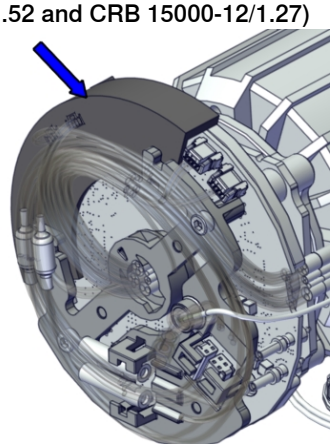
	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000002049
5	Connect the two connectors to the torque sensor board. • TQ.A to CH1/A • TQ.B to CH2/B	 xx2000002053
6	Insert 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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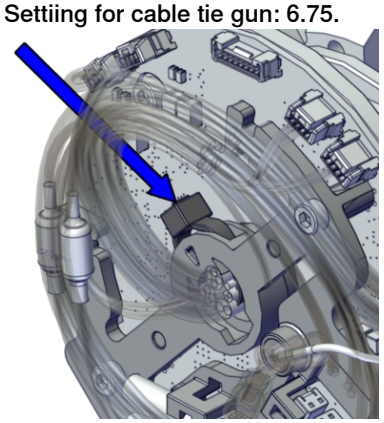
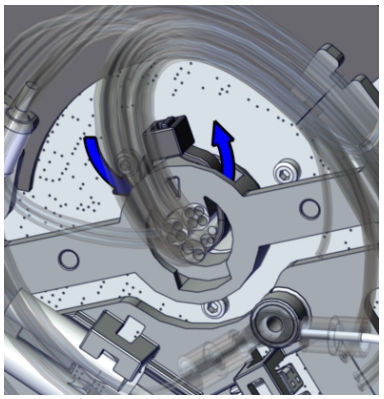
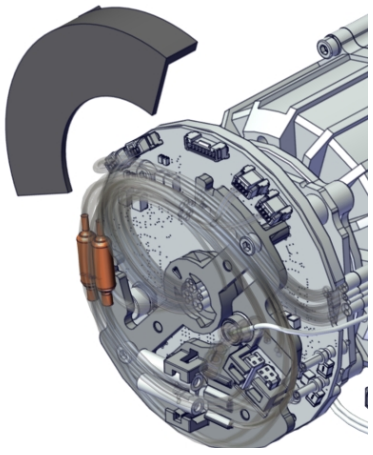
5.3.5 Replacing the axis-4 cabling

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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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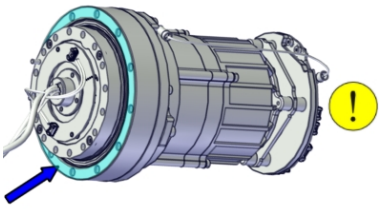
	Action	Note
9	Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.	Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059
10	Remove the protection plate.	 xx2100000301

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5.3.5 Replacing the axis-4 cabling
Continued

Preparations before fitting the joint unit

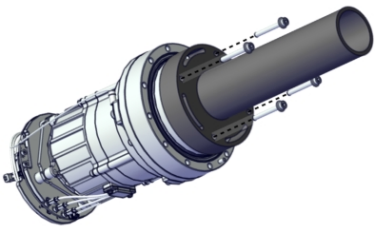
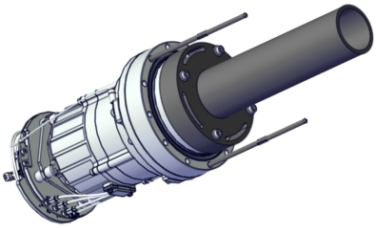
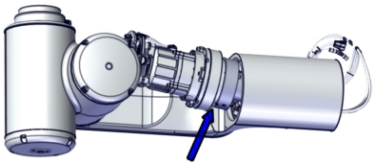
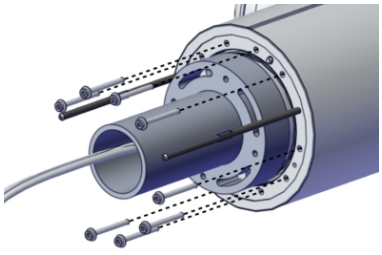
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  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 53*.	

Refitting the axis-4 joint unit

	Action	Note
1	**CAUTION** Axis-4 joint unit used for CRB 15000-5/0.95 has the same appearance as that used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Do not mix the joint units for different manipulator variants. Always check the mark or label on the joint units before refitting.	

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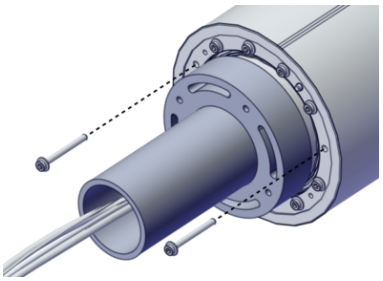
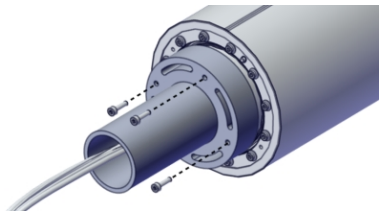
	Action	Note
2	Fit the lifting aid to the joint unit. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079143-001 (for CRB 15000-5/0.95) / 3HAC087546-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
3	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
4	Fit the joint unit to the tubular, 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.	 xx2000002117
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.  xx2100000326

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5.3.5 Replacing the axis-4 cabling

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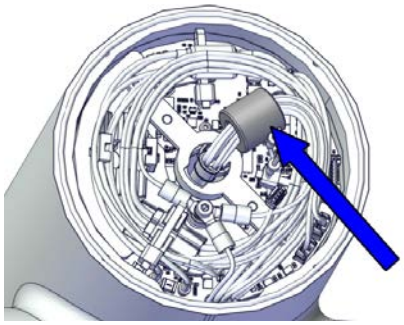
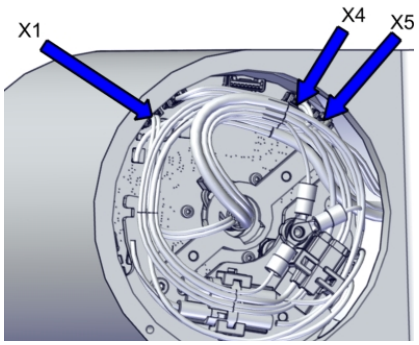
	Action	Note
6	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002091
7	Pre-tighten the screws crosswise.	
8	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm (for CRB 15000-5/0.95) / 1.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)
9	Remove the lifting aid by removing the screws.	 xx2000002090
10	Clean pushed-out flange sealant, if any.	

Connecting the axis-4 joint unit cabling

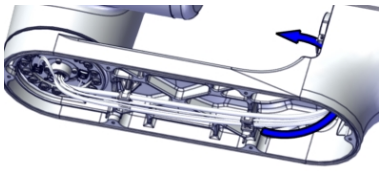
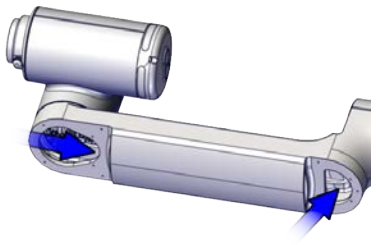
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484

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	Action	Note
3	Thread the cables D4/5.X4 and D4/5.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • D4/5.X1 to X1 • D4/5.X4 to X4 • D4/5.X5 to X5	 xx2000002088

Connecting the tilt cabling

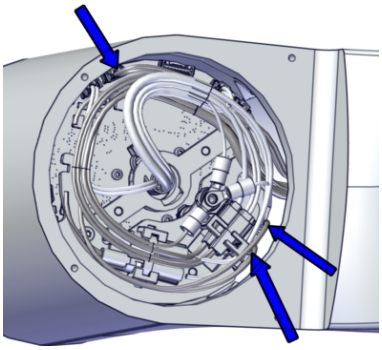
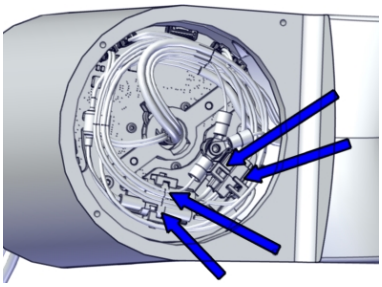
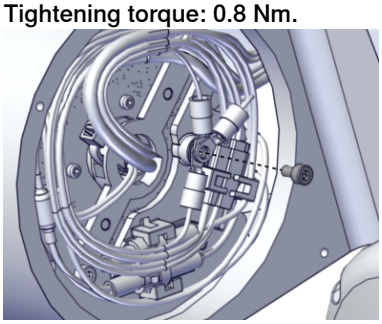
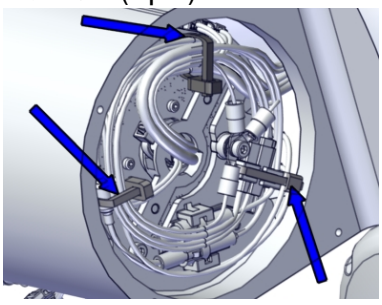
	Action	Note
1	Insert the cabling into the tubular.	**Valid for CRB 15000-5/0.95**  xx2000002148 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000845

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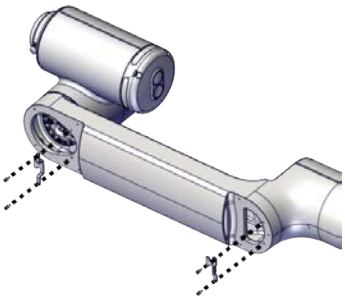
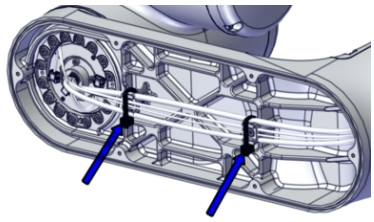
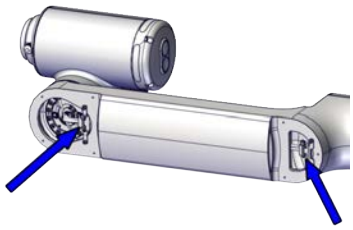
5.3.5 Replacing the axis-4 cabling

Continued

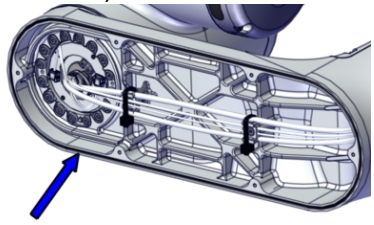
	Action	Note
2	Reconnect the connectors to the drive board. • D3/4.X2 to X2 • D3/4.DC- to Ground • D3/4.DC+ to +DC	 xx2000002125
3	Connect the connectors to each other and snap them to the cable holders. • J4/5.DC+ to J5/6.DC+ • J4/5.DC- to J5/6.DC- • J4/5.CS to J5/6.CS • J4/5.CP to J5/6.CP	 xx2000002089
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 to joint unit with cable ties.	Cable ties (3 pcs)  xx2000002086

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	Action	Note
6	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Refit the cable brackets.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs for each). Tightening torque: 0.8 Nm.  xx2300000843
7	Secure the cabling to tubular with cable ties.	Cable ties (2 pcs) **Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842

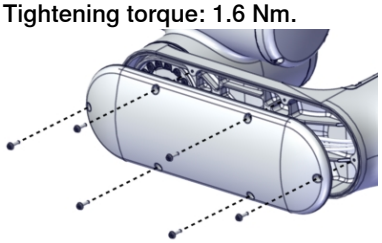
Refitting the tubular cover (-5/0.95)

	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

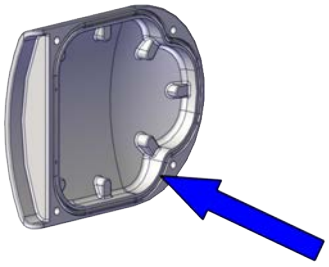
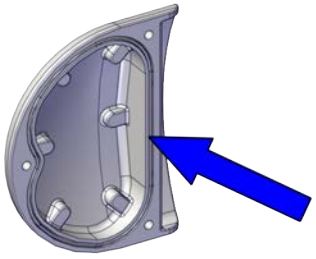
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5.3.5 Replacing the axis-4 cabling
Continued

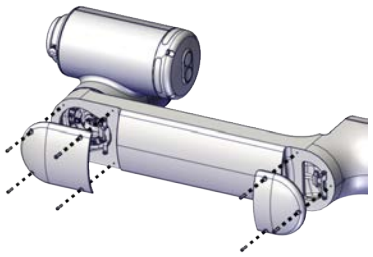
	Action	Note
2	Refit the cover with new attachment screws.	Flange socket head screw with glue: 3HAB3413-312 M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover of CRB 15000-5/0.95. Always use new screws. If ordering a new axis-4 or axis-5 joint unit spare part, new screws for the tubular cover are included. Tightening torque: 1.6 Nm.  xx2000002123

Refitting the tubular cover (-10/1.52 and -12/1.27)

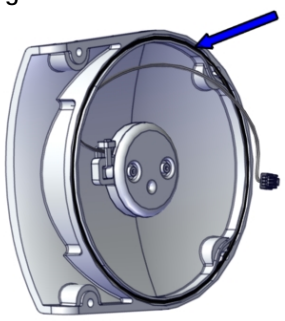
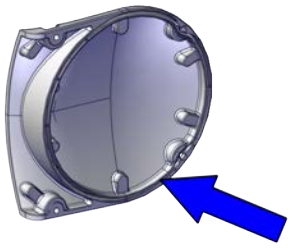
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damged.	O-ring: 3HAC061327-076 O-ring: 3HAB3772-166 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2300000846  xx2300000847

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	Action	Note
2	Refit the covers with new attachment screws.	Hex socket head cap screw:M3x12 12.9 Lafre 2C2B/FC6.9 (7 pcs in total) Tightening torque: 1.4 Nm.  xx2300000841

Refitting the axis-4 cover

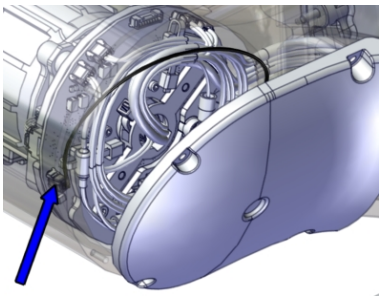
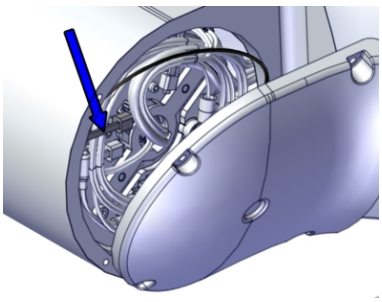
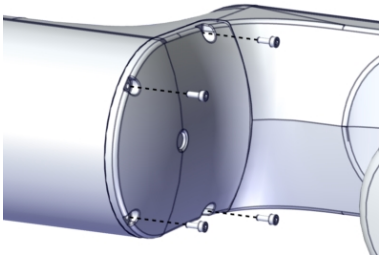
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	**Valid for CRB 15000-5/0.95** O-ring: 3HAC061327-051  xx2000002092 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 O-ring: 3HAC061327-051  xx2300000848

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5.3.5 Replacing the axis-4 cabling

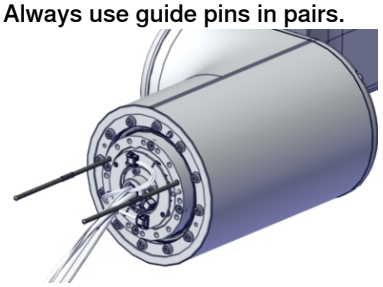
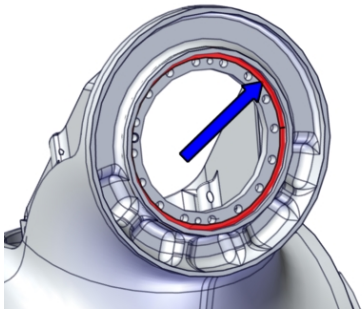
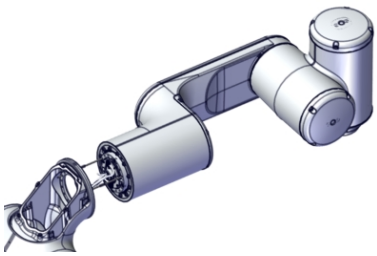
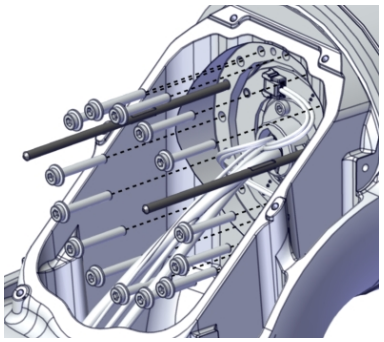
Continued

	Action	Note
2	**For robots with RobotWare earlier than 7.10** Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	Tweezers  xx2000002085
3	**For robots with RobotWare earlier than 7.10** 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 (for CRB 15000-5/0.95) / 0.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Tightening torque: 0.9 Nm  xx2000002083

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Refitting the tubular

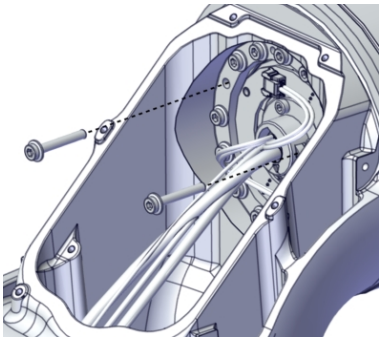
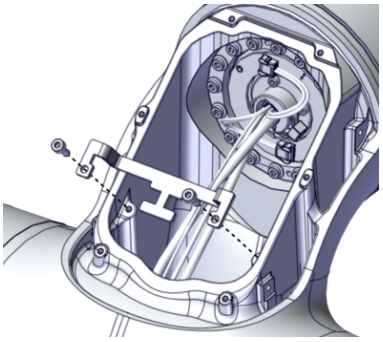
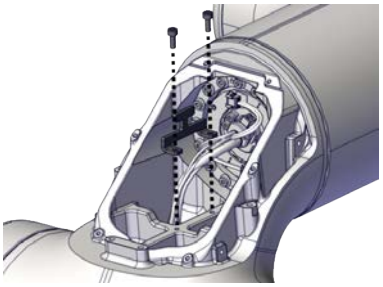
	Action	Note
1	Fit two guide pins to the axis-4 joint.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002093
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the housing mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000002094
3	Lift the tubular into mounting position while inserting the cabling into the housing.	 xx2000002082
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.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111  xx2000002081

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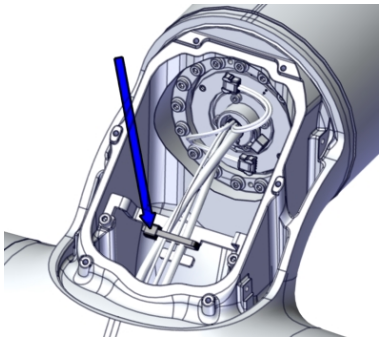
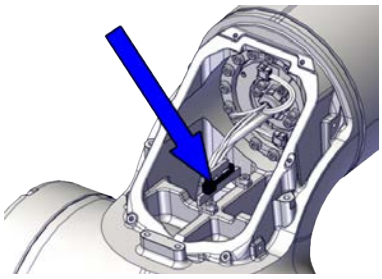
5.3.5 Replacing the axis-4 cabling

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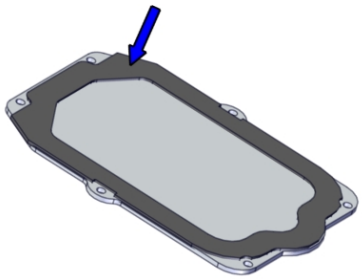
	Action	Note
6	Remove the guide pins and fasten the remaining two screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111  xx2000002079
7	Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.
8	Refit the cable bracket with the two screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm **Valid for CRB 15000-5/0.95**  xx2000002078 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27  xx2300000840

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	Action	Note
9	Secure the cabling with a cable tie.	Cable ties (1 pcs) **Valid for CRB 15000-5/0.95**  xx2000002077 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27  xx2300000839

Closing the housing top cover

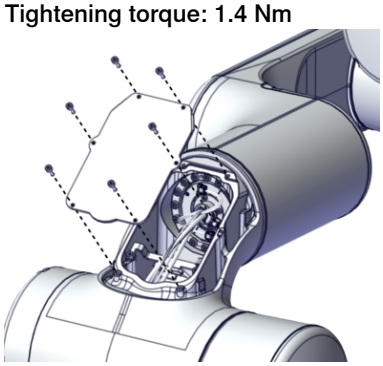
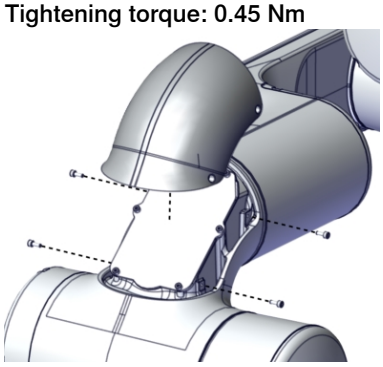
	Action	Note
1	Check the inner plate gasket. Replace if damaged.	Gasket: 3HAC075056-001  xx2000002095

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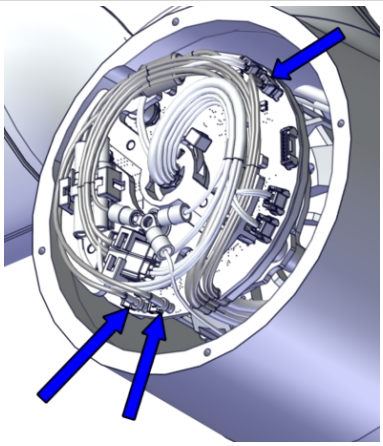
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5.3.5 Replacing the axis-4 cabling

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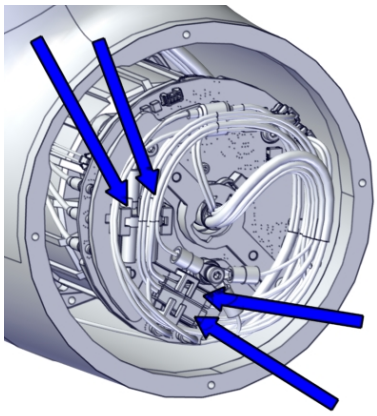
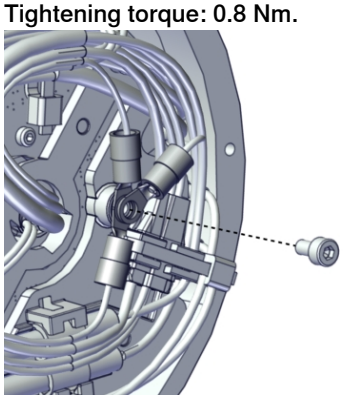
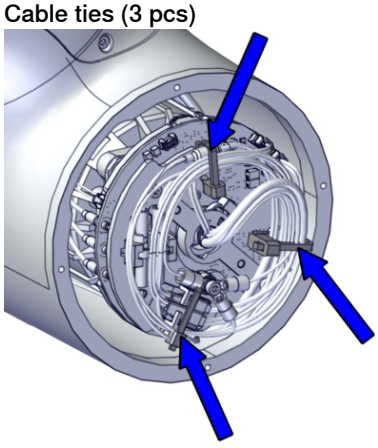
	Action	Note
2	Refit the inner plate with the screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 1.4 Nm  xx2000002076
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.45 Nm  xx2000002075

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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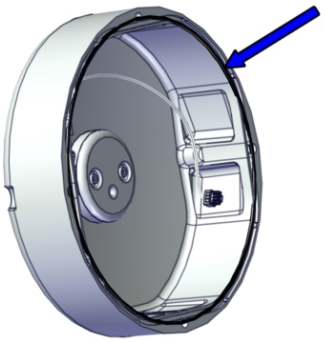
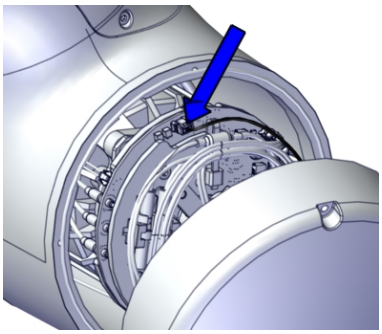
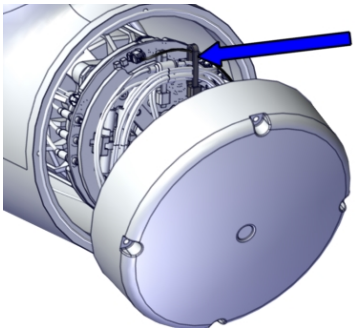
	Action	Note
2	Connect the connectors to each other and snap them to the cable holders. • J3.DC+ to J3.DC+ • J3.DC- to J3.DC- • J3.CS to J3.CS • J3.CP to J3.CP	 xx2000002067
3	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000001945
4	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002066

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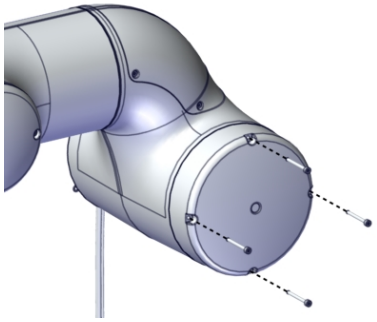
5.3.5 Replacing the axis-4 cabling
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Refitting the housing cover (-5/0.95)

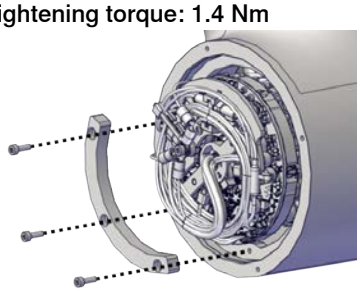
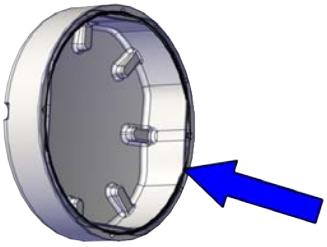
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2	**For robots with RobotWare earlier than 7.10** Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000002023
3	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000002022

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	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

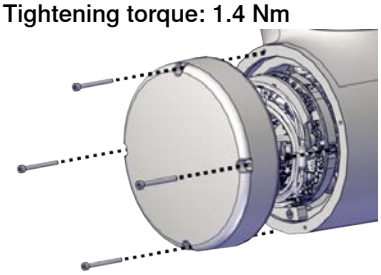
Refitting the housing cover and insert (-10/1.52 and -12/1.27)

	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000834
2	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2300000835

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5.3.5 Replacing the axis-4 cabling
Continued

	Action	Note
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000833

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

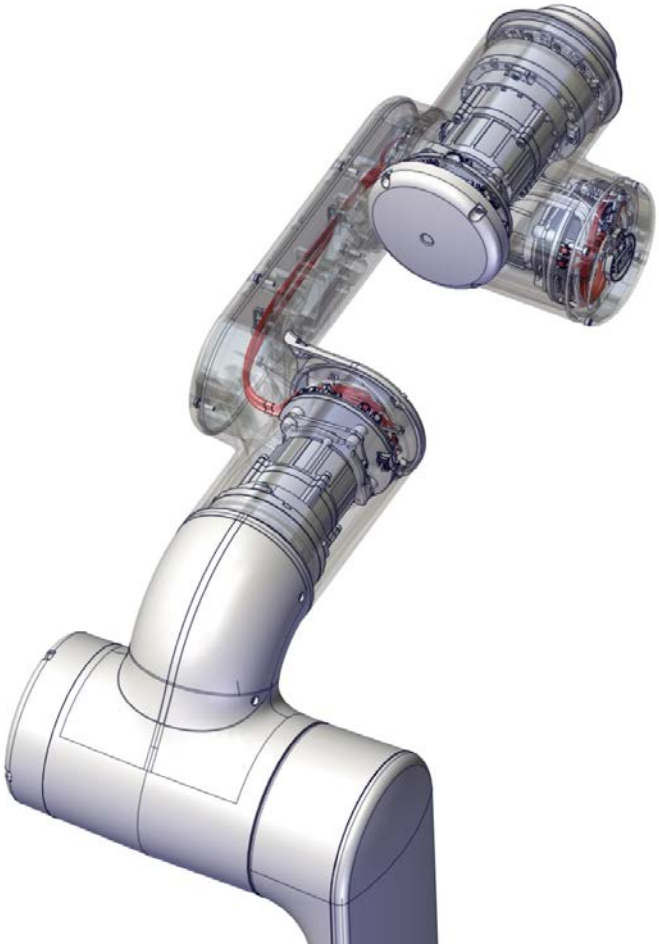
	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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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

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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	Used for CRB 15000-5/0.95. Also order new Cable tie: 3HAC075545-001.
Cable harness, joint 5 (CRB 15000-10/1.52)	3HAC083669-001	Used for CRB 15000-10/1.52. Also order new Cable tie: 3HAC075545-001.
Cable harness, joint 5 (CRB 15000-12/1.27)	3HAC083668-001	Used for CRB 15000-12/1.27. Also order new Cable tie: 3HAC075545-001.
Cable tie	3HAC075545-001	For securing joint unit cable.
Ferrite core	3HAC092224-001	

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 units of CRB 15000-5/0.95.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cable ties	-	
O-ring	3HAC061327-051	Axis-5 cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-051	Axis-5 cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.

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Consumable	Article number	Note
O-ring	3HAC061327-051	Axis-4 cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-051	Axis-4 cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-043	Tubular cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAB3772-166	Tubular cover, upper, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-076	Tubular cover, lower, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-051	Arm-side interface Replace if damaged.
Grease	3HAC042536-001	Shell Gadus S2
Flange socket head screw with glue	3HAB3413-312	M3x12 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue For tubular cover of CRB 15000-5/0.95. 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 (or equivalent)

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: • 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.	

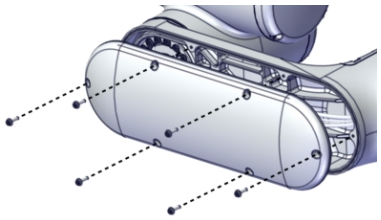
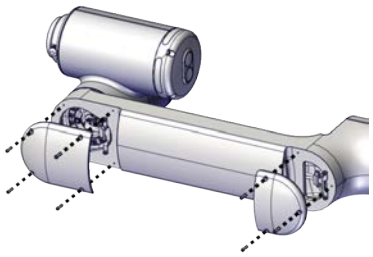
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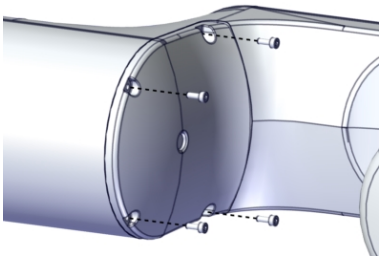
5.3.6 Replacing the axis-5 cabling

Continued

Removing the tubular cover

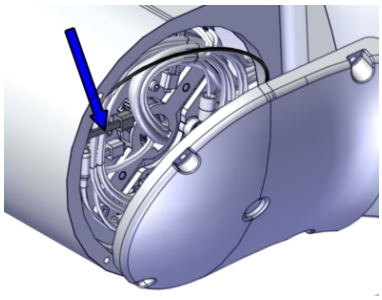
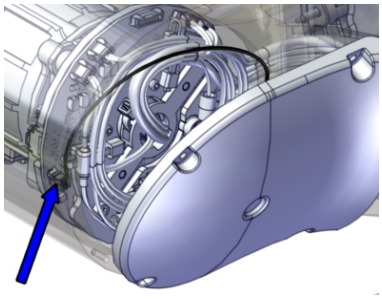
	Action	Note
1	**Valid for CRB 15000-5/0.95** Remove the cover by removing the six screws. Dispose the screws. New screws must be used when refitting the cover. New screws are included in the spare part delivery of the joint unit.	 xx2000002123
2	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the covers by removing the screws.	 xx2300000841

Removing the axis-4 cover

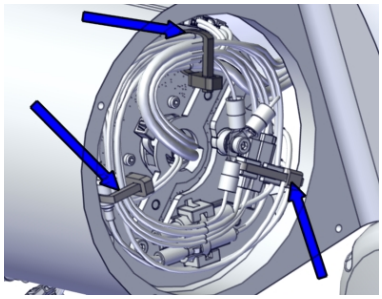
	Action	Note
1	Remove the cover screws.	 xx2000002083
2	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	

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	Action	Note
3	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002084
4	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	Tweezers  xx2000002085

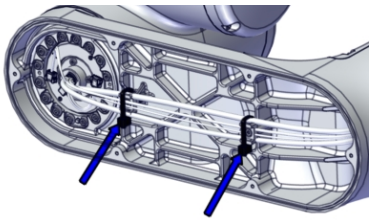
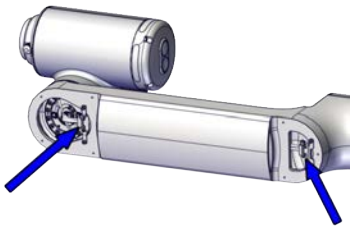
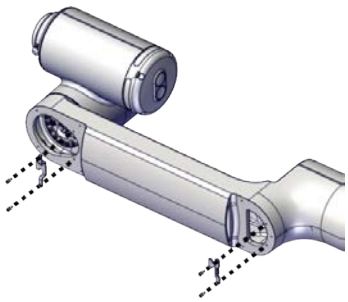
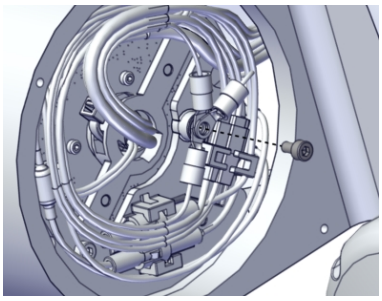
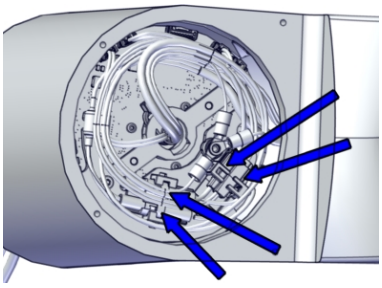
Separating the cabling between the tubular and the tilt

	Action	Note
1	Cut the cable ties on joint unit.	 xx2000002086

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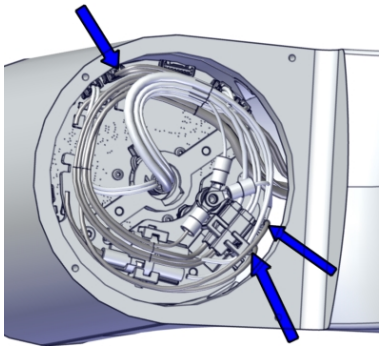
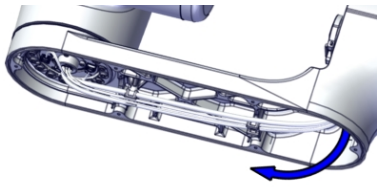
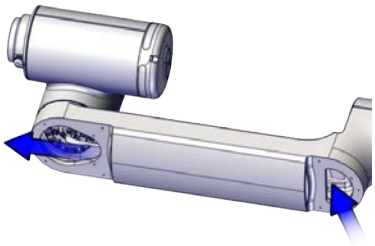
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5.3.6 Replacing the axis-5 cabling
Continued

	Action	Note
2	Cut the cable ties on tubular, if needed.	**Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842
3	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the cable brackets.	 xx2300000843
4	Remove the functional and protective earth cables by removing the screw.	 xx2000002087
5	Snap loose and disconnect the connectors: • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP	 xx2000002089

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	Action	Note
6	Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board: • D3/4.X2 • D3/4.DC- • D3/4.DC+ Use tweezers, if needed.	Tweezers  xx2000002125
7	Pull out the cabling carefully from the tubular.	**Valid for CRB 15000-5/0.95**  xx2000002126 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000844

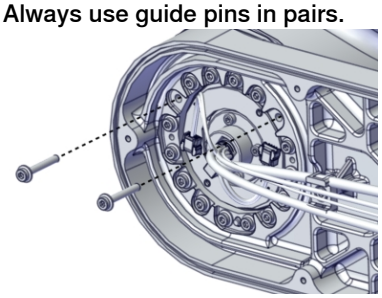
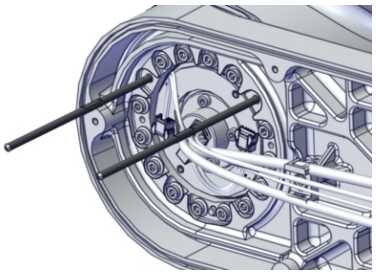
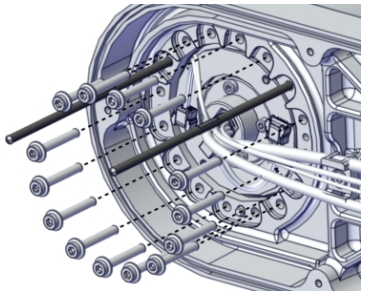
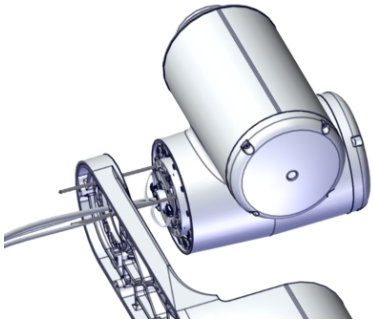
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5.3.6 Replacing the axis-5 cabling

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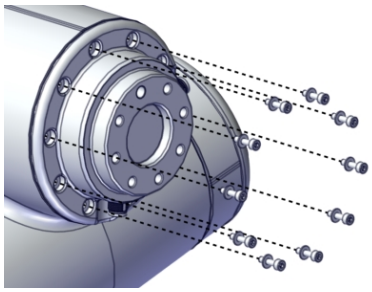
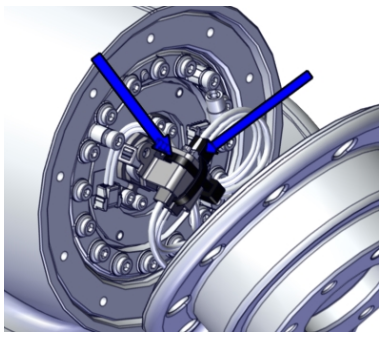
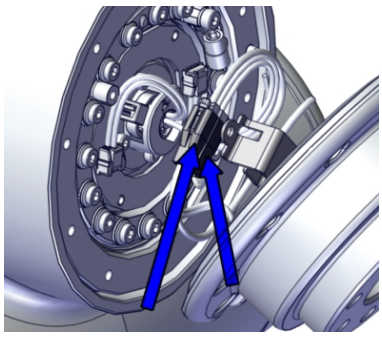
Removing the tilt

	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.	
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

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Removing the tool flange

	Action	Note
1	Remove the tool flange screws and washers.	 xx2000002155
2	**CAUTION** **Valid for CRB 15000-5/0.95** 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	Cut the cable ties.	 xx2000002157
4	Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

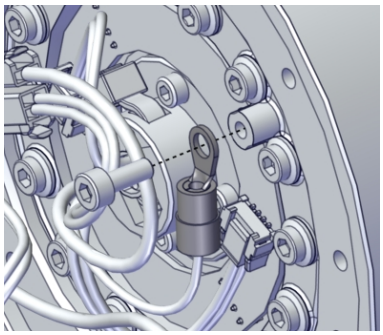
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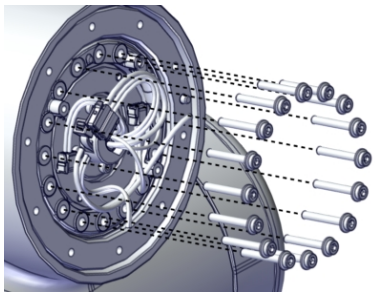
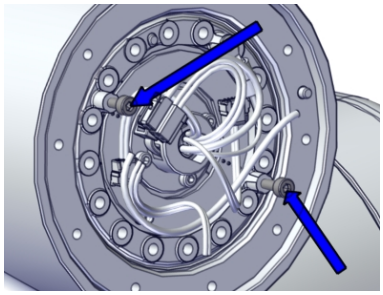
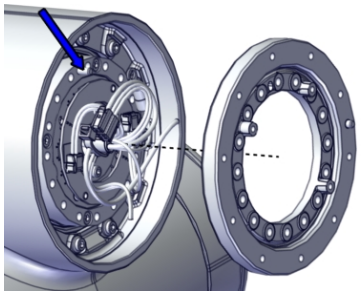
5.3.6 Replacing the axis-5 cabling

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Disconnecting the tool flange functional earth cable

	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000002159

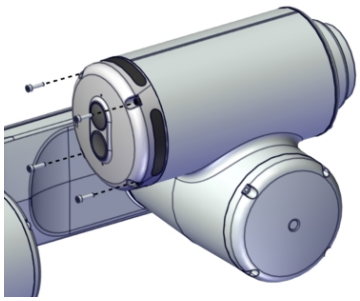
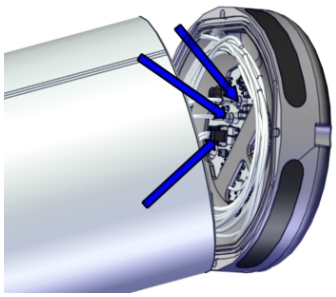
Removing the tool flange adapter

	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
3	Remove the tool flange adapter.	 xx2000002167

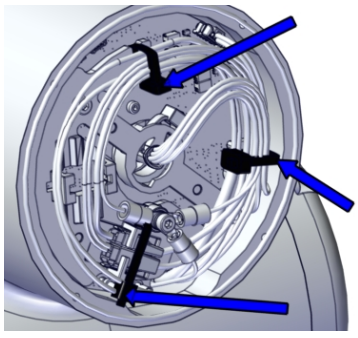
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Removing the arm-side interface

	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. • ASI.DC+ • ASI.DC- • ASI.X1	 xx2100000335

Disconnecting the axis-6 joint unit cabling

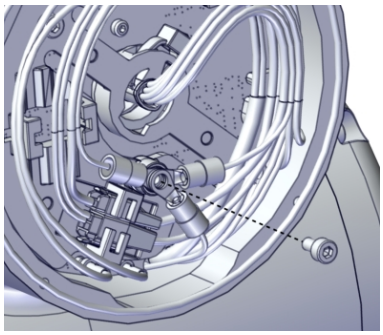
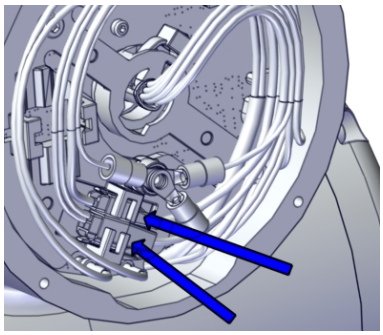
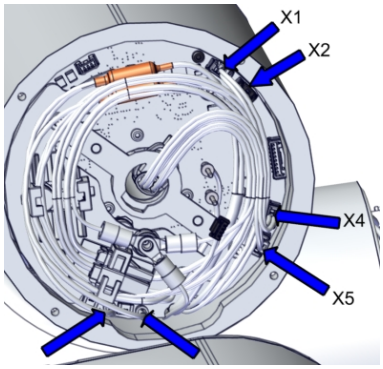
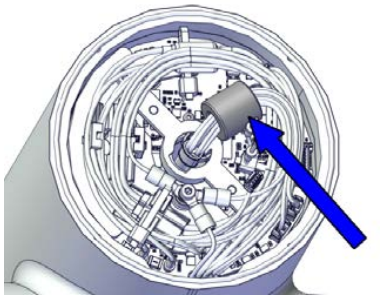
	Action	Note
1	Cut the cable ties.	 xx2000002161

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5.3.6 Replacing the axis-5 cabling

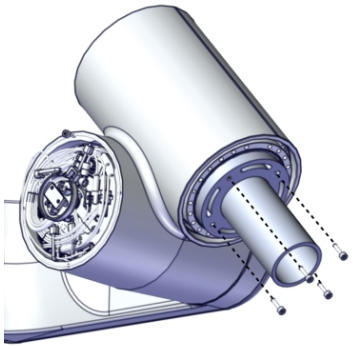
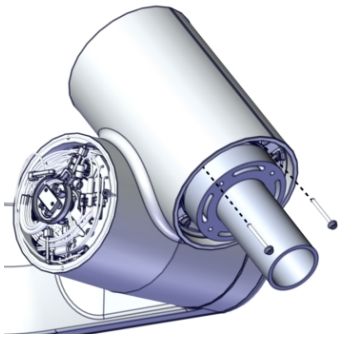
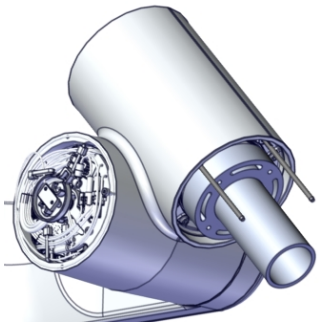
Continued

	Action	Note
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002162
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 **CAUTION** Use tweezers to unlock connectors and pull them off.	Tweezers  xx2000002164
5	Remove the ferrite core by pulling the cables D6.X4 and D6.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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Removing the axis-6 joint unit

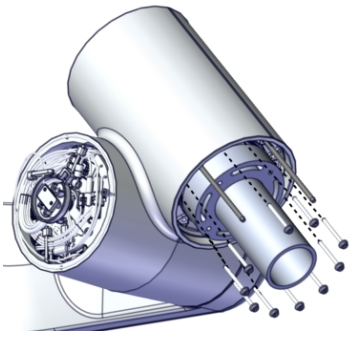
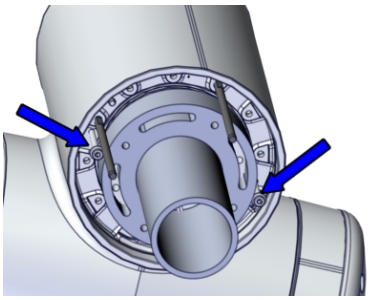
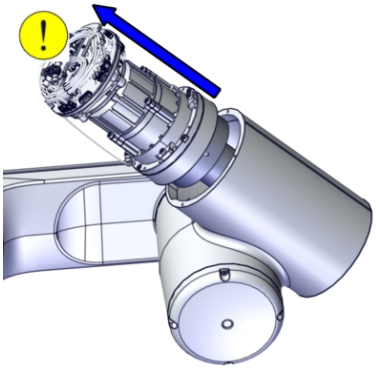
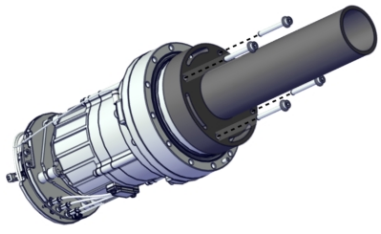
	Action	Note
1	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002168 Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.
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

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5.3.6 Replacing the axis-5 cabling

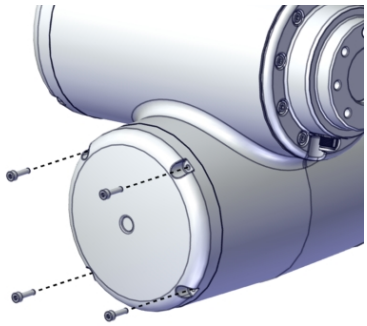
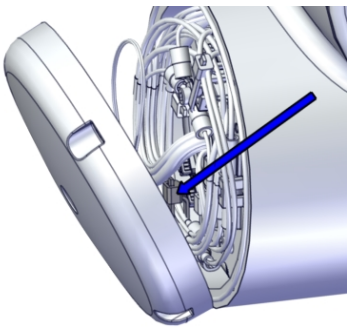
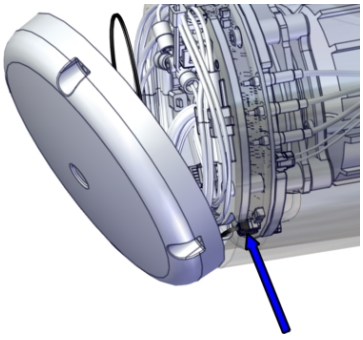
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	Action	Note
4	Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000329
5	Press the joint unit out 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

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Removing the axis-5 cover

	Action	Note
1	Remove the cover by removing the four screws.	 xx2000002132
2	**CAUTION** **Valid for CRB 15000-5/0.95** 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	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002133
4	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002134

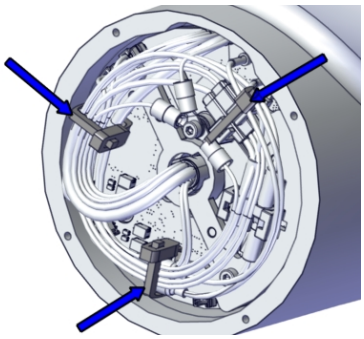
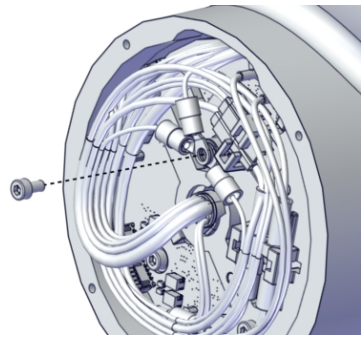
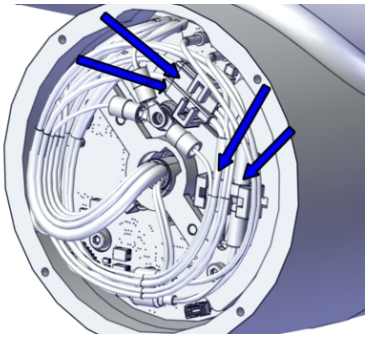
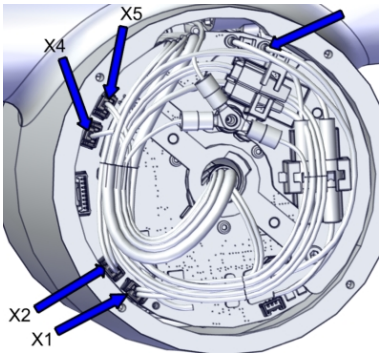
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5.3.6 Replacing the axis-5 cabling

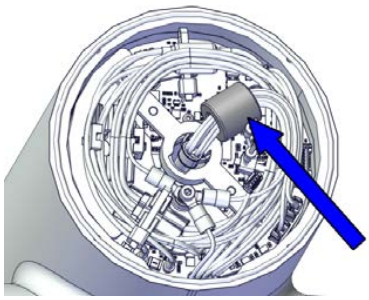
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Disconnecting the axis-5 joint unit cabling

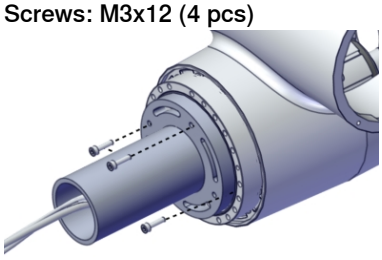
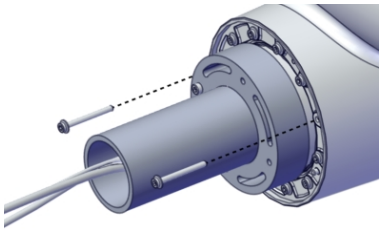
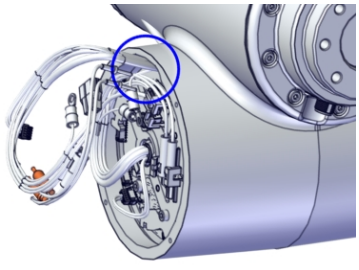
	Action	Note
1	Cut the cable ties.	 xx2000002135
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002136
3	Snap loose and disconnect the connectors: • J5/6.DC+ • J5/6.DC- • J5/6.CS • J5/6.CP	 xx2000002137
4	Disconnect the connectors from the drive board. • D4/5.X1 • D5.DC+ • D5.DC- • D4/5.X4 • D5.X2 • D4/5.X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	Tweezers  xx2000002138

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	Action	Note
5	Remove the ferrite core by pulling the cables D4/5.X4 and D4/5.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-5 joint unit

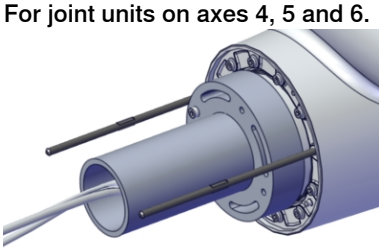
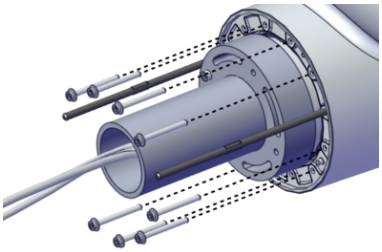
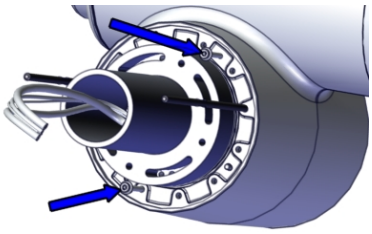
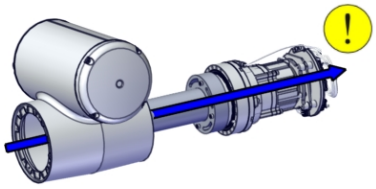
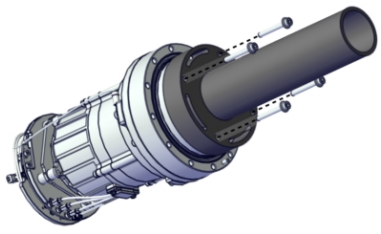
	Action	Note
1	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002139
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2000002140
3	Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 xx2100000284

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5.3.6 Replacing the axis-5 cabling

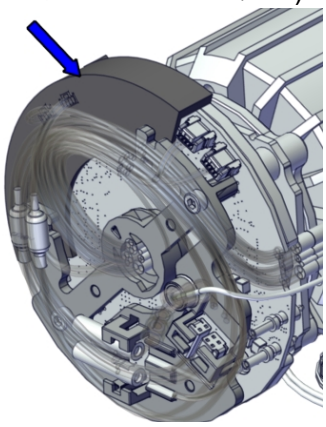
Continued

	Action	Note
4	Fit two guide pins to the axis-5 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2100000332
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.	 xx2100000333
6	Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2100000334
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

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Removing the joint cable

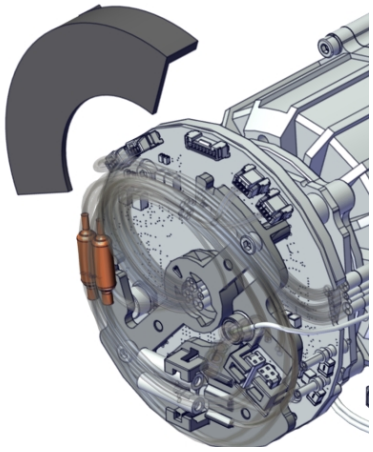
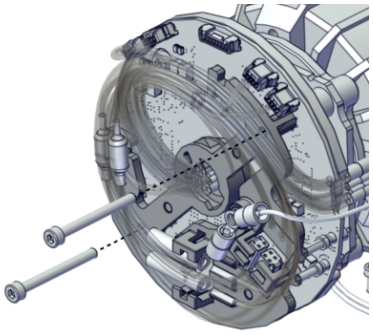
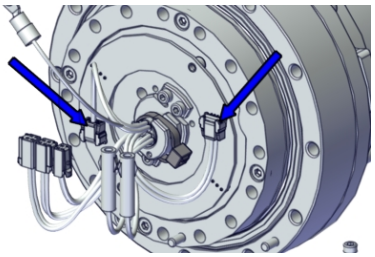
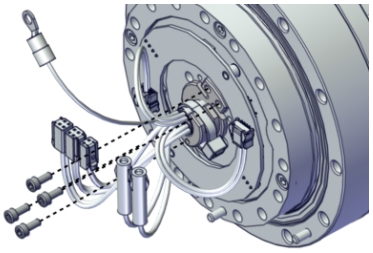
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Fit the protection plate to the drive board unit. **Tip** Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
3	Cut the cable tie at the drive board.	 xx2000002058

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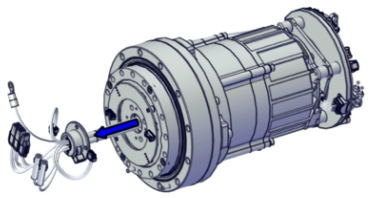
5.3.6 Replacing the axis-5 cabling

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. • TQ.A • TQ.B	 xx2000002053
7	Remove the cable plate by removing the attachment screws.	 xx2000002049

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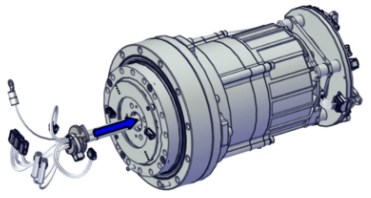
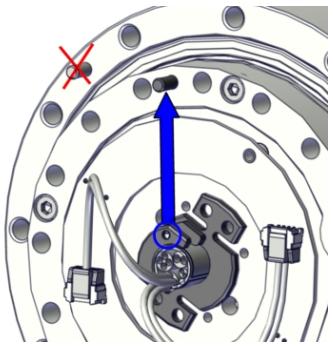
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	Action	Note
8	Remove the joint cable from the hollow shaft from the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002060

Refitting the joint cabling

Use these procedures to refit the joint-5 cabling.

Refitting the joint cable

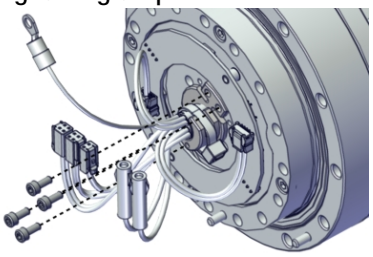
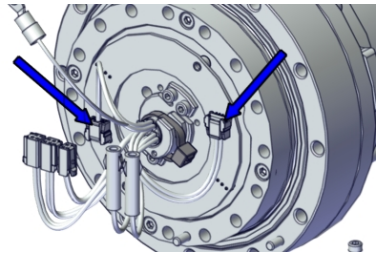
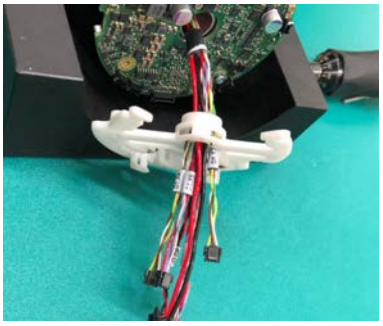
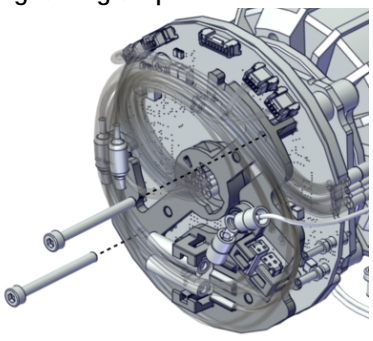
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Place the joint cable through the hollow shaft from the torque sensor side. **CAUTION** The connectors and the joint 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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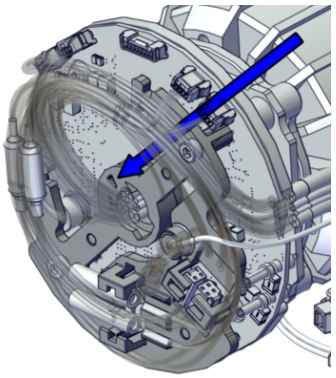
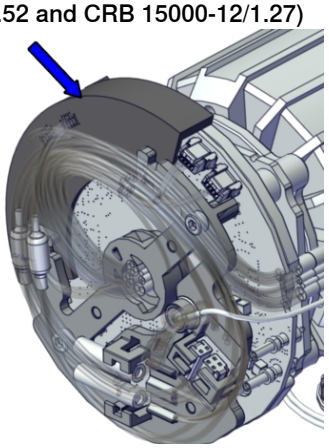
5.3.6 Replacing the axis-5 cabling

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. • 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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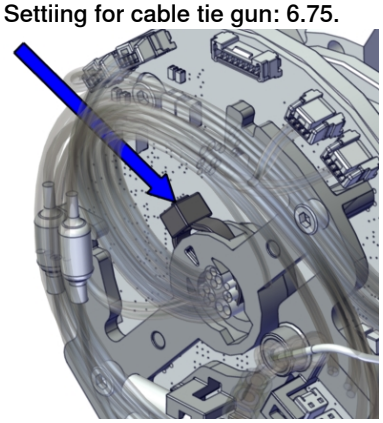
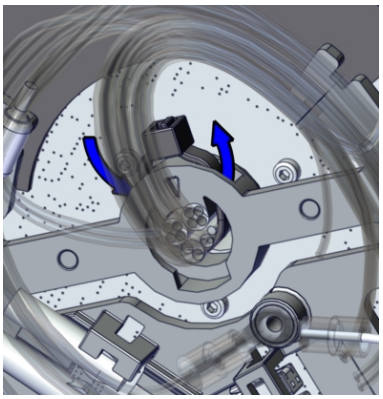
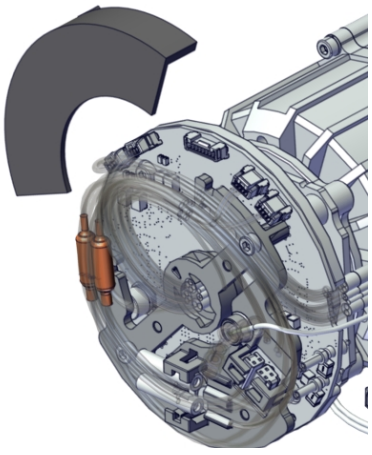
	Action	Note
7	Keep the cabling loose, making sure not to twist or strain it. Use the cable tie to pre-fix the cable by hand.	 xx2100000507
8	Fit the protection plate to the drive board unit.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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5.3.6 Replacing the axis-5 cabling

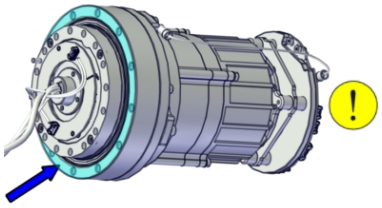
Continued

	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 EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059
10	Remove the protection plate.	 xx2100000301

Continues on next page

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Preparations before fitting the joint unit (-5/0.95)

	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 53*.	
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 (or equivalent)  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 53*.	

Refitting the axis-5 joint unit and transition cabling

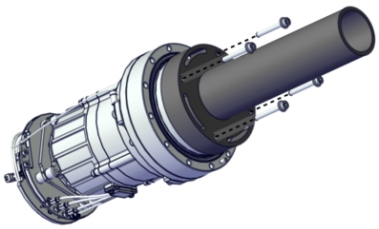
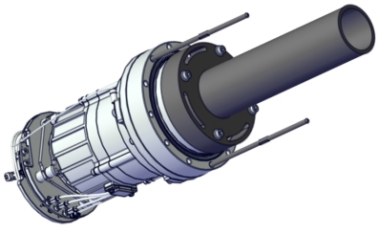
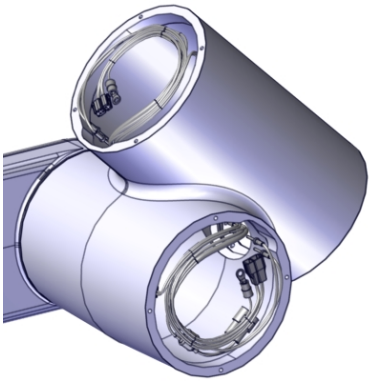
	Action	Note
1	**CAUTION** Axis-5 joint unit used for CRB 15000-5/0.95 has the same appearance as that used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Do not mix the joint units for different manipulator variants. Always check the mark or label on the joint units before refitting.	

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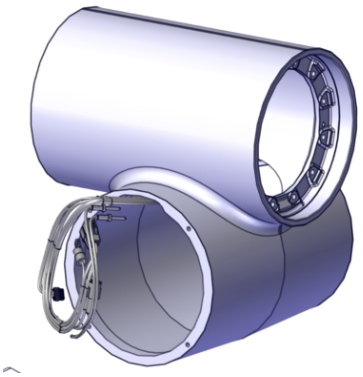
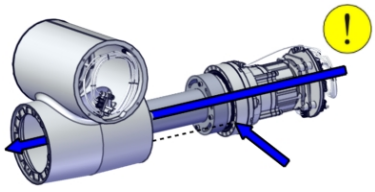
5.3.6 Replacing the axis-5 cabling

Continued

	Action	Note
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: 3HAC079143-001 (for CRB 15000-5/0.95) / 3HAC087546-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
3	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
4	Fit the transition cable between axis-5 and axis-6 joint units into the tilt.	Cable harness, transition joint-5 and joint-6: 3HAC083726-001  xx2100000040

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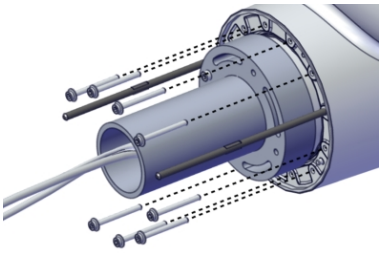
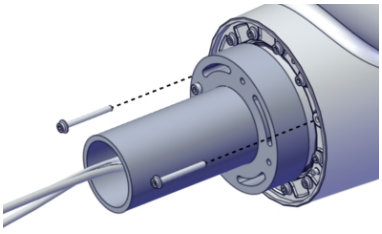
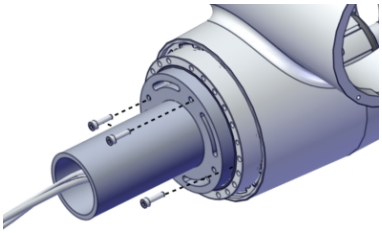
	Action	Note
5	Place the cabling at the slot before refitting the joint unit.	 xx2100000041  xx2100000285
6	Fit the joint unit to the tilt, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002142

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5.3.6 Replacing the axis-5 cabling

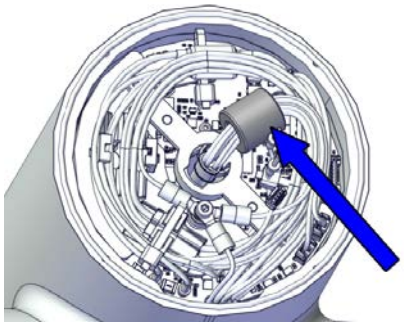
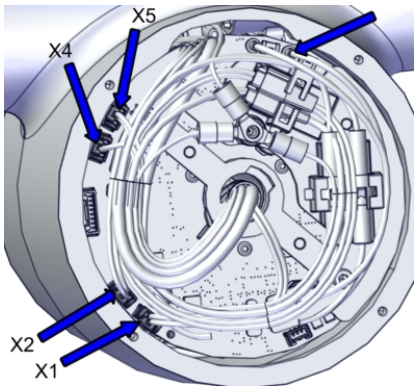
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	Action	Note
7	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000333
8	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002140
9	Pre-tighten the screws crosswise.	
10	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm (for CRB 15000-5/0.95) / 1.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)
11	Remove the lifting aid by removing the screws.	 xx2000002139
12	Clean pushed-out flange sealant, if any.	

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Connecting the axis-5 joint unit cabling

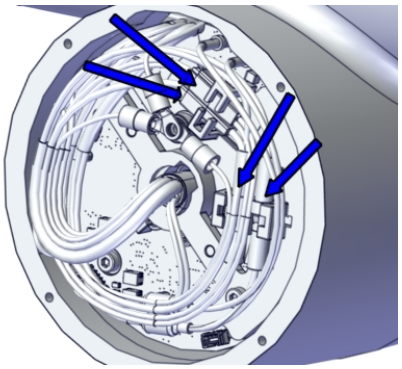
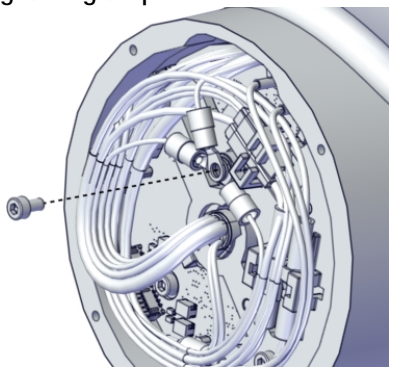
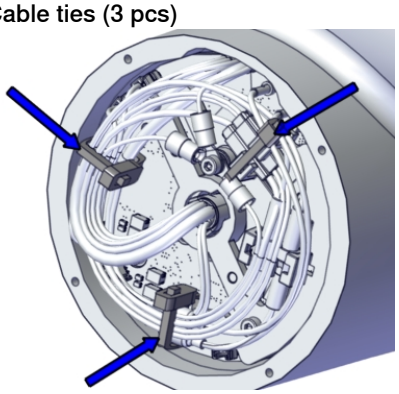
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D4/5.X4 and D4/5.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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

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5.3.6 Replacing the axis-5 cabling

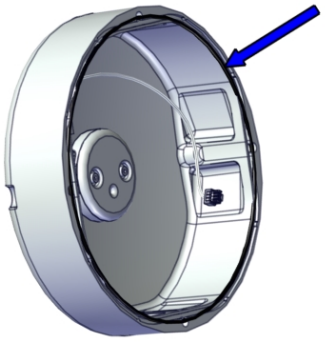
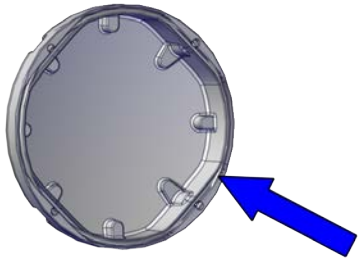
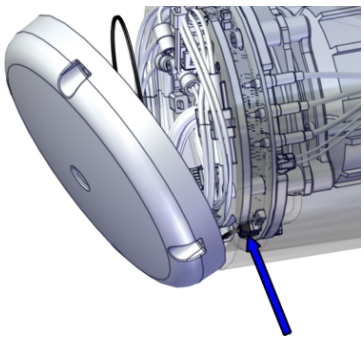
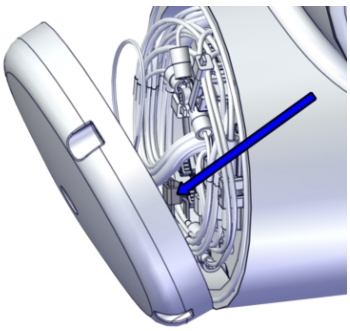
Continued

	Action	Note
5	Connect the connectors to each other and snap them to the cable holders. • 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
6	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
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002135

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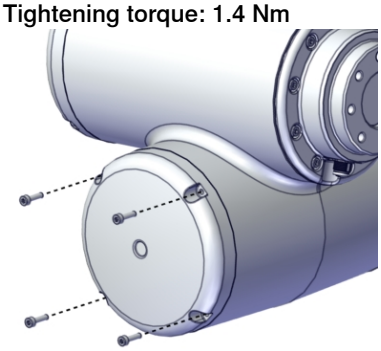
Refitting the axis-5 cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	**Valid for CRB 15000-5/0.95** O-ring: 3HAC061327-051  xx2000001962 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 O-ring: 3HAC061327-051  xx2300000849
2	**For robots with RobotWare earlier than 7.10** Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	 xx2000002134
3	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000002133

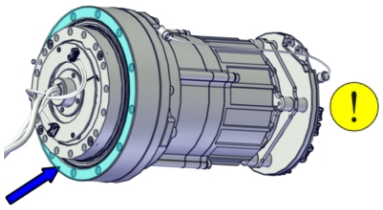
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5.3.6 Replacing the axis-5 cabling
Continued

	Action	Note
4	Refit the cover with the four screws.	**Valid for CRB 15000-5/0.95** Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.2 Nm **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2000002132

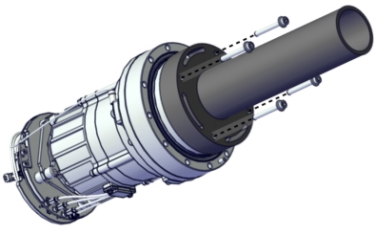
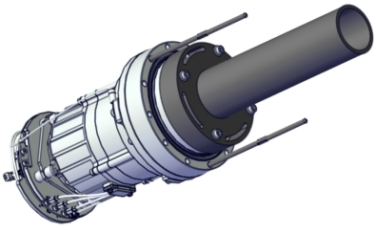
Preparations before fitting the joint unit (-5/0.95)

	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 53*.	
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 (or equivalent)  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 53*.	

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Refitting the axis-6 joint unit

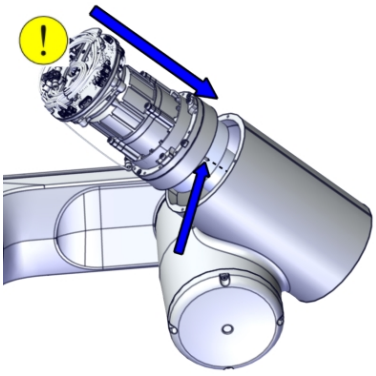
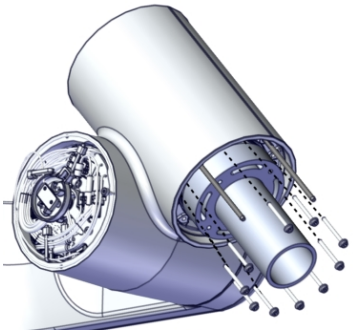
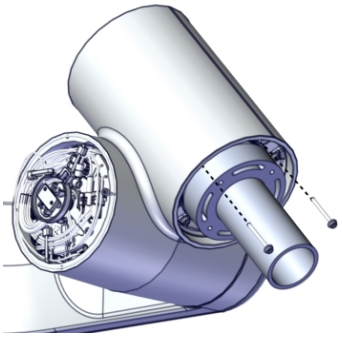
	Action	Note
1	**CAUTION** Axis-6 joint unit used for CRB 15000-5/0.95 has the same appearance as that used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Do not mix the joint units for different manipulator variants. Always check the mark or label on the joint units before refitting.	
2	Fit the lifting 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: 3HAC079143-001 (for CRB 15000-5/0.95) / 3HAC087546-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
3	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
4	Place the cabling at the slot before refitting the joint unit.	 xx2100000041

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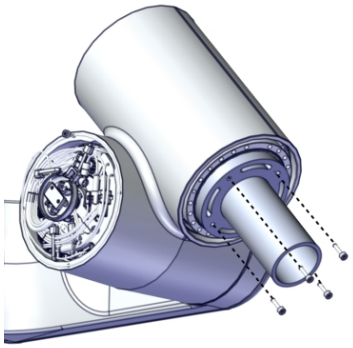
5.3.6 Replacing the axis-5 cabling

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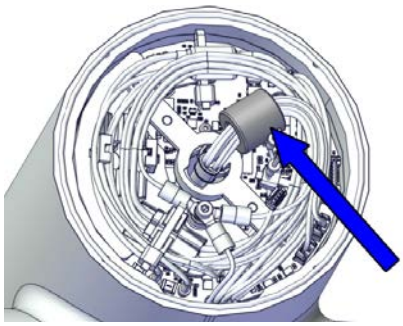
	Action	Note
5	Fit the joint unit to the tilt, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002195
6	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000329
7	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002170
8	Pre-tighten the screws crosswise.	
9	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm (for CRB 15000-5/0.95) / 1.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)

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	Action	Note
10	Remove the lifting aid by removing the screws.	 xx2000002168
11	Clean pushed-out flange sealant, if any.	

Connecting the axis-6 joint unit cabling

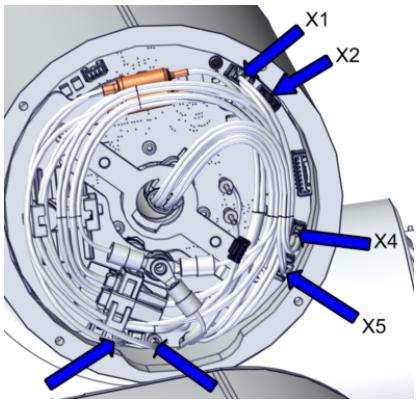
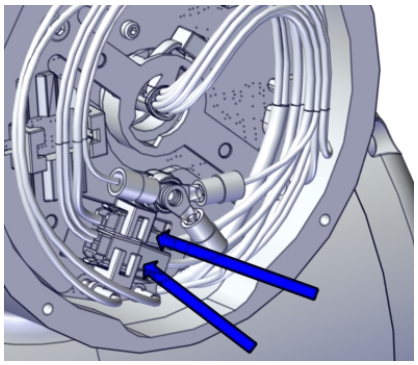
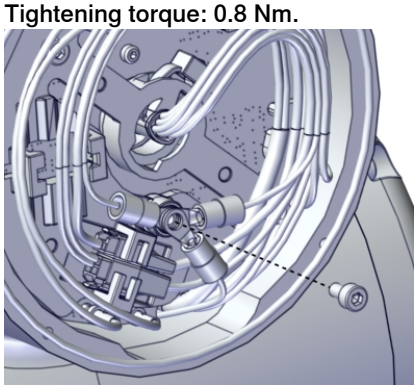
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D6.X4 and D6.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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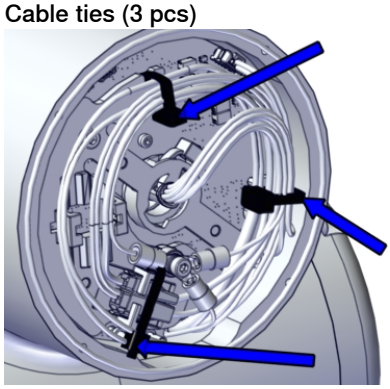
5.3.6 Replacing the axis-5 cabling

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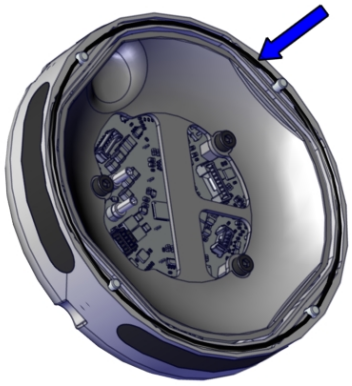
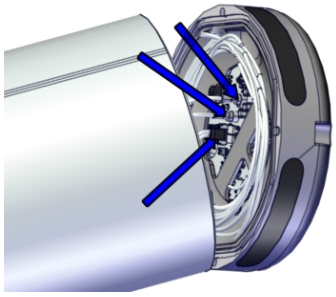
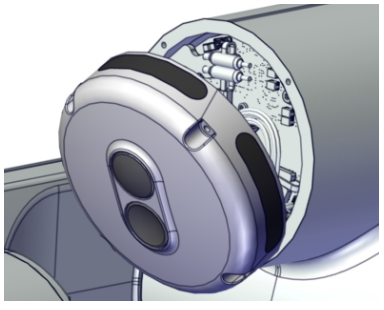
	Action	Note
4	Reconnect the connectors to the drive board. • D6.X1 to X1 • D6.DC+ to +DC • D6.DC- to Ground • D6.X4 to X4 • D6.X2 to X2 • D6.X5 to X5	 xx2000002164
5	Connect the connectors to each other and snap them to the cable holders. • J7.CS to J7.CS • J7.CP to J7.CP	 xx2000002163
6	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002162

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	Action	Note
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002161

Refitting the arm-side interface

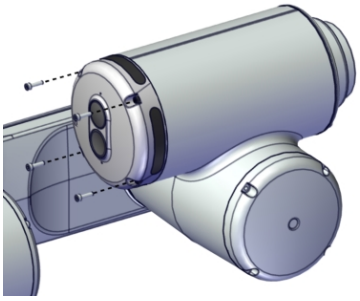
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002551
2	Place the arm-side interface at mounting position and reconnect the connectors. • ASI.DC+ • ASI.DC- • ASI.X1 The correct orientation of the arm-side interface is with the convex button in upper position. **Note** Do not leave the arm-side interface in location without being secured with the attachment screws.	 xx2100000335  xx2100000336

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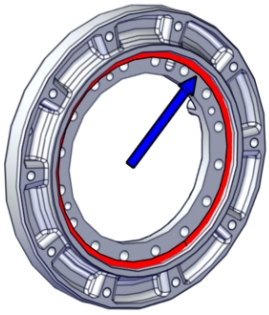
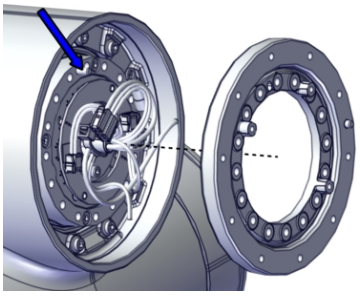
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5.3.6 Replacing the axis-5 cabling

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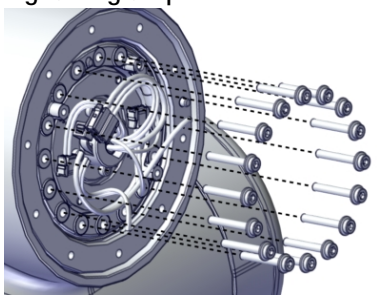
	Action	Note
3	Refit the arm-side interface with four screws.	**Valid for CRB 15000-5/0.95** Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002550

Refitting the tool flange adapter

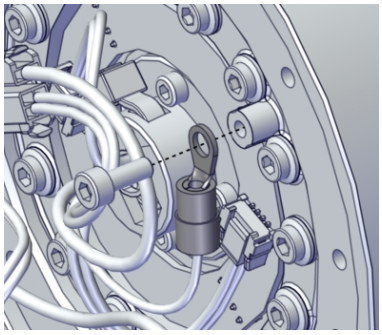
	Action	Note
1	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the adapter mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000002196
2	Refit the tool flange adapter, aligning the pin with the pin hole.	Tool flange adapter: 3HAC073952-001  xx2000002167

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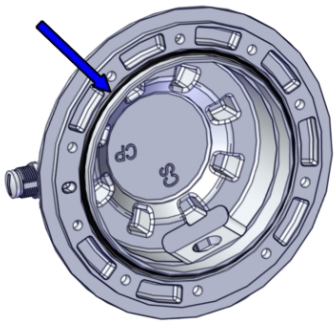
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	Action	Note
3	Secure with screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) Tightening torque: 1.8 Nm.  xx2000002165

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

Refitting the tool flange

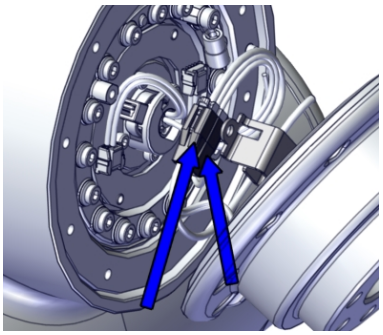
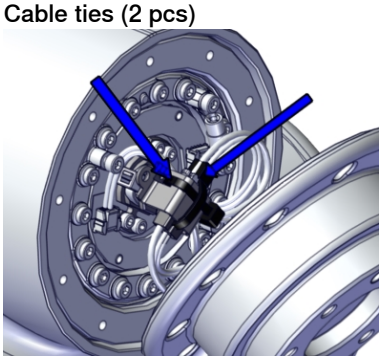
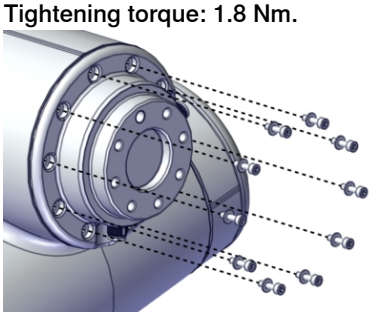
	Action	Note
1	Check the o-ring on the tool flange and lubricate with grease. Replace if damaged.	Axis-6 flange: 3HAC073953-001 O-ring: 3HAB3772-182 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002197

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5.3.6 Replacing the axis-5 cabling

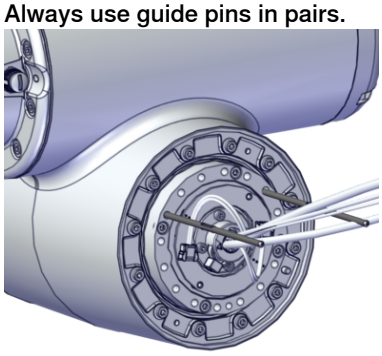
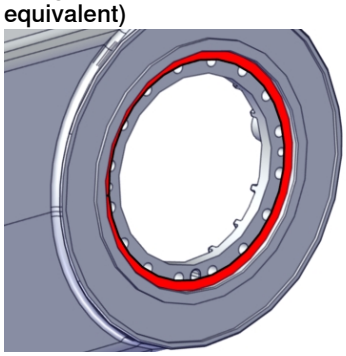
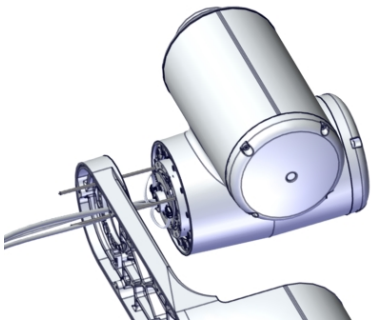
Continued

	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 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

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Refitting the tilt

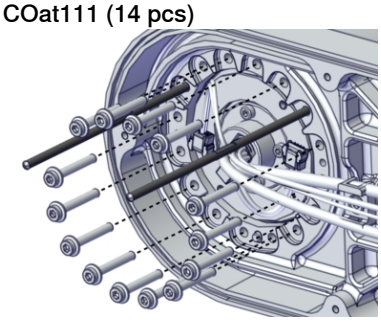
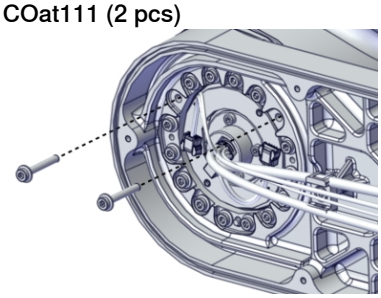
	Action	Note
1	Fit two guide pins to the axis-5 joint.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002146
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the tubular mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000002147
3	Lift the tilt into mounting position while inserting the cabling into the tubular.	 xx2000002131
4	Slide the tilt into place on the guide pins.	

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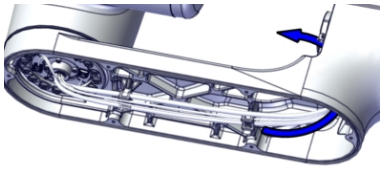
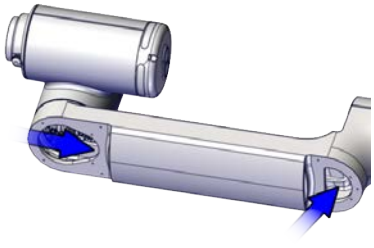
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5.3.6 Replacing the axis-5 cabling

Continued

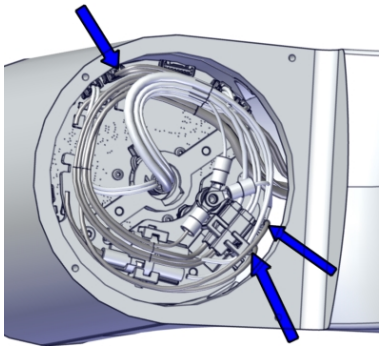
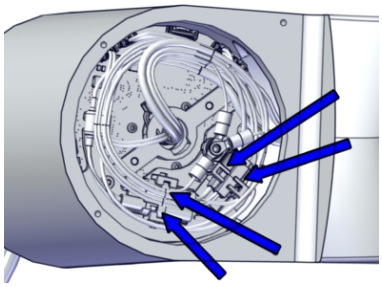
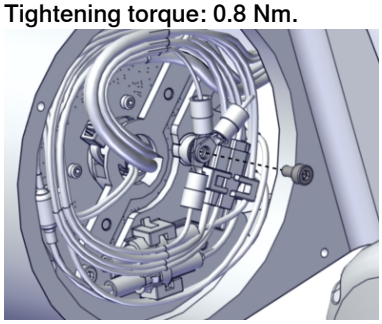
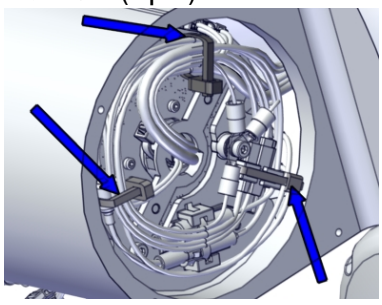
	Action	Note
5	Secure the tilt to the tubular with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (14 pcs)  xx2000002130
6	Remove the guide pins and fasten the remaining two screws.	Flange socket head screw: M3x20 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.	**Valid for CRB 15000-5/0.95**  xx2000002148 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000845

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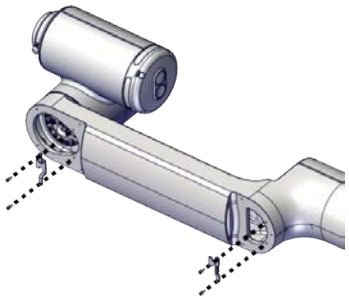
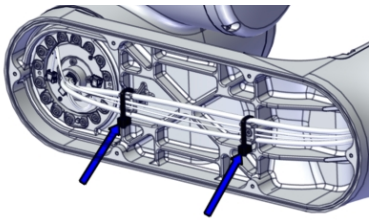
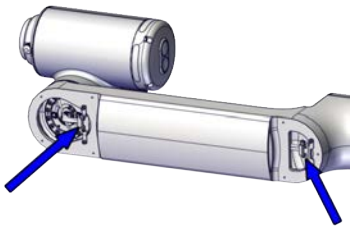
	Action	Note
2	Reconnect the connectors to the drive board. • D3/4.X2 to X2 • D3/4.DC- to Ground • D3/4.DC+ to +DC	 xx2000002125
3	Connect the connectors to each other and snap them to the cable holders. • J4/5.DC+ to J5/6.DC+ • J4/5.DC- to J5/6.DC- • J4/5.CS to J5/6.CS • J4/5.CP to J5/6.CP	 xx2000002089
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 to joint unit with cable ties.	Cable ties (3 pcs)  xx2000002086

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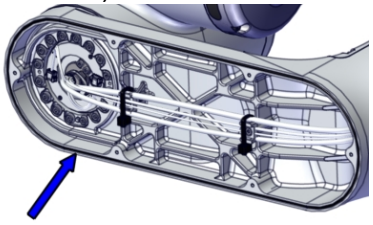
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5.3.6 Replacing the axis-5 cabling

Continued

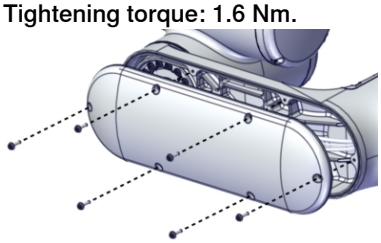
	Action	Note
6	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Refit the cable brackets.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs for each). Tightening torque: 0.8 Nm.  xx2300000843
7	Secure the cabling to tubular with cable ties.	Cable ties (2 pcs) **Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842

Refitting the tubular cover (-5/0.95)

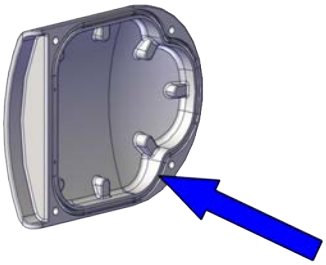
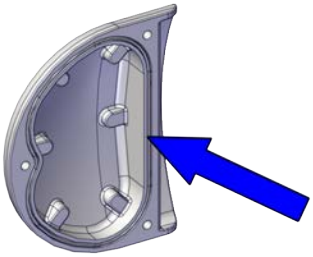
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-043 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002149

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	Action	Note
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 of CRB 15000-5/0.95. 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

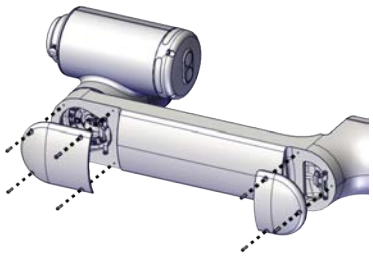
Refitting the tubular cover (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damged.	O-ring: 3HAC061327-076 O-ring: 3HAB3772-166 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2300000846  xx2300000847

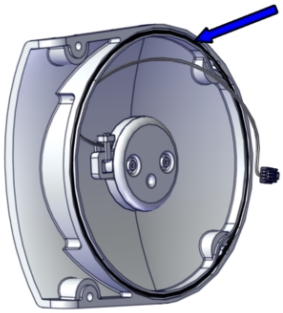
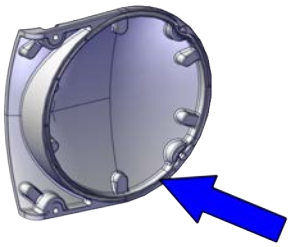
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5.3.6 Replacing the axis-5 cabling
Continued

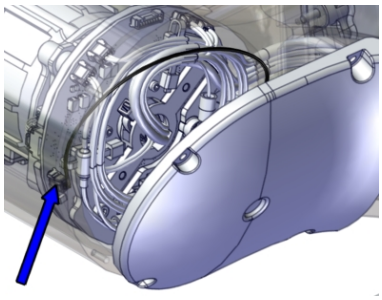
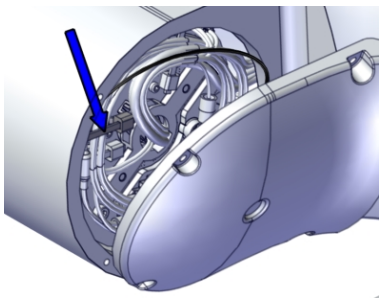
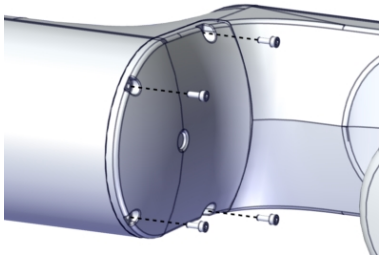
	Action	Note
2	Refit the covers with new attachment screws.	Hex socket head cap screw:M3x12 12.9 Lafre 2C2B/FC6.9 (7 pcs in total) Tightening torque: 1.4 Nm.  xx2300000841

Refitting the axis-4 cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	**Valid for CRB 15000-5/0.95** O-ring: 3HAC061327-051  xx2000002092 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 O-ring: 3HAC061327-051  xx2300000848

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	Action	Note
2	**For robots with RobotWare earlier than 7.10** Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	Tweezers  xx2000002085
3	**For robots with RobotWare earlier than 7.10** 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 (for CRB 15000-5/0.95) / 0.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Tightening torque: 0.9 Nm  xx2000002083

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5.3.6 Replacing the axis-5 cabling
Continued

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

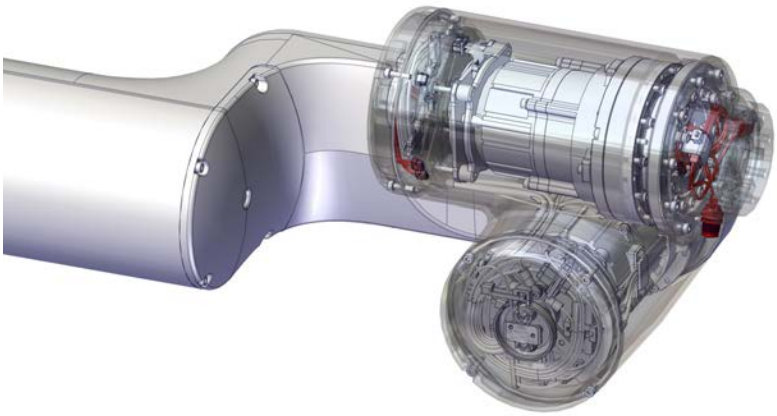
	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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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.

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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 units of CRB 15000-5/0.95.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

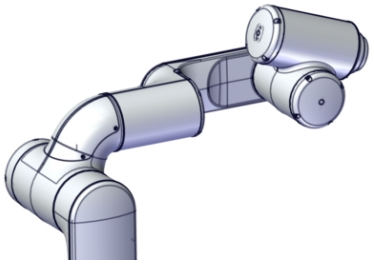
Required consumables

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 (or equivalent)

Removing the joint cabling

Use these procedures to remove the joint-6 cabling.

Preparations before removing the cabling

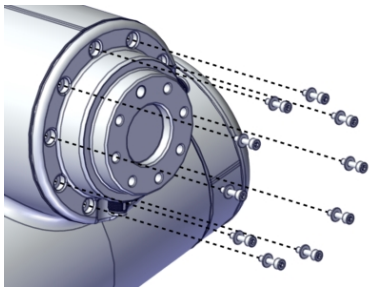
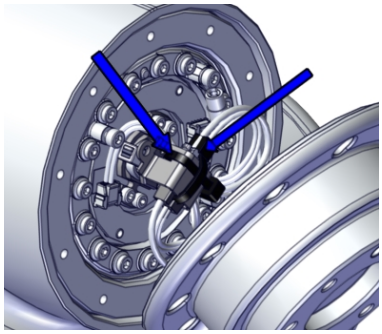
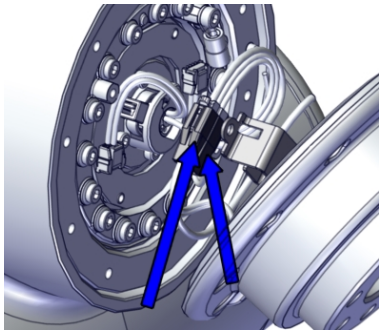
	Action	Note
1	Jog the robot to the specified position: • Axis 1: No significance. • Axis 2: No significance. • Axis 3: No significance. • Axis 4: No significance. • Axis 5: approximately +20° • Axis 6: 0° (home position) **CAUTION** Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000043

Continues on next page

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	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** **Valid for CRB 15000-5/0.95** 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	Cut the cable ties.	 xx2000002157
4	Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

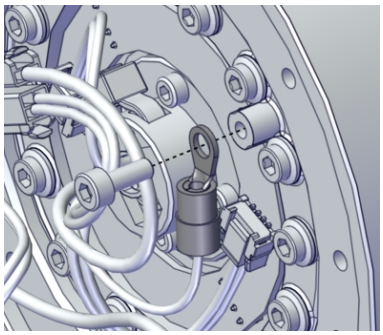
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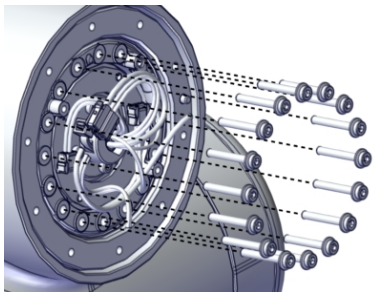
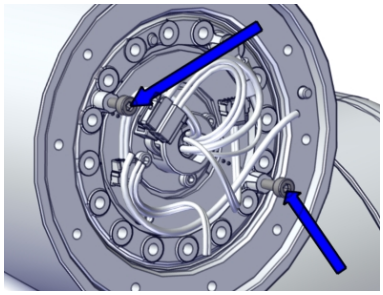
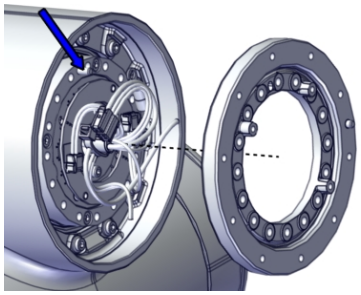
5.3.7 Replacing the axis-6 cabling

Continued

Disconnecting the tool flange functional earth cable

	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000002159

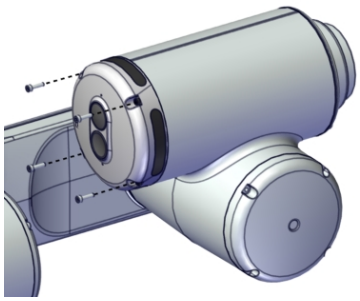
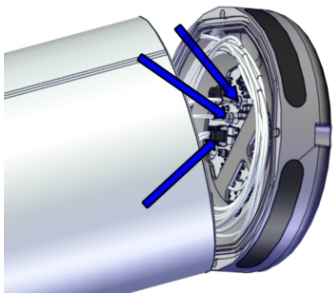
Removing the tool flange adapter

	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
3	Remove the tool flange adapter.	 xx2000002167

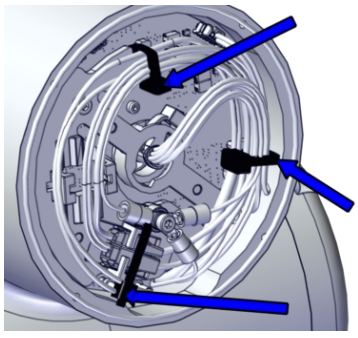
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Removing the arm-side interface

	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. • ASI.DC+ • ASI.DC- • ASI.X1	 xx2100000335

Disconnecting the axis-6 joint unit cabling

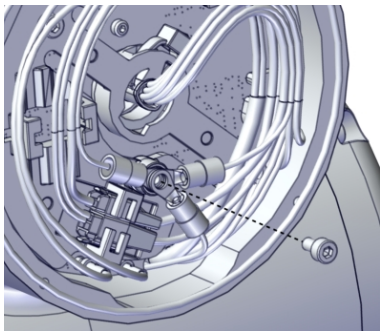
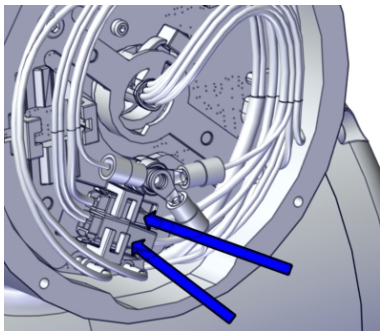
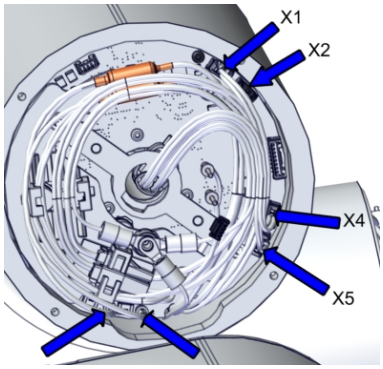
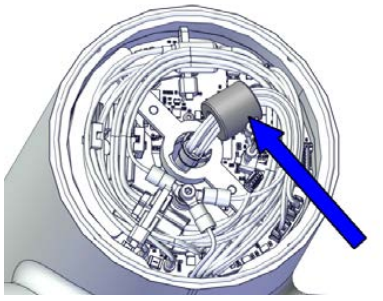
	Action	Note
1	Cut the cable ties.	 xx2000002161

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5.3.7 Replacing the axis-6 cabling

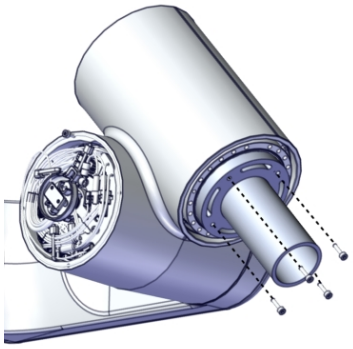
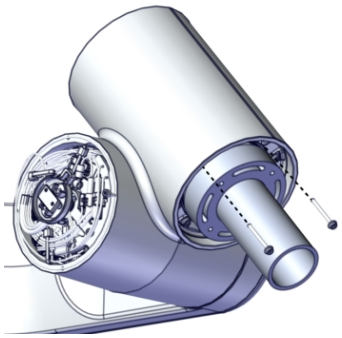
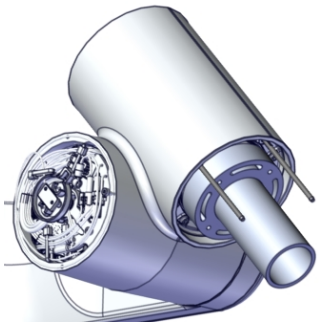
Continued

	Action	Note
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002162
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 **CAUTION** Use tweezers to unlock connectors and pull them off.	Tweezers  xx2000002164
5	Remove the ferrite core by pulling the cables D6.X4 and D6.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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Removing the axis-6 joint unit

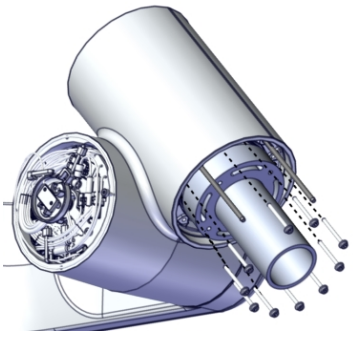
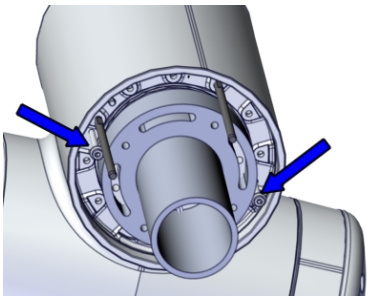
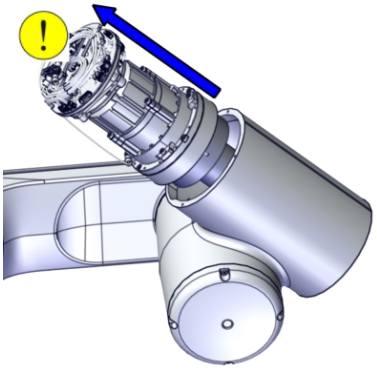
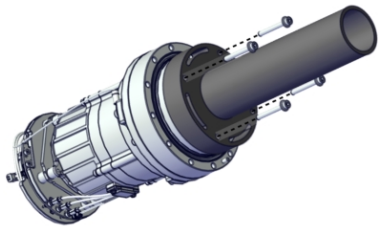
	Action	Note
1	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002168 Position shown in the figure shows axis 5 jogged to +20°, which is a more convenient position when replacing only the axis-6 joint unit.
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

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5.3.7 Replacing the axis-6 cabling

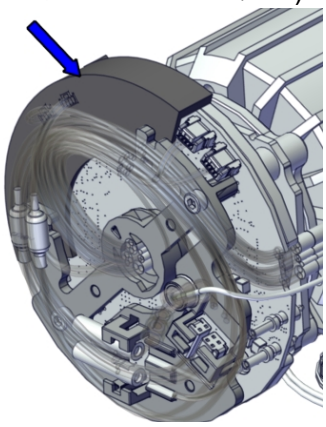
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	Action	Note
4	Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000329
5	Press the joint unit out 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

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Removing the joint cable

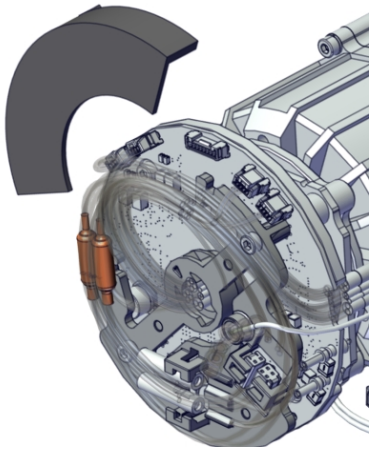
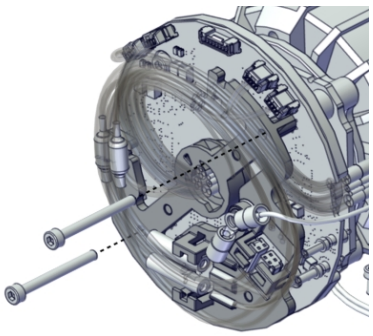
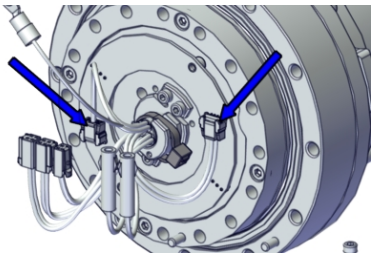
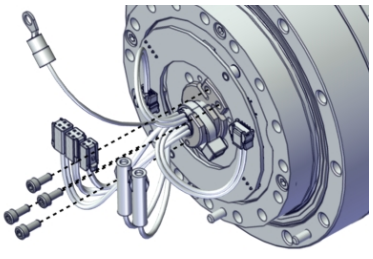
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Fit the protection plate to the drive board unit. **Tip** Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
3	Cut the cable tie at the drive board.	 xx2000002058

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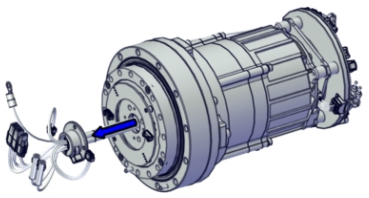
5.3.7 Replacing the axis-6 cabling

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. • TQ.A • TQ.B	 xx2000002053
7	Remove the cable plate by removing the attachment screws.	 xx2000002049

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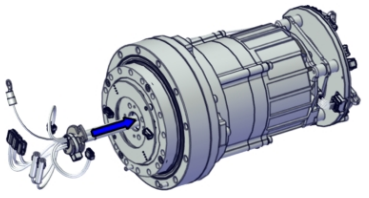
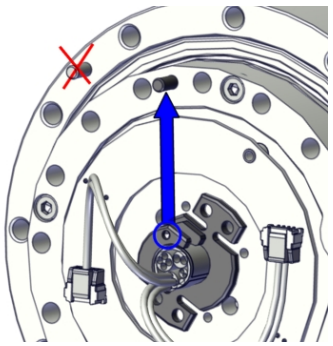
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	Action	Note
8	Remove the joint cable from the hollow shaft from the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002060

Refitting the joint cabling

Use these procedures to refit the joint-6 cabling.

Refitting the joint cable

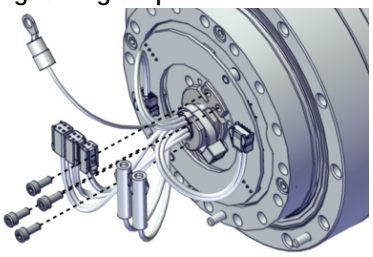
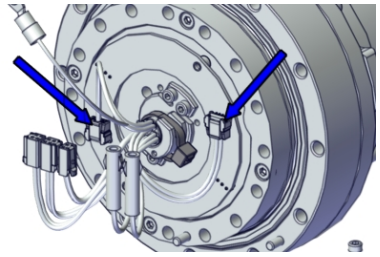
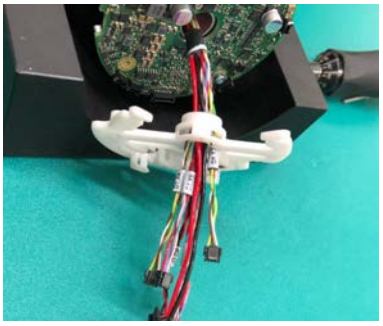
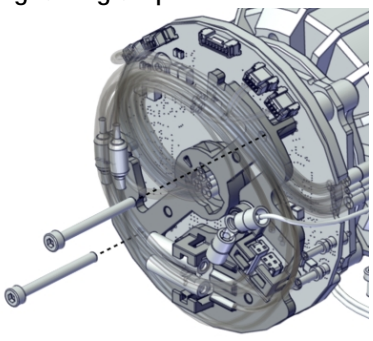
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Place the joint cable through the hollow shaft from the torque sensor side. **CAUTION** The connectors and the joint 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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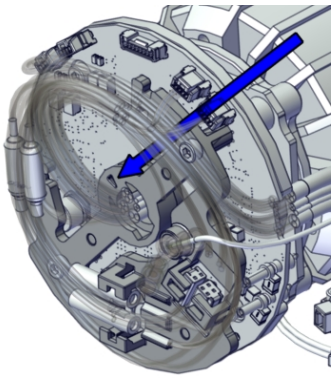
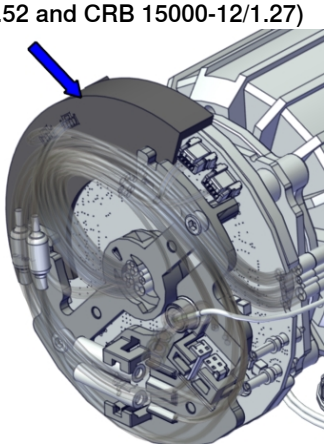
5.3.7 Replacing the axis-6 cabling

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. • 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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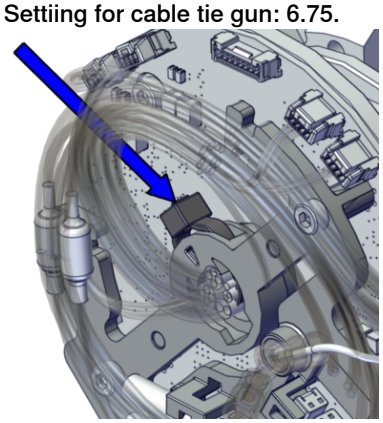
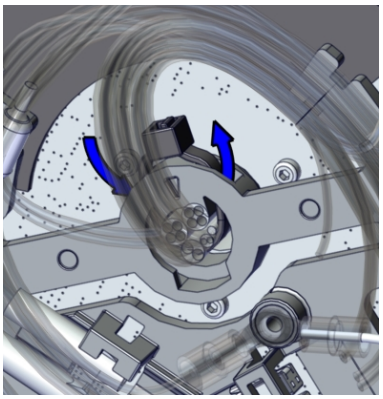
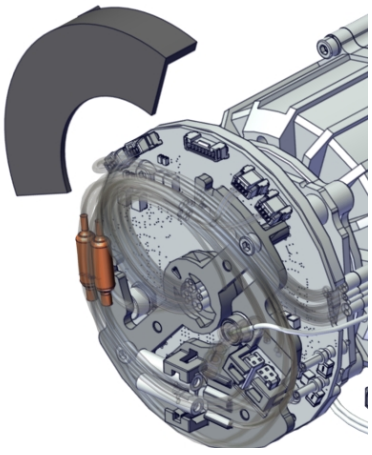
	Action	Note
7	Keep the cabling loose, making sure not to twist or strain it. Use the cable tie to pre-fix the cable by hand.	 xx2100000507
8	Fit the protection plate to the drive board unit.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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5.3.7 Replacing the axis-6 cabling

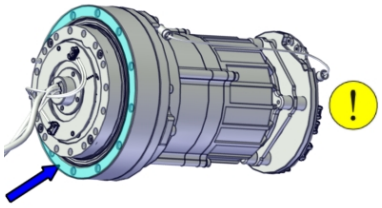
Continued

	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 EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059
10	Remove the protection plate.	 xx2100000301

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Preparations before fitting the joint unit (-5/0.95)

	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 53*.	
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 (or equivalent)  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 53*.	

Refitting the axis-6 joint unit

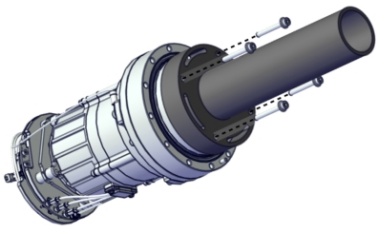
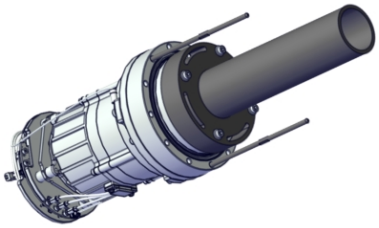
	Action	Note
1	**CAUTION** Axis-6 joint unit used for CRB 15000-5/0.95 has the same appearance as that used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Do not mix the joint units for different manipulator variants. Always check the mark or label on the joint units before refitting.	

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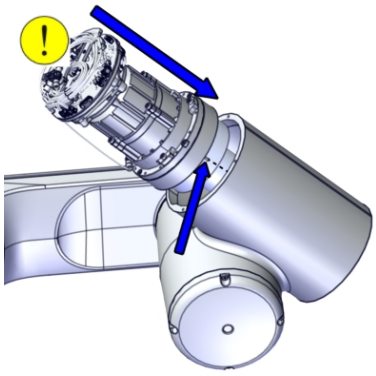
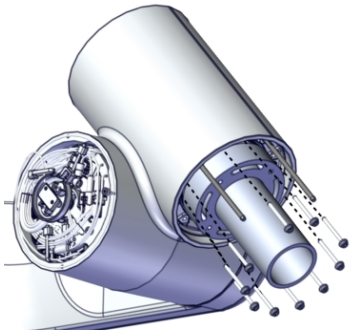
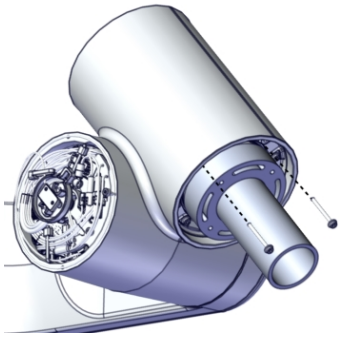
5.3.7 Replacing the axis-6 cabling

Continued

	Action	Note
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: 3HAC079143-001 (for CRB 15000-5/0.95) / 3HAC087546-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
3	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
4	Place the cabling at the slot before refitting the joint unit.	 xx2100000041

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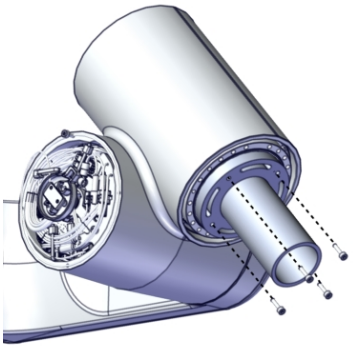
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	Action	Note
5	Fit the joint unit to the tilt, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002195
6	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000329
7	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002170
8	Pre-tighten the screws crosswise.	
9	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm (for CRB 15000-5/0.95) / 1.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)

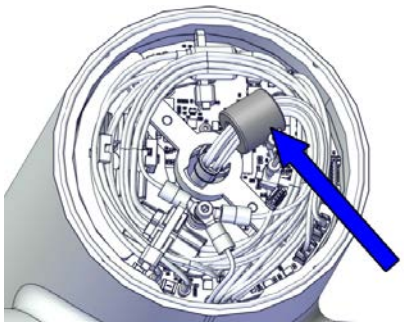
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5.3.7 Replacing the axis-6 cabling
Continued

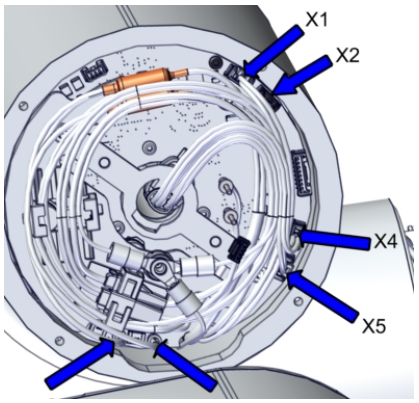
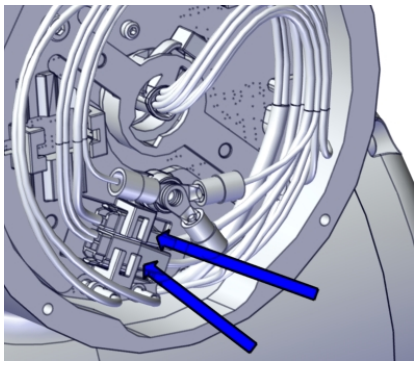
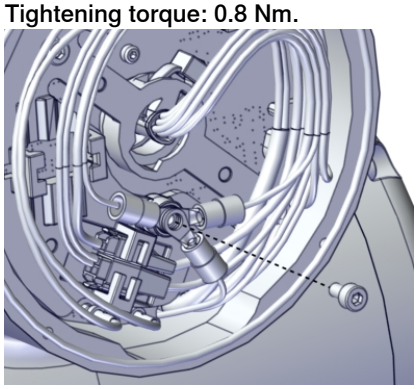
	Action	Note
10	Remove the lifting aid by removing the screws.	 xx2000002168
11	Clean pushed-out flange sealant, if any.	

Connecting the axis-6 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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D6.X4 and D6.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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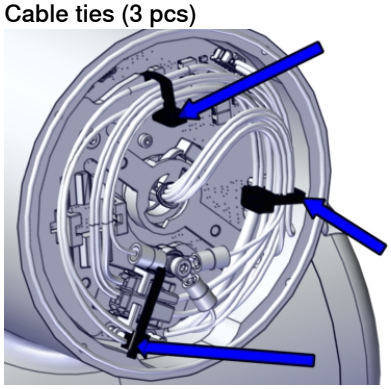
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	Action	Note
4	Reconnect the connectors to the drive board. • D6.X1 to X1 • D6.DC+ to +DC • D6.DC- to Ground • D6.X4 to X4 • D6.X2 to X2 • D6.X5 to X5	 xx2000002164
5	Connect the connectors to each other and snap them to the cable holders. • J7.CS to J7.CS • J7.CP to J7.CP	 xx2000002163
6	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

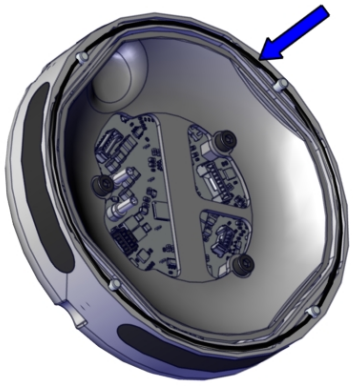
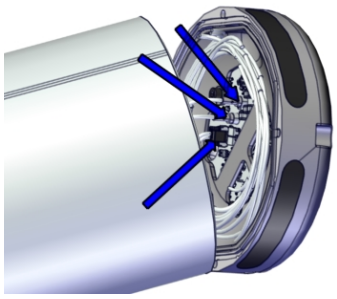
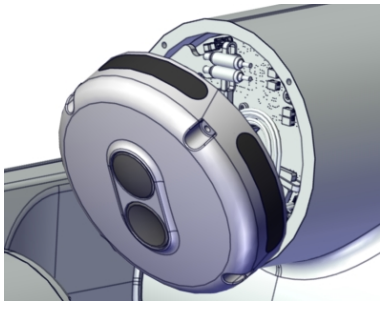
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5.3.7 Replacing the axis-6 cabling
Continued

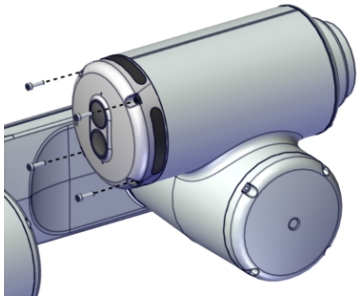
	Action	Note
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002161

Refitting the arm-side interface

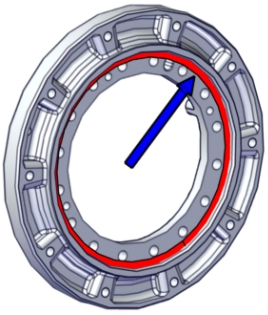
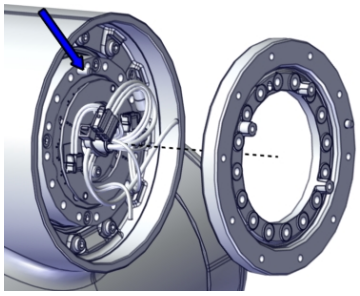
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002551
2	Place the arm-side interface at mounting position and reconnect the connectors. • ASI.DC+ • ASI.DC- • ASI.X1 The correct orientation of the arm-side interface is with the convex button in upper position. **Note** Do not leave the arm-side interface in location without being secured with the attachment screws.	 xx2100000335  xx2100000336

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	Action	Note
3	Refit the arm-side interface with four screws.	**Valid for CRB 15000-5/0.95** Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002550

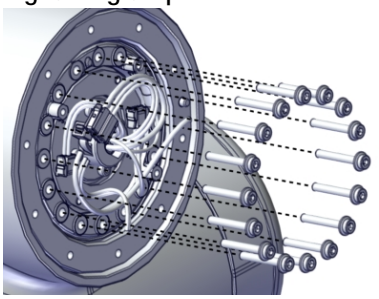
Refitting the tool flange adapter

	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 (or equivalent)  xx2000002196
2	Refit the tool flange adapter, aligning the pin with the pin hole.	Tool flange adapter: 3HAC073952-001  xx2000002167

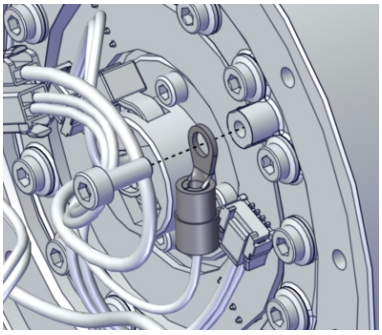
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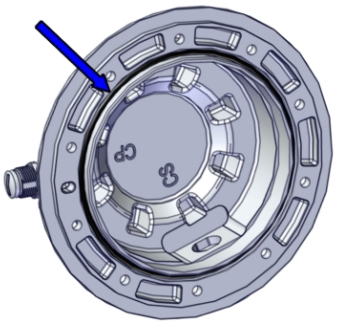
5.3.7 Replacing the axis-6 cabling
Continued

	Action	Note
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

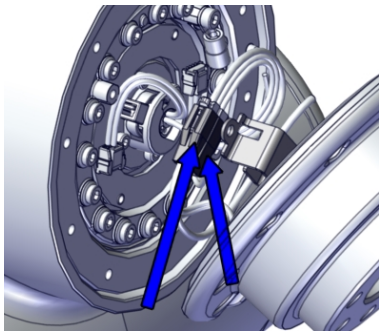
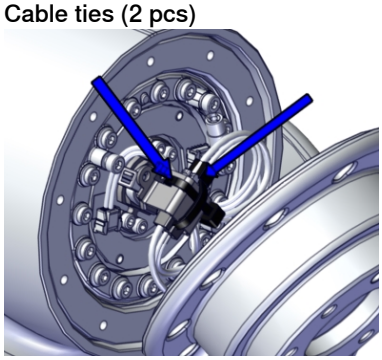
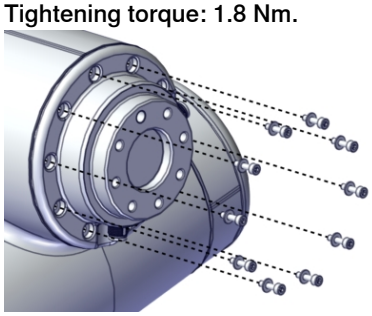
	Action	Note
1	Secure the cable for functional earth to the tool flange adapter with a screw.	 xx2000002159

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

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	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 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

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5.3.7 Replacing the axis-6 cabling
Continued

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

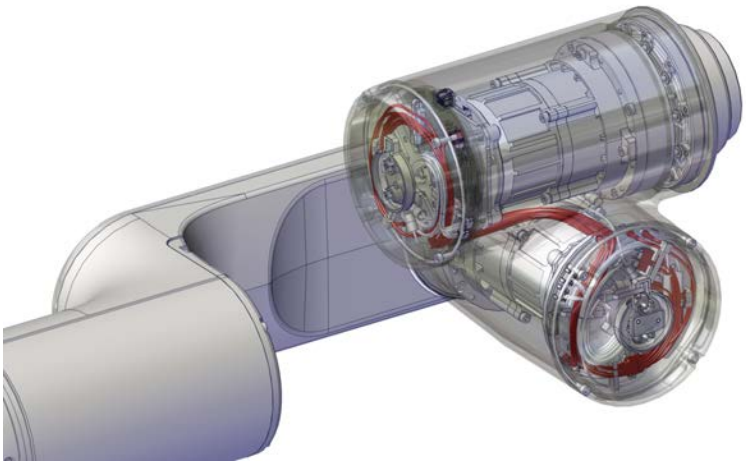
	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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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 972*.

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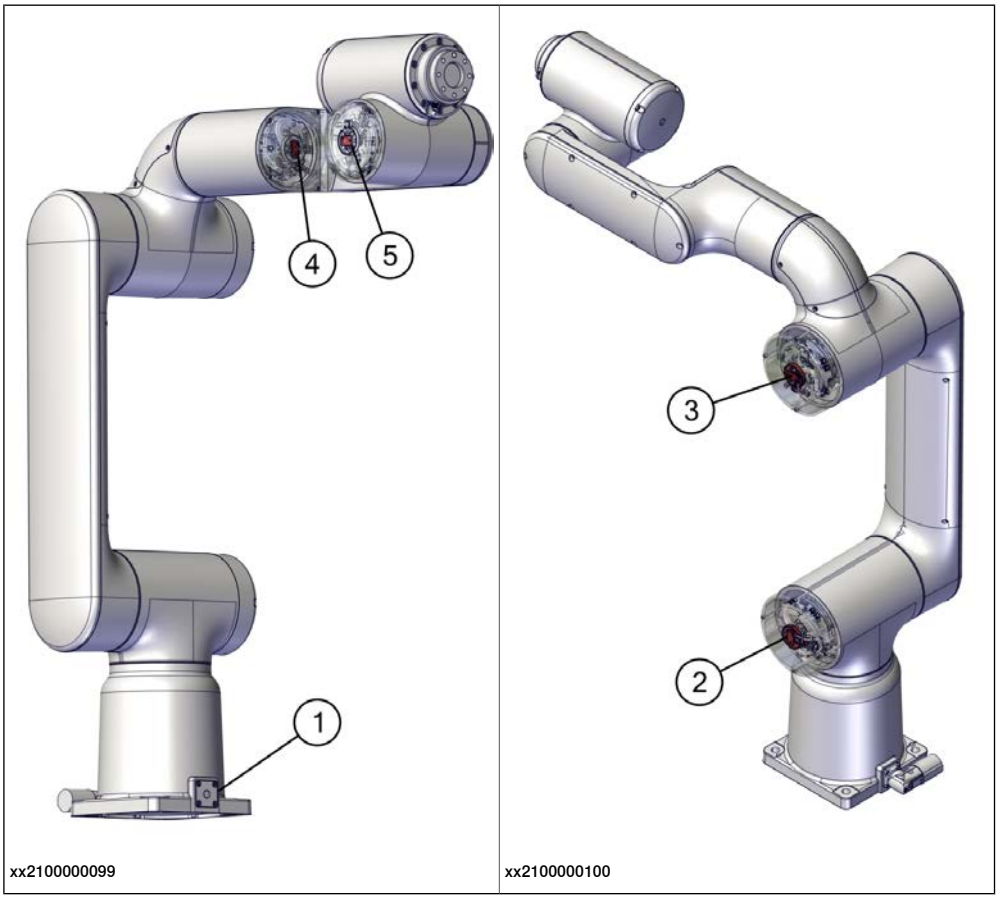
5.3.9 Replacing the brake release unit

Location of the brake release unit

CAUTION

Brake release units exist only on robots with RobotWare earlier than 7.10. On robots with RobotWare 7.10 or later, brake release units are unavailable.

The brake release units are located as shown in the figure.



xx2100000099 xx2100000100

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.

Continues on next page

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2 Replace the brake release unit.

Required spare parts

Note

The spare parts related to the brake release function using the external tool are discontinued from Q2 2023.

Spare part	Article number	Note
Brake release unit	3HAC079144-001	Axis 1 **Note** The spare parts related to the brake release function using the external tool are discontinued from Q2 2023.
Brake release unit	3HAC079145-001	Axes 2, 3, 4 and 5 **Note** The spare parts related to the brake release function using the external tool are discontinued from Q2 2023.

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Note

The spare parts related to the brake release function using the external tool are discontinued from Q2 2023.

Consumable	Article number	Note
Cable ties	-	
O-ring	3HAB3772-119	Axis-1 brake release unit Replace if damaged.
O-ring	3HAB3772-64	Base cover, used for CRB 15000-5/0.95.
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.

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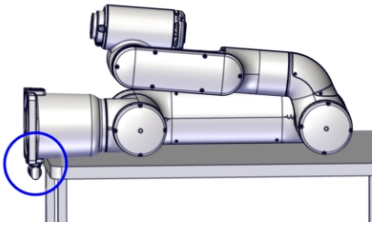
5.3.9 Replacing the brake release unit
Continued

Consumable	Article number	Note
O-ring	3HAC061327-051	Axis-4 cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-051	Axis-5 cover, used for CRB 15000-5/0.95. Replace if damaged.
Grease	3HAC031695-001	Harmonic Grease 4B No.2 Used to lubricate the seals.
Grease	3HAC042536-001	Shell Gadus S2

Replacing the brake release unit for axis 1

Use these procedures to replace the brake release unit.

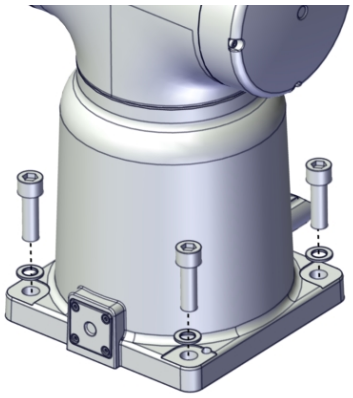
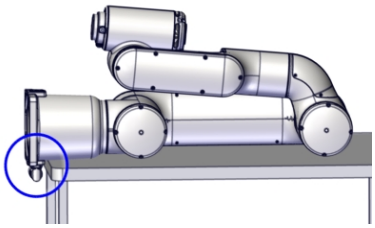
Preparations before removing the brake release unit

	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 0° • Axis 3: +85° • Axis 4: 0° • Axis 5: 0° • Axis 6: 0°	 xx2100000113
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	
3	Prepare a working bench where the robot can be laid down on its back with the base socket outside the table edge.	 xx2100000414

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Laying down the robot (-5/0.95)

	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. • 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. **CAUTION** Do not leave the robot standing unfastened to the foundation, it is not stable on its own.	 xx2100000415  xx2100000414

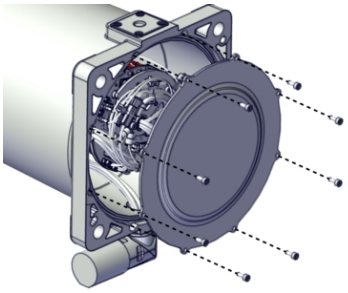
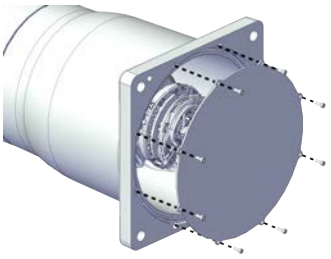
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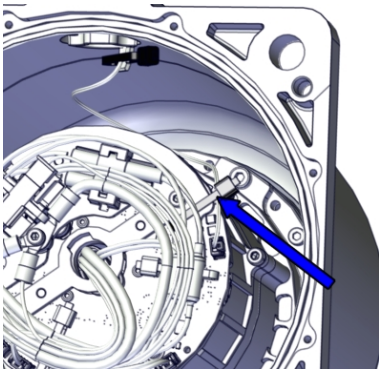
5.3.9 Replacing the brake release unit

Continued

Removing the base cover

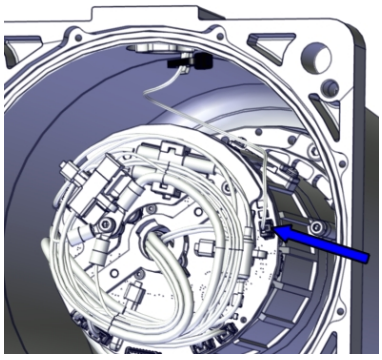
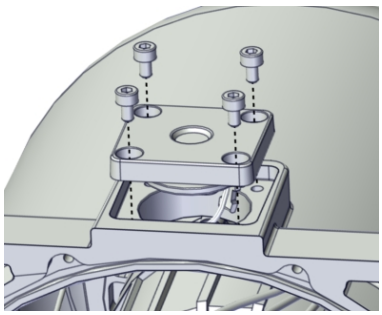
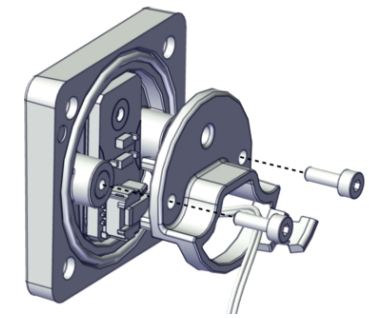
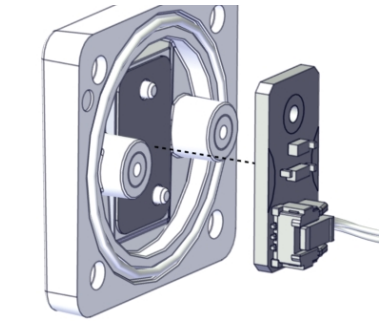
	Action	Note
1	Remove the bottom cover by removing the attachment screws.	**Valid for CRB 15000-5/0.95**  xx2000002007 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000760

Removing the brake release unit

	Action	Note
1	Cut the cable tie.	 xx2100000410

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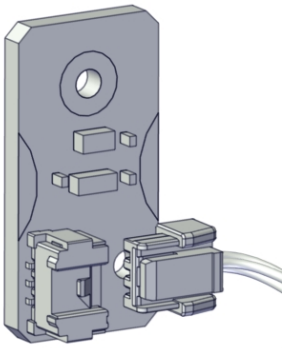
	Action	Note
2	Disconnect the brake release cable from the board.	 xx2100000411
3	Remove the brake release unit by removing the screws.	 xx2100000413
4	Remove the brake release cover by removing the two screws.	 xx2100000416
5	Remove the brake release board.	 xx2100000418

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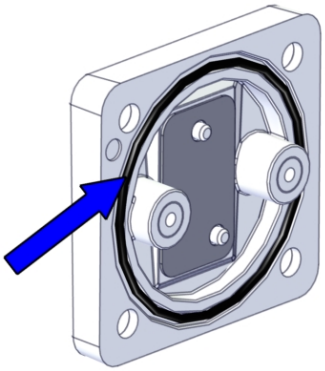
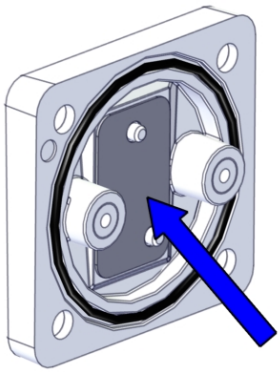
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5.3.9 Replacing the brake release unit

Continued

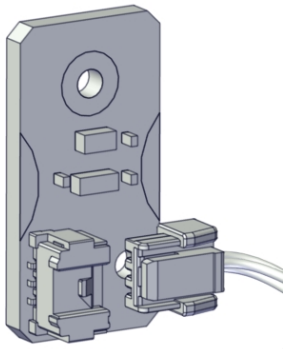
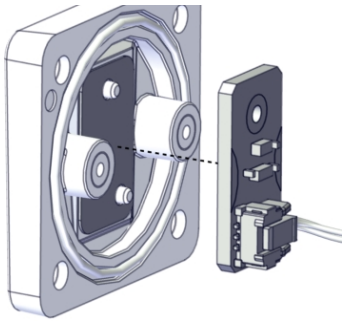
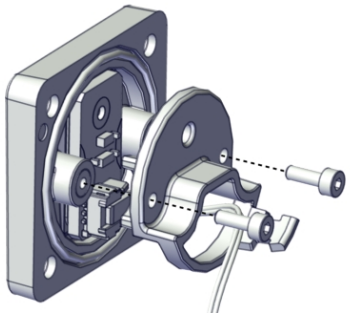
	Action	Note
6	Disconnect the brake release cable from the board.	 xx2100000417

Refitting the brake release unit

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 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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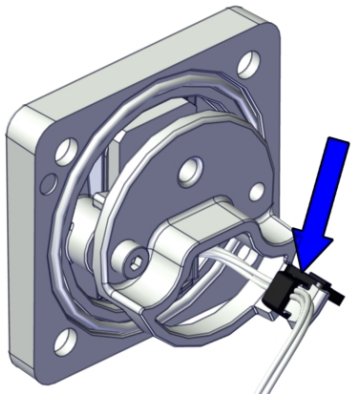
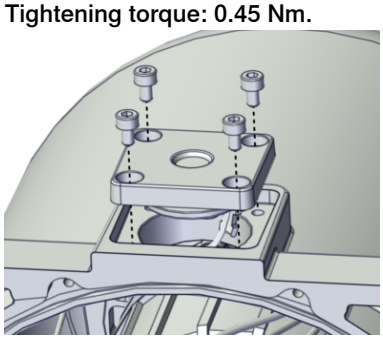
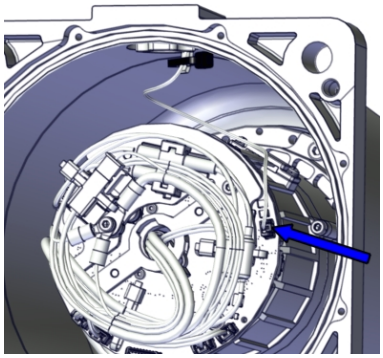
	Action	Note
3	Connect the brake release cable to the board.	Brake release unit: 3HAC079144-001  xx2100000417
4	Fit the brake release board to the sheet metal.	 xx2100000418
5	Fit the brake release cover and secure with two screws.	Screws: M2x6 12.9 Gleitmo 605 (2 pcs) Tightening torque: 0.2 Nm.  xx2100000416

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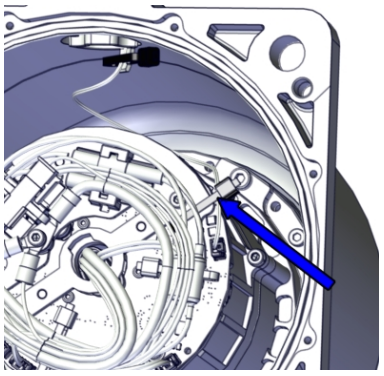
5.3.9 Replacing the brake release unit

Continued

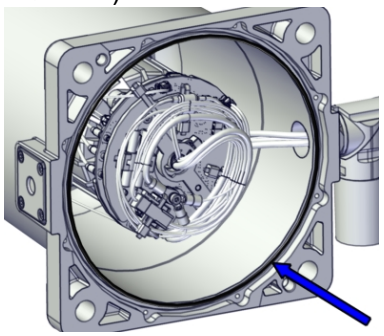
	Action	Note
6	Secure the brake release cable with a cable tie.	 xx2100000421
7	Refit the brake release unit with the screws.	Screws: M3x5 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2100000413
8	Reconnect the brake release connector DR.X8 to the drive board.	 xx2100000411

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	Action	Note
9	Secure the brake release cable with a cable tie.	 xx2100000410

Refitting the base cover (-5/0.95)

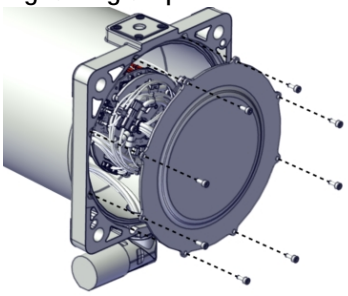
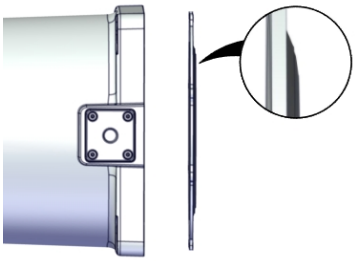
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAB3772-64 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016

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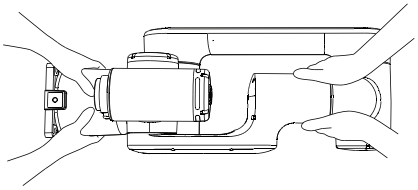
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5.3.9 Replacing the brake release unit

Continued

	Action	Note
2	Refit the bottom cover with the attachment screws. **Note** For CRB 15000-5/0.95, 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

Lifting and securing the robot (-5/0.95)

	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	Carry the robot to the installation site. **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 .

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	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. • 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: 32 Nm ±10%

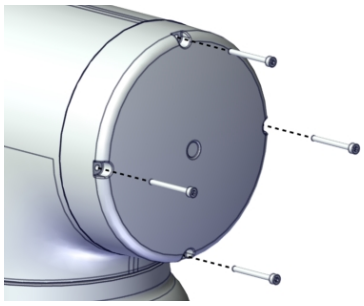
Concluding procedure

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

Replacing the brake release unit for axes 2, 3, 4 and 5

Use these procedures to replace the brake release unit.

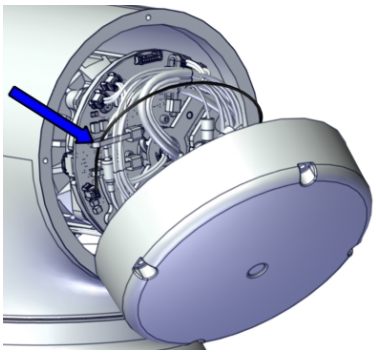
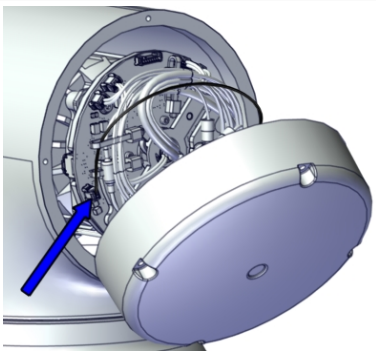
Opening the joint unit cover

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover screws.	 xx2000001935
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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.	

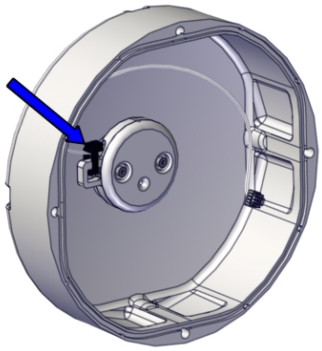
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5.3.9 Replacing the brake release unit
Continued

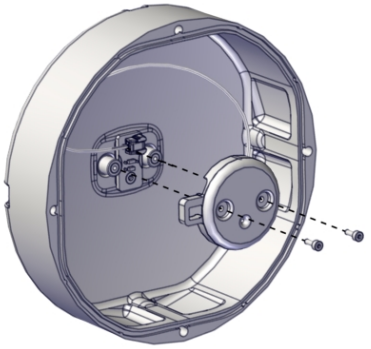
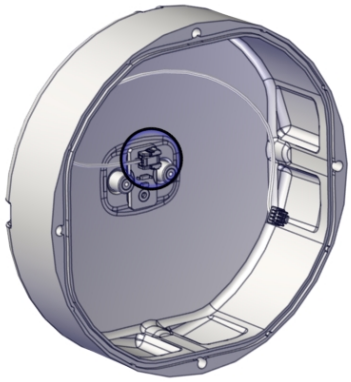
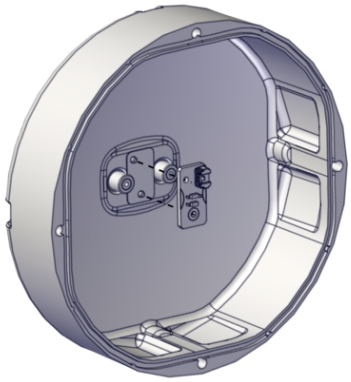
	Action	Note
4	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000001931
5	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000001932

Removing the brake release unit

	Action	Note
1	Cut the cable tie.	 xx2100000096

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	Action	Note
2	Remove the brake release cover by removing the two screws.	 xx2100000095
3	Disconnect the brake release cable from the board.	 xx2100000094
4	Remove the brake release board.	 xx2100000093

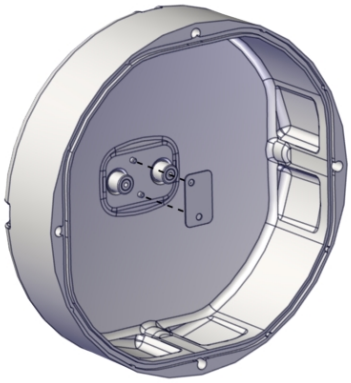
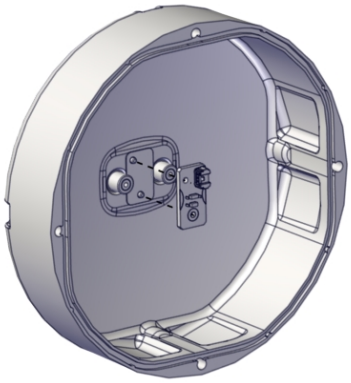
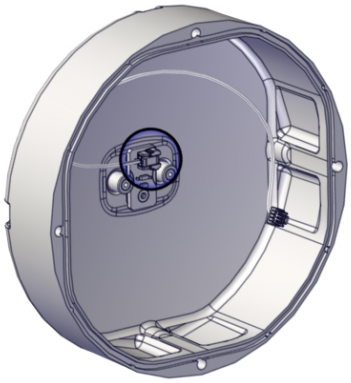
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5.3.9 Replacing the brake release unit

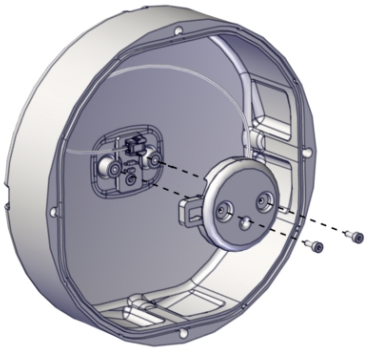
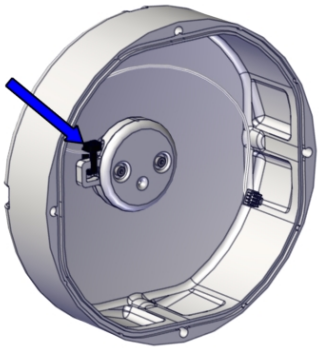
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Refitting the brake release unit

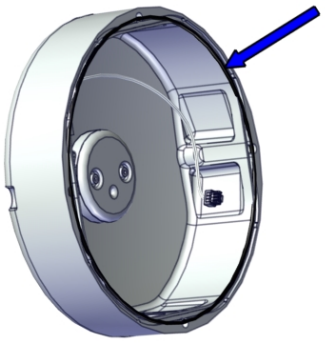
	Action	Note
1	If not already fitted, place the sheet metal inside the cover.	 xx2100000092
2	Fit the brake release board to the sheet metal.	 xx2100000093
3	Connect the brake release cable to the board.	 xx2100000094

Continues on next page

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	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

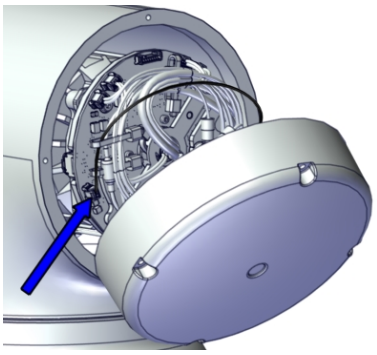
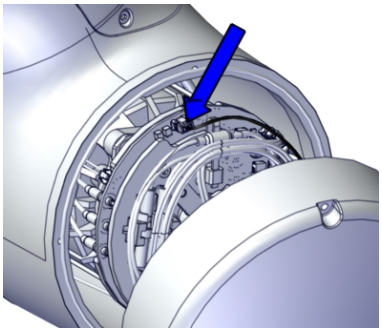
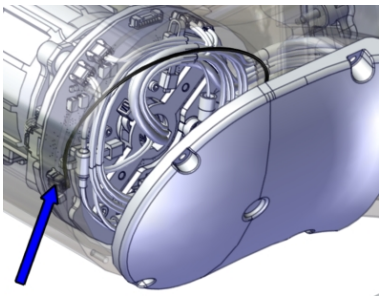
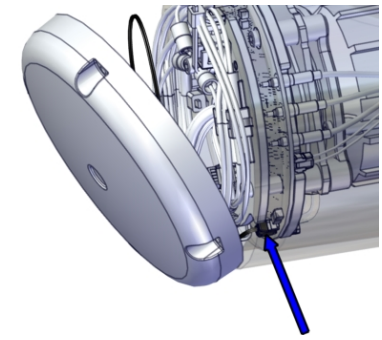
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962

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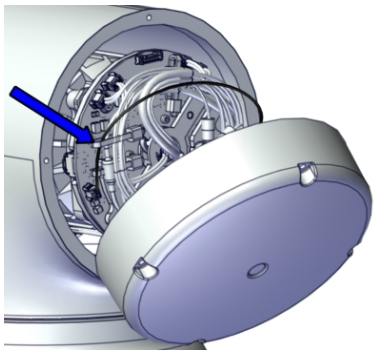
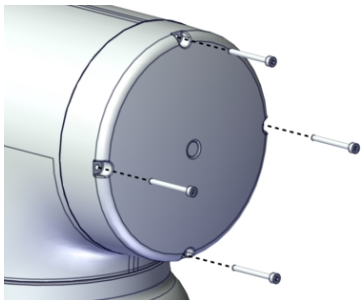
5.3.9 Replacing the brake release unit

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.	Axis 2:  xx2000001932 Axis 3:  xx2000002023 Axis 4: Tweezers  xx2000002085 Axis 5:  xx2000002134

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	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. See *Test run after installation, maintenance, or repair on page 89*.	

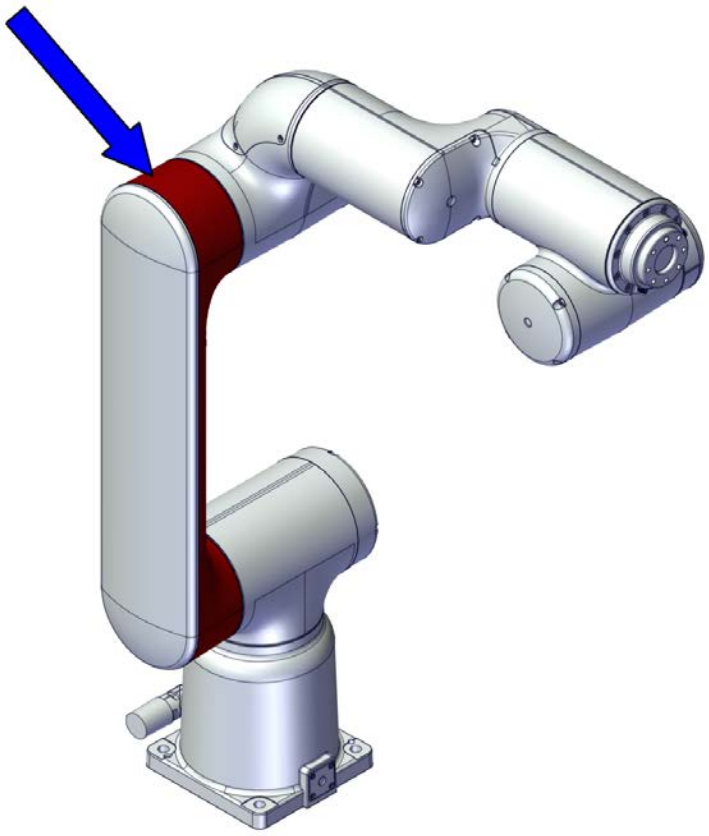
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5.4 Upper and lower arms

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*.

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Spare part	Article number	Note
Lower arm	3HAC073948-001	Used for CRB 15000-5/0.95.
Lower arm	3HAC081051-001	Used for CRB 15000-10/1.52 and CRB 15000-12/1.27.

Required tools and equipment

Equipment	Article number	Note
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M5x125	3HAC087786-001	Always use guide pins in pairs. For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Cable ties	-	
O-ring	3HAC061327-044	Lower arm, inner cover of CRB 15000-5/0.95. 1 pcs / cover. Replace if damaged.
O-ring	3HAC061327-075	Lower arm, lower inner cover of CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-044	Lower arm, upper inner cover of CRB 15000-10/1.52 and CRB 15000-12/1.27. 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.	

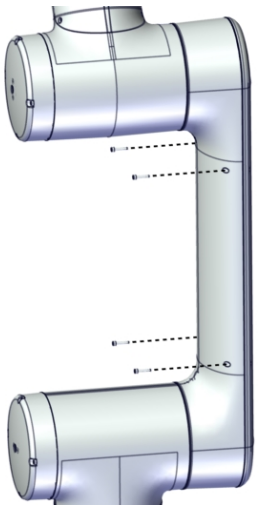
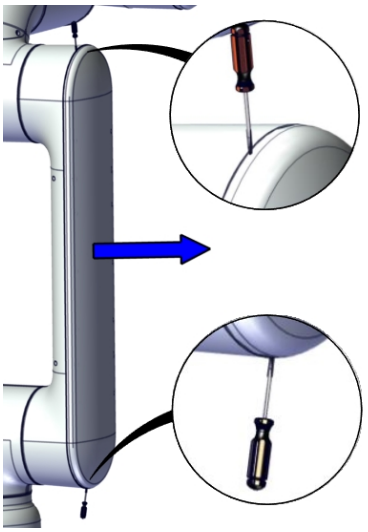
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5.4.1 Replacing the lower arm

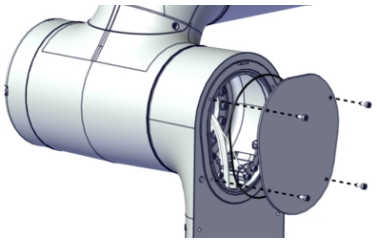
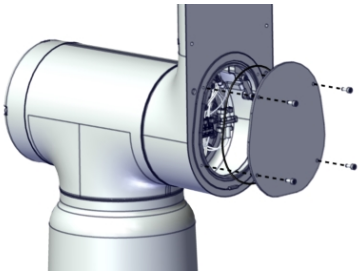
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Removing the lower arm covers (-5/0.95)

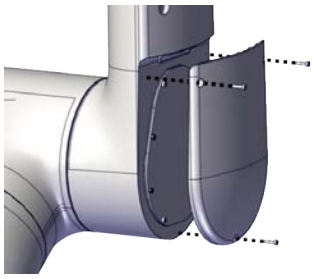
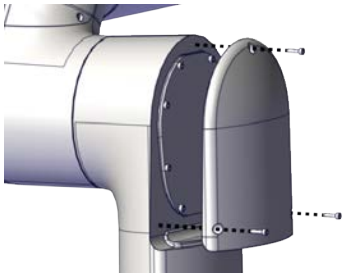
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the four lower arm cover screws.	 xx2000001929
3	Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267

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	Action	Note
4	Remove the inner covers by removing the screws.	 xx2000001947  xx2000001930

Removing the lower arm covers (-10/1.52 and -12/1.27)

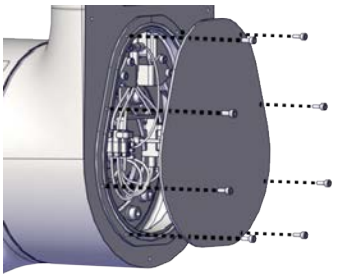
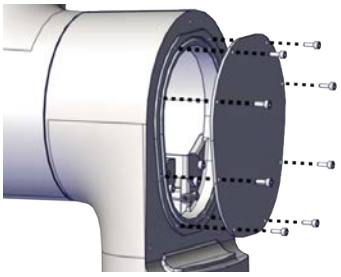
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the lower arm covers by removing the screws.	 xx2300000812  xx2300000829

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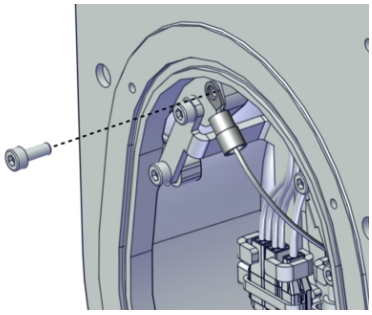
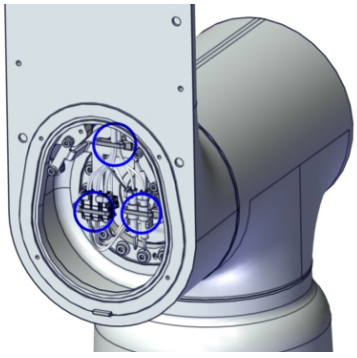
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5.4.1 Replacing the lower arm

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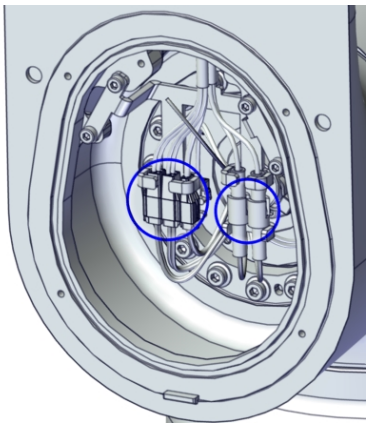
	Action	Note
3	Remove the inner covers by removing the screws.	 xx2300000813  xx2300000830

Disconnecting the cabling between the lower arm and the swing

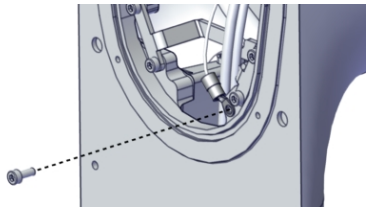
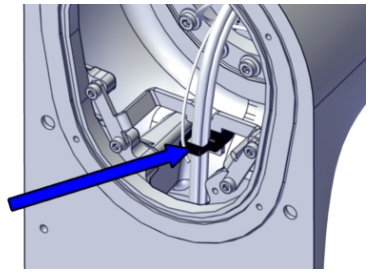
	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936
2	Cut the cable ties.	 xx2000001937

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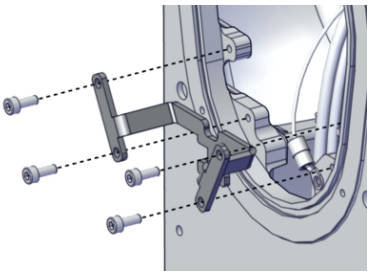
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	Action	Note
3	Snap loose and disconnect all connectors.	 xx2000001938

Loosening the cabling between the lower and upper arm

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

Removing the upper arm

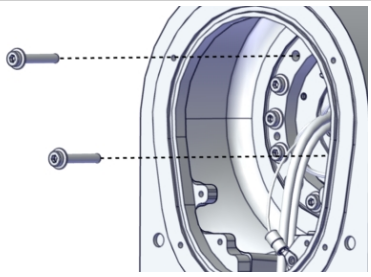
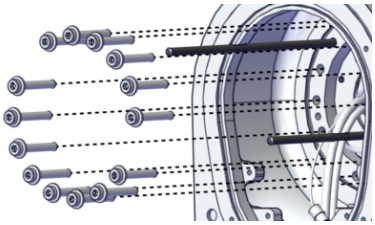
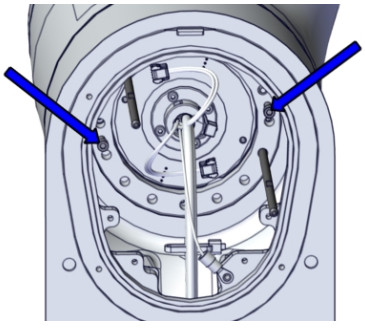
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001966

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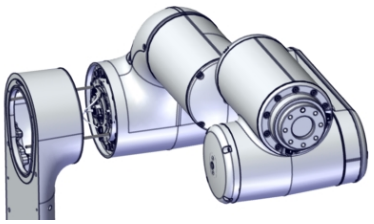
5.4.1 Replacing the lower arm

Continued

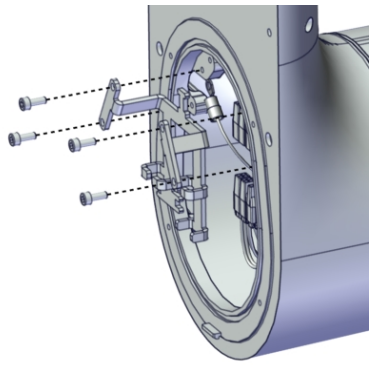
	Action	Note
2	Secure the weight of the upper arm. **CAUTION** The weight of the complete upper arm is 14 kg.	
3	Remove two attachment screws.	 xx2000001967
4	Fit two guide pins to the axis-3 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001968
5	Remove the remaining 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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	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 lower arm

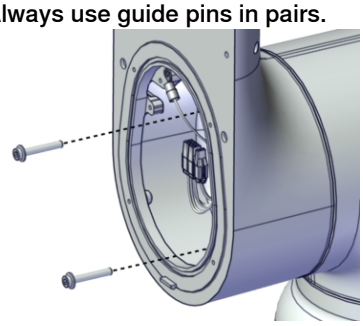
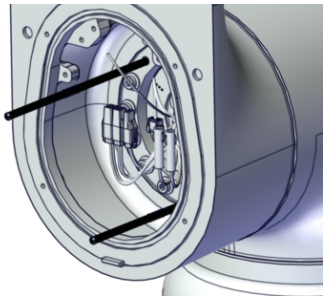
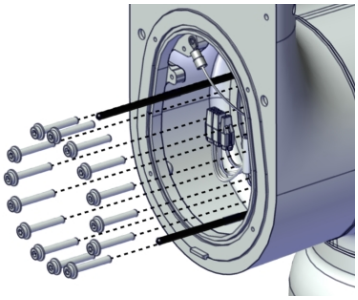
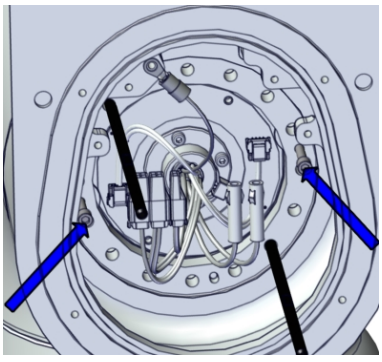
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939
2	Secure the weight of the lower arm.	

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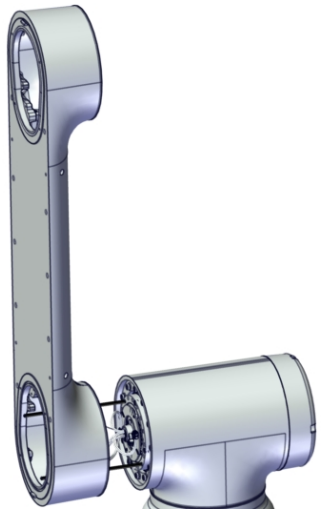
5.4.1 Replacing the lower arm

Continued

	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit.	**Valid for CRB 15000-5/0.95** Guide pin, M4x120: 3HAC077786-001 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Guide pin, M5x125: 3HAC087786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

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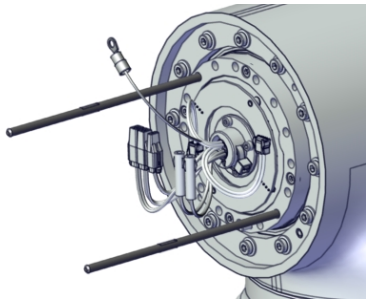
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	Action	Note
6	Remove the lower arm from the swing.	 xx2000001952

Refitting the lower arm

Use these procedures to refit the lower arm.

Refitting the lower arm

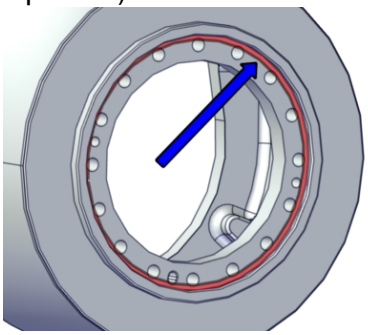
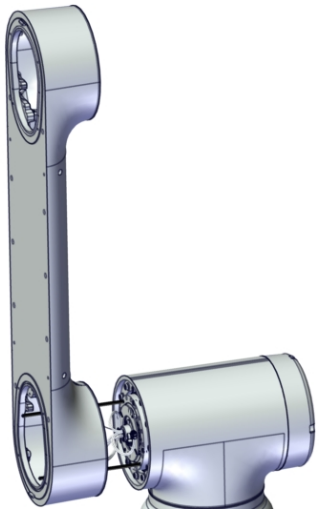
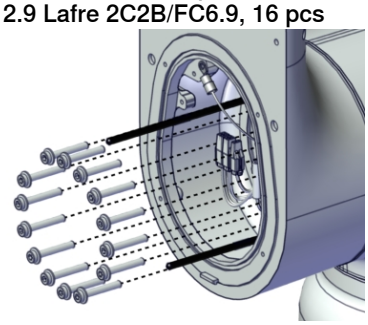
	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	**Valid for CRB 15000-5/0.95** Guide pin, M4x120: 3HAC077786-001 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Guide pin, M5x125: 3HAC087786-001  xx2000001949

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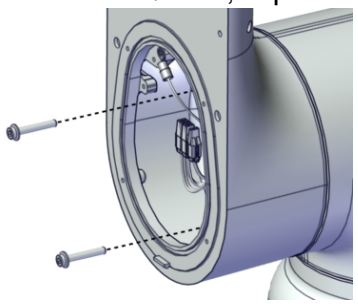
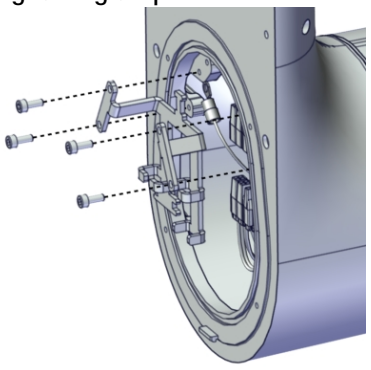
5.4.1 Replacing the lower arm

Continued

	Action	Note
2	**Valid for CRB 15000-5/0.95** 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 (or equivalent)  xx2000001963
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. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	**Valid for CRB 15000-5/0.95** Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2000001940

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	Action	Note
5	Remove the guide pins and fasten the remaining two screws.	**Valid for CRB 15000-5/0.95** Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2000001951
6	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm (for CRB 15000-5/0.95) / 8.2 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)
7	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

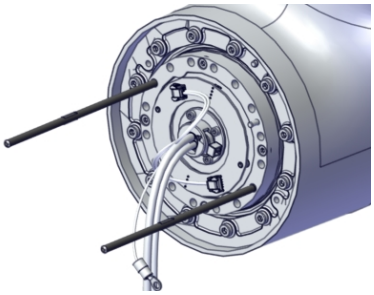
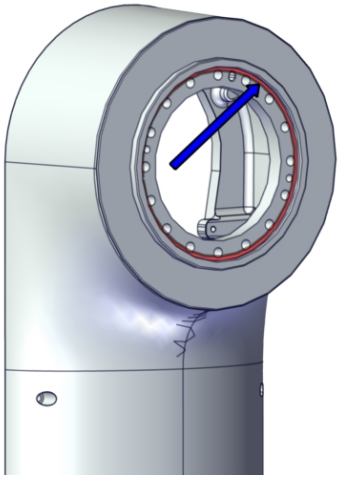
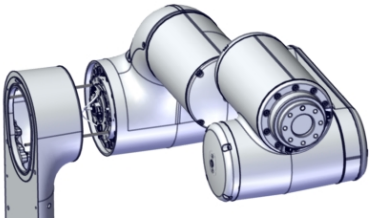
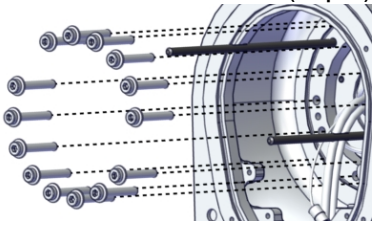
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5.4.1 Replacing the lower arm

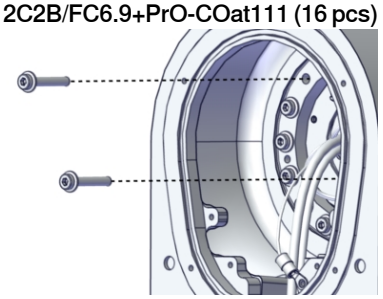
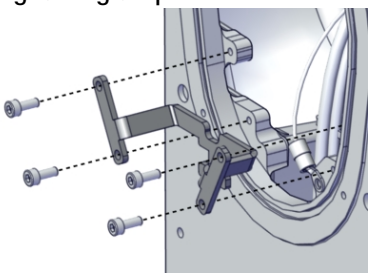
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Refitting the upper arm

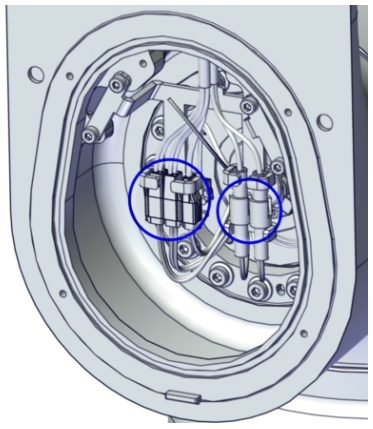
	Action	Note
1	Fit two guide pins to the axis-3 joint.	Guide pin, M4x120: 3HAC077786-001  xx2000001971
2	**Valid for CRB 15000-5/0.95** Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000001973
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

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	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)  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

Connecting the cabling between the lower arm and swing

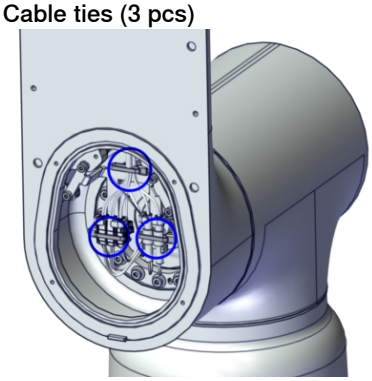
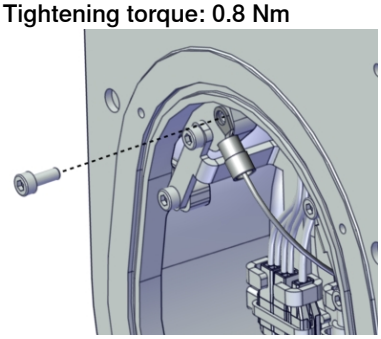
	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938

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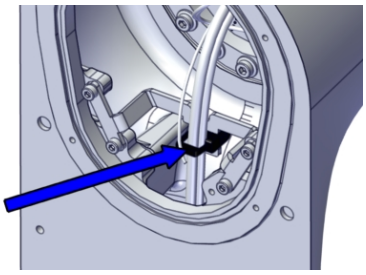
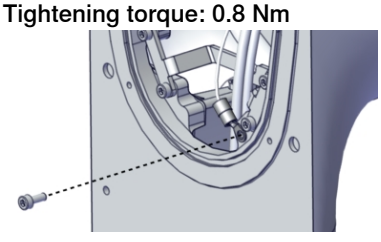
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5.4.1 Replacing the lower arm

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

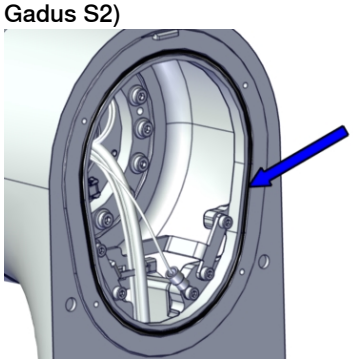
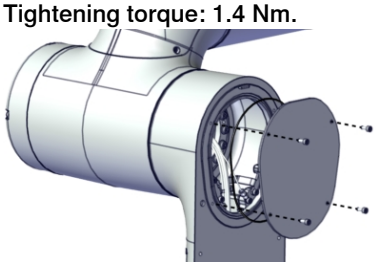
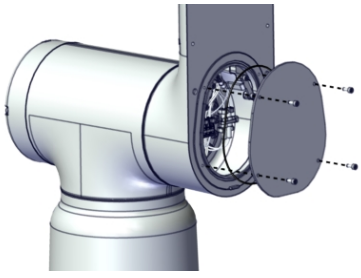
Fastening the cabling between the lower and upper arm

	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

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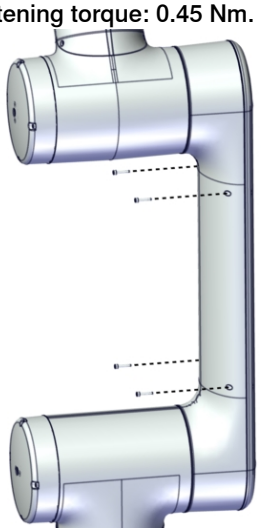
Refitting the lower arm covers (-5/0.95)

	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

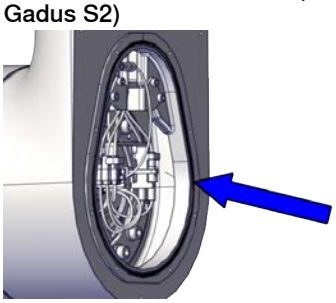
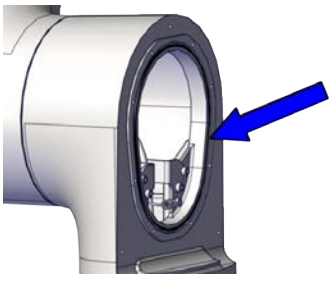
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5.4.1 Replacing the lower arm
Continued

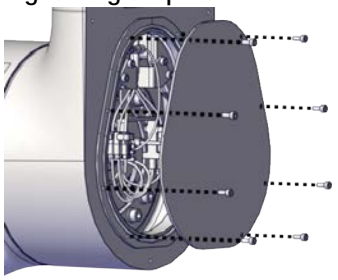
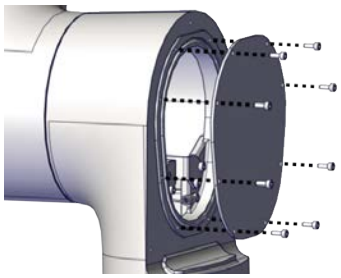
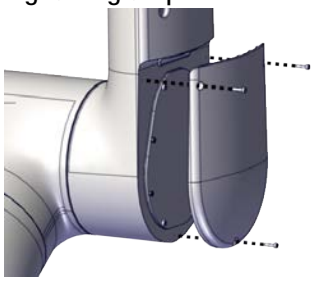
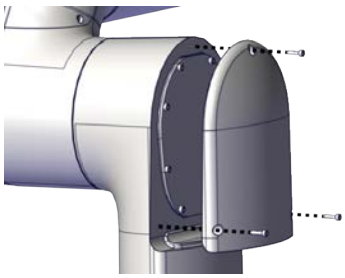
	Action	Note
3	Snap the lower arm cover into place.	Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000001929
4	Secure the cover with four screws.	

Refitting the lower arm covers (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-075 O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2300000832  xx2300000831

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	Action	Note
2	Refit the inner covers with eight screws each.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) x 2 Tightening torque: 1.4 Nm.  xx2300000813  xx2300000830
3	Snap the lower arm cover into place.	Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) x 2 Tightening torque: 1.4 Nm.  xx2300000812  xx2300000829
4	Secure the cover with three screws.	

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5.4.1 Replacing the lower arm

Continued

Concluding procedure

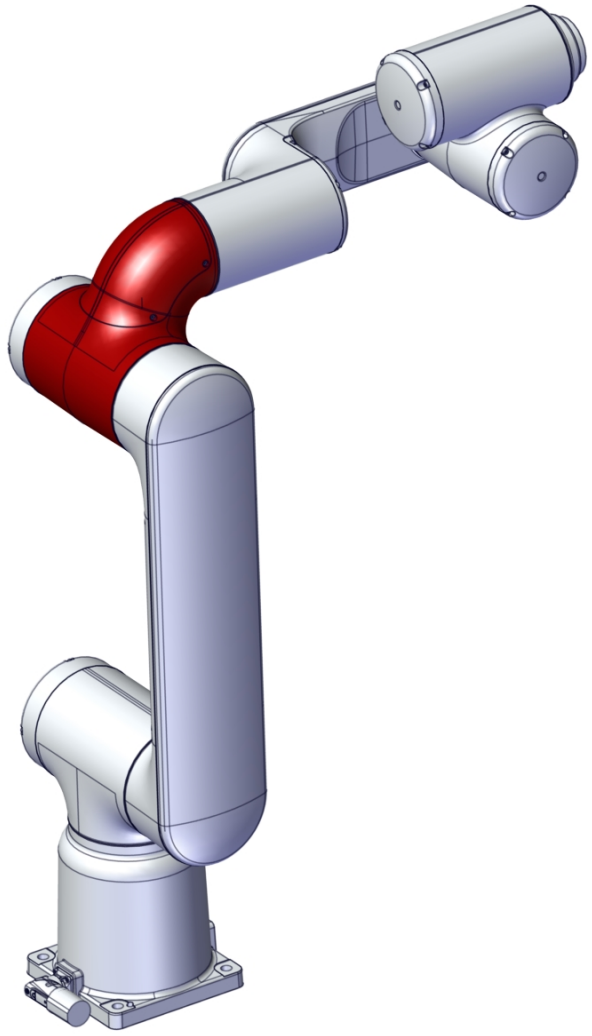
	Action	Note
1	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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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.

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5.4.2 Replacing the housing
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
Housing	3HAC073949-001	Used for CRB 15000-5/0.95. Also order new attachment screws for the axis-3 joint unit: 3HAB3413-435 (12 pcs).
Housing	3HAC087550-001	Used for CRB 15000-10/1.52 and CRB 15000-12/1.27.
Flange socket head screw with glue	3HAB3413-435	M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. 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 of CRB 15000-5/0.95. Attachment screws M4x35 (4 pcs) are enclosed.
Lifting aid	3HAC087788-001	For joint unit on axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M3x110	3HAC077787-001	Always use guide pins in pairs.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Cable ties	-	

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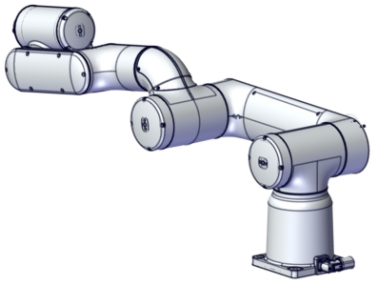
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Consumable	Article number	Note
Gasket	3HAC075056-001	Cover inside housing Replace if damaged.
Flange socket head screw with glue	3HAB3413-435	M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. 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, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-047	Housing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-044	Lower arm, inner cover of CRB 15000-5/0.95. 1 pcs / cover. Replace if damaged.
O-ring	3HAC061327-044	Lower arm, upper inner cover of CRB 15000-10/1.52 and CRB 15000-12/1.27. 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: • Axis 1: 0° • Axis 2: +90° (suggested position for convenient working position) • Axis 3: -80° • Axis 4: 0° • Axis 5: 0° • Axis 6: 0°	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000002
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

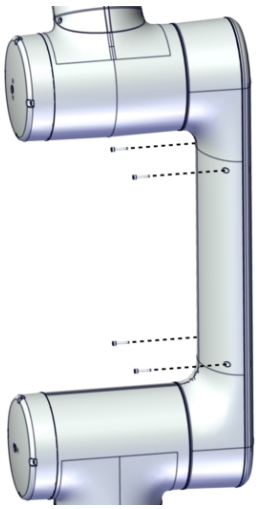
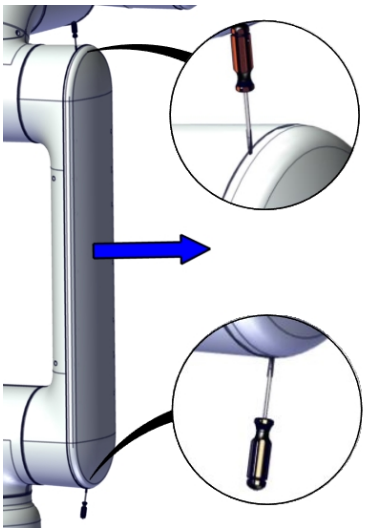
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5.4.2 Replacing the housing

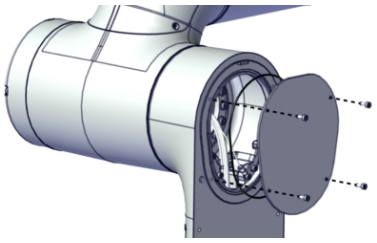
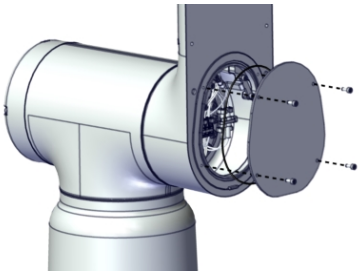
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Removing the lower arm covers (-5/0.95)

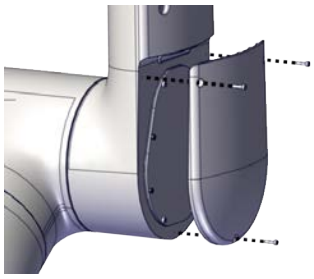
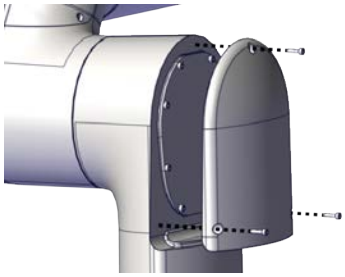
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the four lower arm cover screws.	 xx2000001929
3	Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267

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	Action	Note
4	Remove the inner covers by removing the screws.	 xx2000001947  xx2000001930

Removing the lower arm covers (-10/1.52 and -12/1.27)

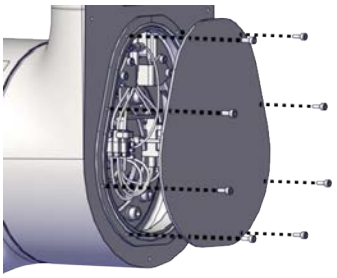
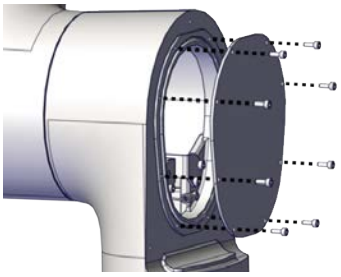
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the lower arm covers by removing the screws.	 xx2300000812  xx2300000829

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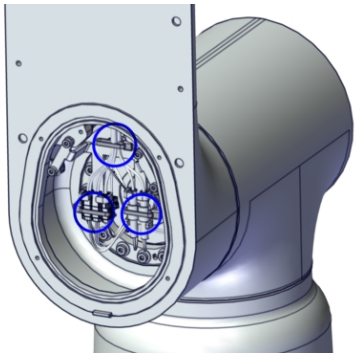
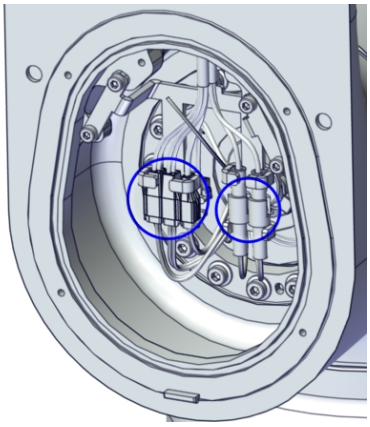
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5.4.2 Replacing the housing

Continued

	Action	Note
3	Remove the inner covers by removing the screws.	 xx2300000813  xx2300000830

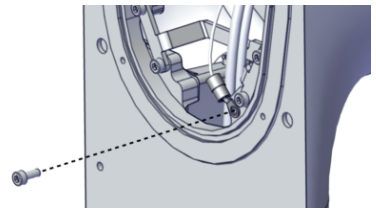
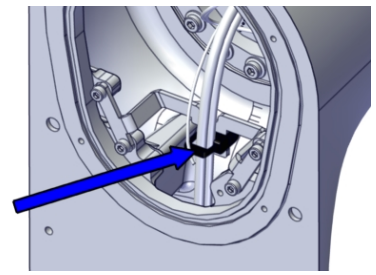
Disconnecting the upper arm cabling

	Action	Note
1	Cut the cable ties.	 xx2000001937
2	Snap loose and disconnect all connectors.	 xx2000001938

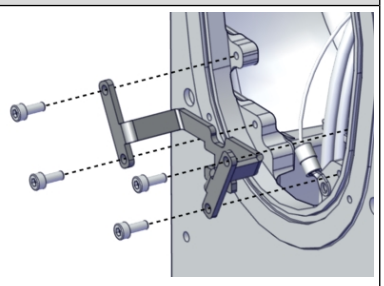
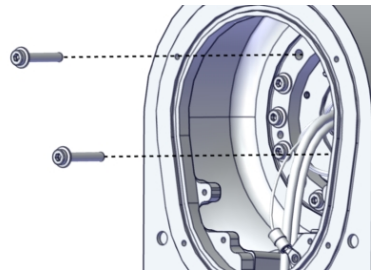
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Loosening the cabling between the lower and upper arm

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

Removing the upper arm

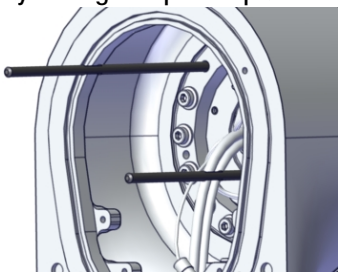
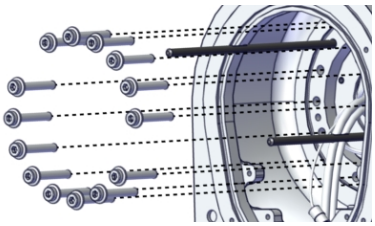
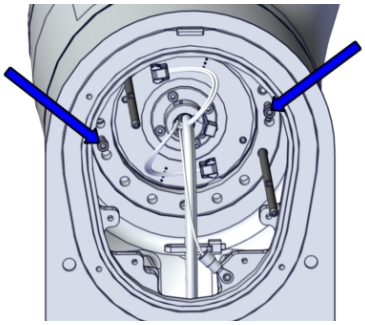
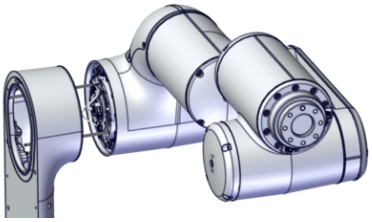
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001966
2	Secure the weight of the upper arm. **CAUTION** The weight of the complete upper arm is 14 kg.	
3	Remove two attachment screws.	 xx2000001967

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5.4.2 Replacing the housing

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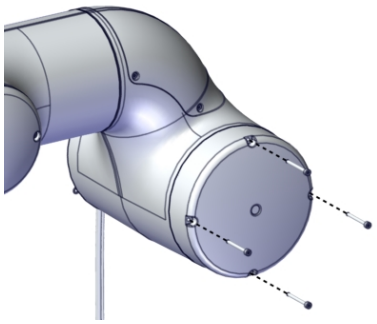
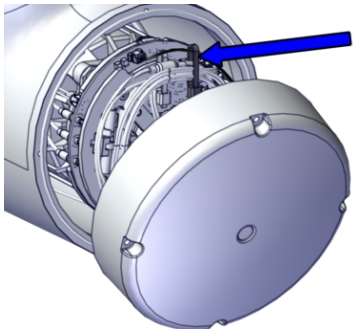
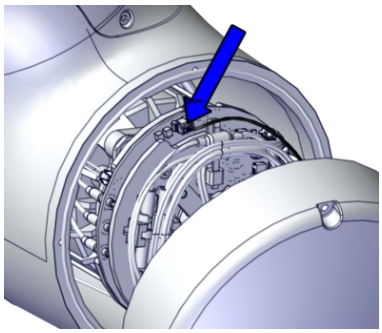
	Action	Note
4	Fit two guide pins to the axis-3 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001968
5	Remove the remaining attachment screws.	 xx2000001969
6	Press the upper arm out of position by using two fully threaded attachment screws as removal tools.	 xx2100000001
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 (-5/0.95)

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

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	Action	Note
2	Remove the cover screws.	 xx2000002021
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002022
5	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002023

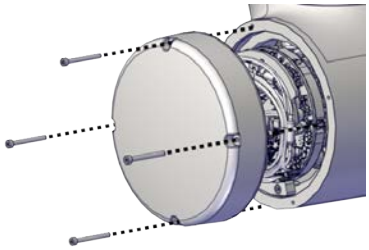
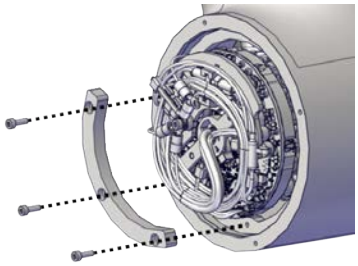
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5.4.2 Replacing the housing

Continued

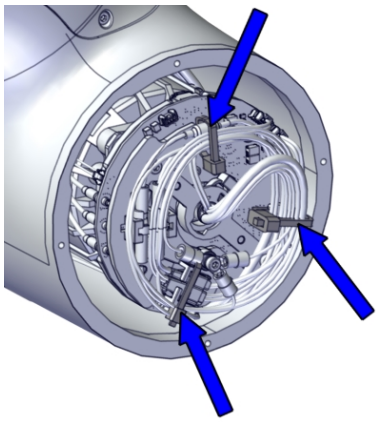
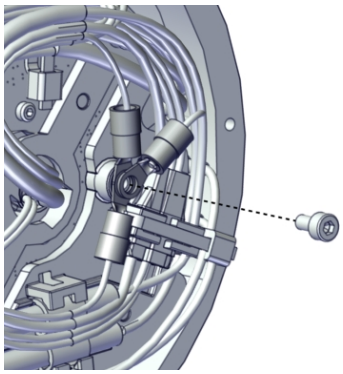
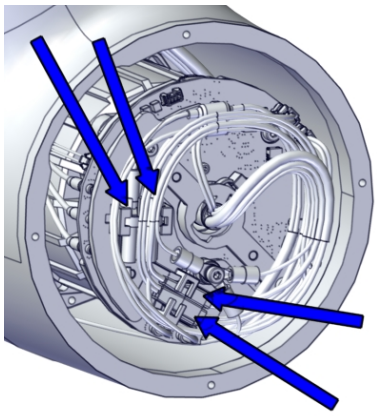
Removing the housing cover and insert (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000833
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	Remove the insert.	 xx2300000834

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Disconnecting the axis-3 joint unit cabling

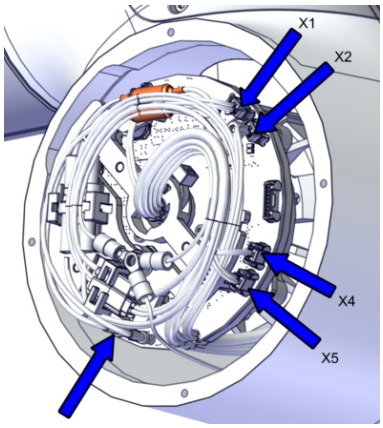
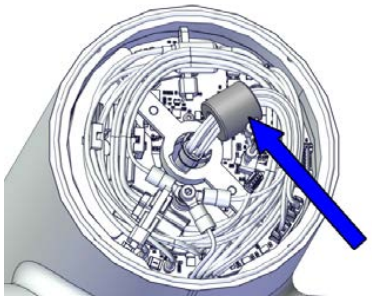
	Action	Note
1	Cut the cable ties.	 xx2000002066
2	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
3	Snap loose and disconnect the connectors: • J4.DC+ • J4.DC- • J4.CS • J4.CP	 xx2000002067

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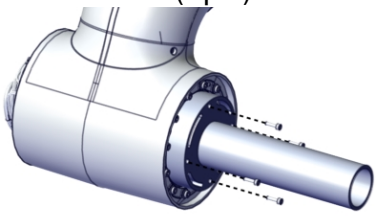
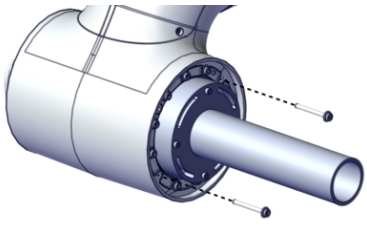
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5.4.2 Replacing the housing

Continued

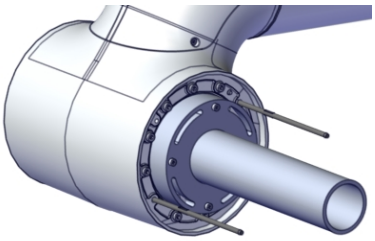
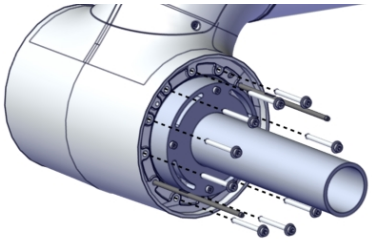
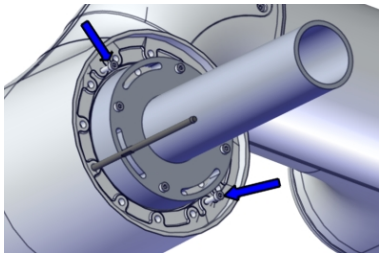
	Action	Note
4	Disconnect the connectors from the drive board. • D3.X1 • D3/4.DC+ • D3/4.DC- • D3.X4 • D3/4.X2 • D3.X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002068
5	Remove the ferrite core by pulling the cables D3.X4 and D3.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-3 joint unit (-5/0.95)

	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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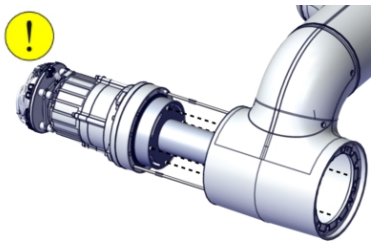
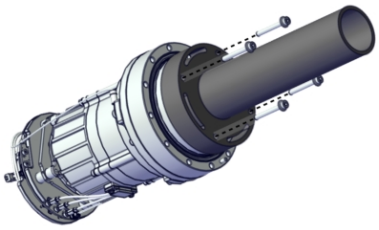
	Action	Note
3	Fit two guide pins to the axis-3 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002576
4	Remove the remaining attachment screws. Use two screws 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

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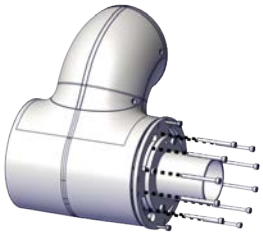
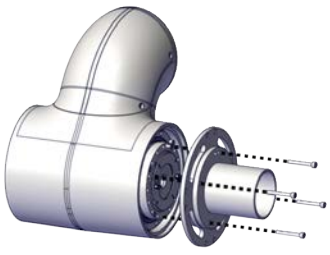
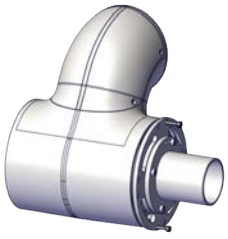
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5.4.2 Replacing the housing

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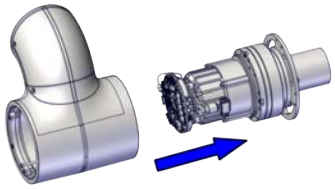
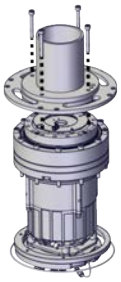
	Action	Note
7	Remove the joint unit from the housing. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002071
8	Remove the lifting aid and guide pins.	 xx2000001957

Removing the axis-3 joint unit (-10/1.52 and -12/1.27)

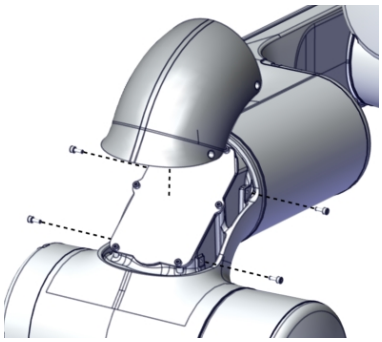
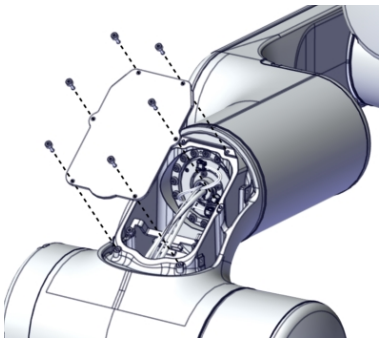
	Action	Note
1	Remove the attachment screws.	 xx2300000799
2	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC087788-001 Screws: M4x30 (4 pcs)  xx2300000800
3	Use two fully attachment screws as removal tools to press the joint unit out of position.	 xx2300000801

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	Action	Note
4	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.	 xx2300000802
5	Remove the lifting aid.	 xx2300000804

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

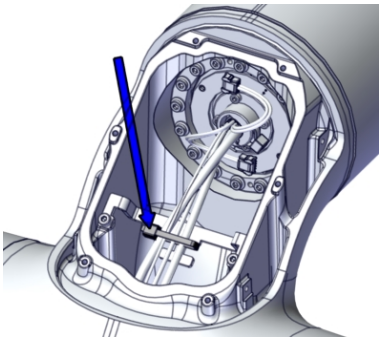
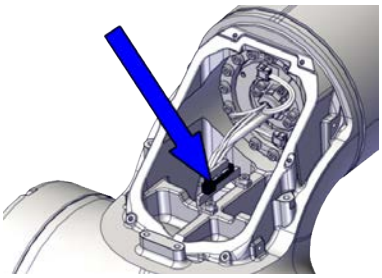
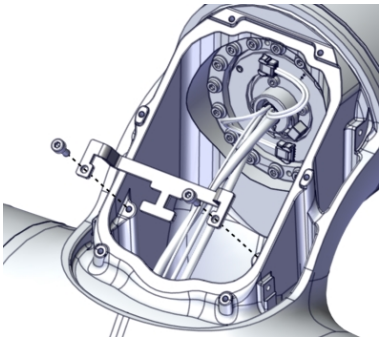
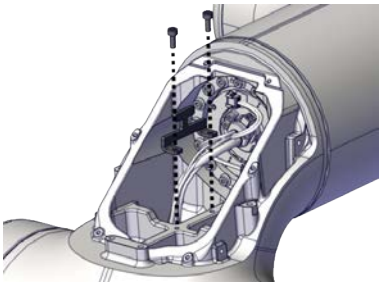
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5.4.2 Replacing the housing

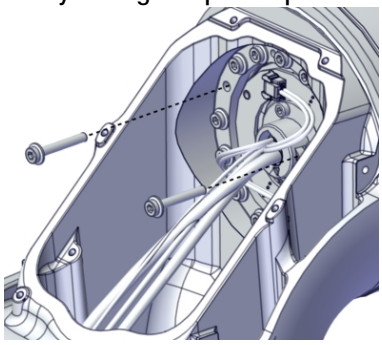
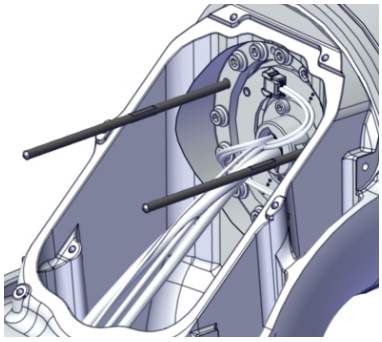
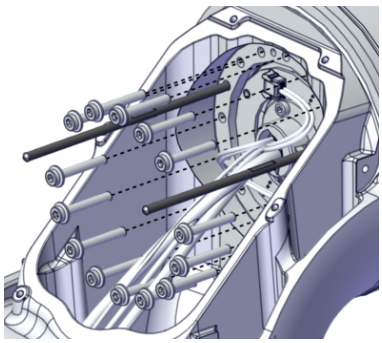
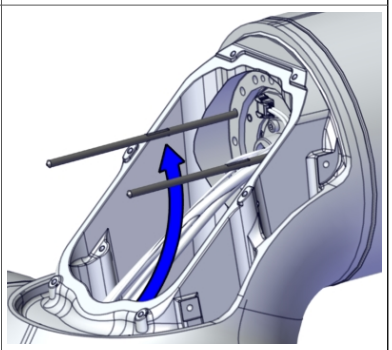
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Removing the tubular

	Action	Note
1	Cut the cable tie.	**Valid for CRB 15000-5/0.95**  xx2000002077 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000839
2	Remove the cable bracket by removing the two screws.	**Valid for CRB 15000-5/0.95**  xx2000002078 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000840

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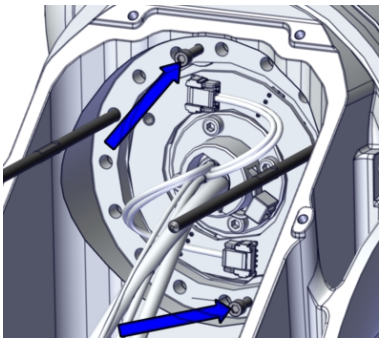
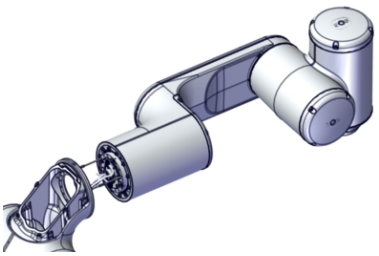
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	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-4 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002079  xx2000002080
4	Remove the remaining attachment screws.	 xx2000002081
5	Pull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

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5.4.2 Replacing the housing
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

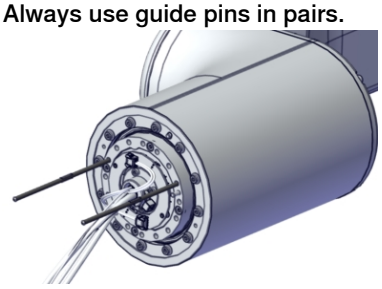
Replacing the housing

	Action	Note
1	Replace the housing.	Housing: 3HAC073949-001 (for CRB 15000-5/0.95) / 3HAC087550-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)

Refitting the housing

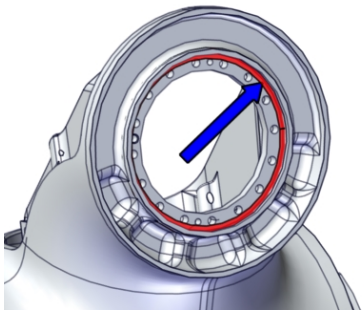
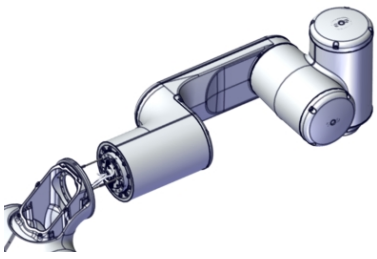
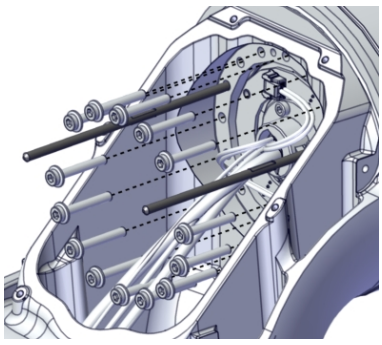
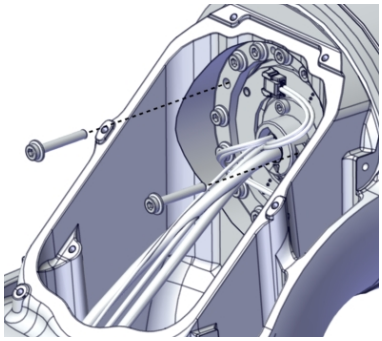
Use these procedures to refit the housing.

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

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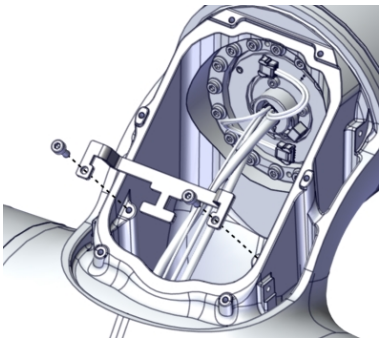
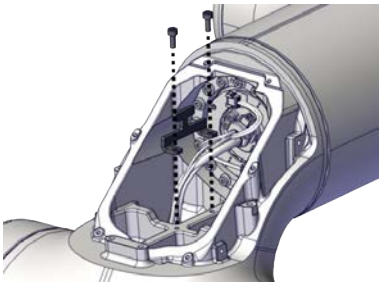
	Action	Note
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the housing mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000002094
3	Lift the tubular into mounting position while inserting the cabling into the housing.	 xx2000002082
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.	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

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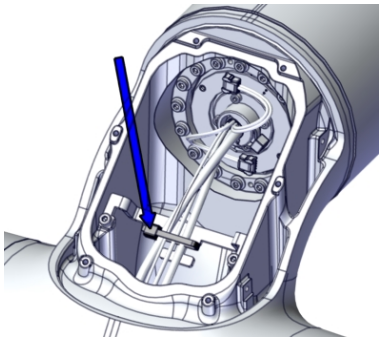
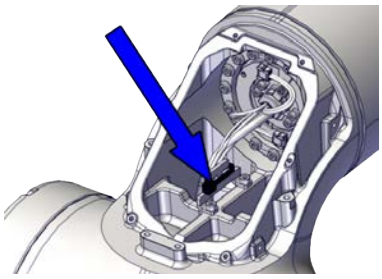
5.4.2 Replacing the housing

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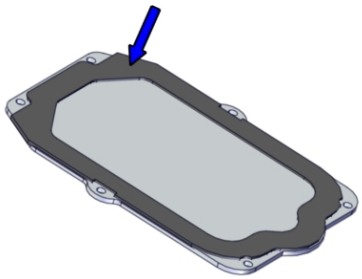
	Action	Note
7	Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.
8	Refit the cable bracket with the two screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm **Valid for CRB 15000-5/0.95**  xx2000002078 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27  xx2300000840

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	Action	Note
9	Secure the cabling with a cable tie.	Cable ties (1 pcs) **Valid for CRB 15000-5/0.95**  xx2000002077 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27  xx2300000839

Closing the housing top cover

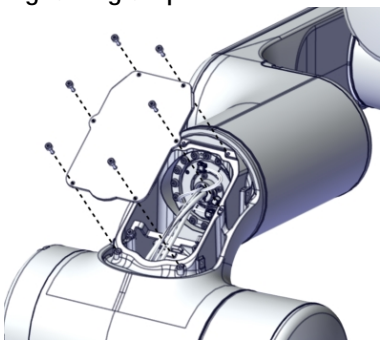
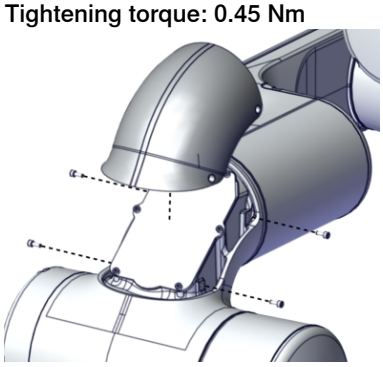
	Action	Note
1	Check the inner plate gasket. Replace if damaged.	Gasket: 3HAC075056-001  xx2000002095

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5.4.2 Replacing the housing

Continued

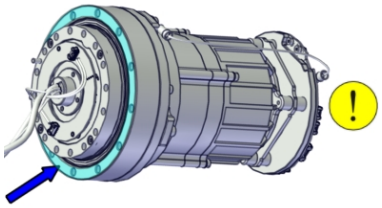
	Action	Note
2	Refit the inner plate with the screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 1.4 Nm  xx2000002076
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.45 Nm  xx2000002075

Preparations before fitting the joint unit

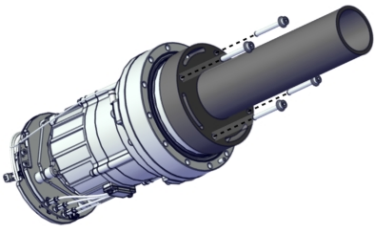
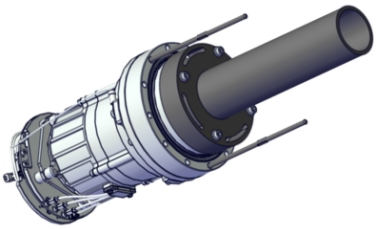
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	

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	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 (or equivalent)  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 53*.	

Refitting the axis-3 joint unit (-5/0.95)

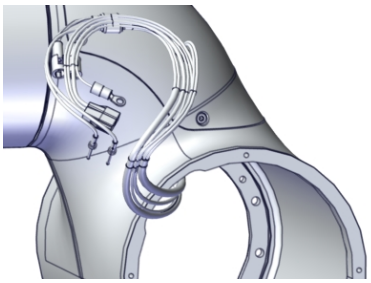
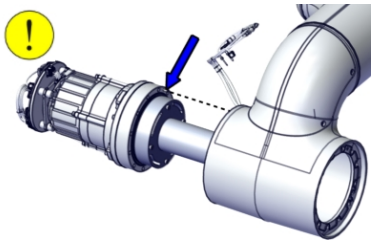
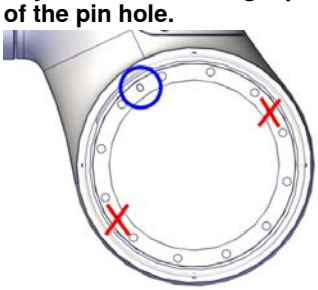
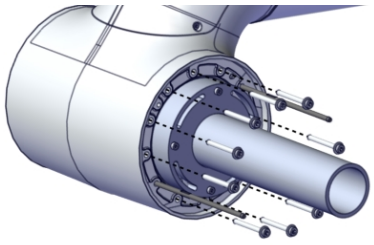
	Action	Note
1	Fit the lifting aid to the joint unit. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957
2	Fit two guide pins to the joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002438

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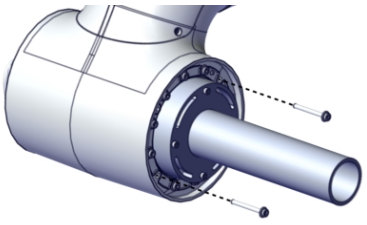
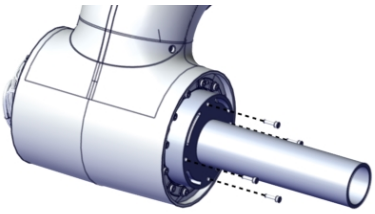
5.4.2 Replacing the housing

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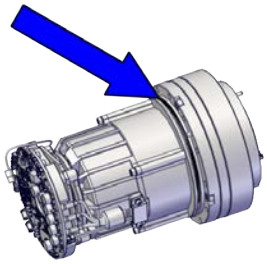
	Action	Note
3	Place the cabling at the slot before refitting the joint unit.	 xx2100000004
4	Fit the joint unit to the housing, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002072 **Pay attention to the right position of the pin hole.**  xx2400001485
5	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 Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000320

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	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.	

Refitting the axis-3 joint unit (-10/1.52 and -12/1.27)

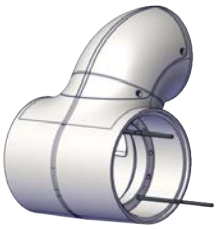
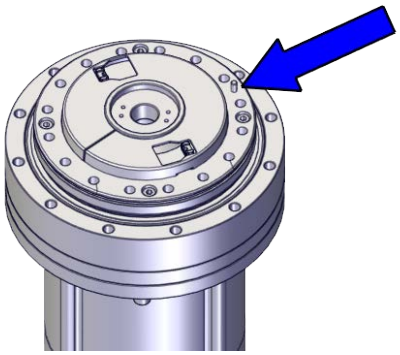
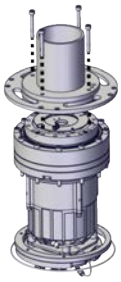
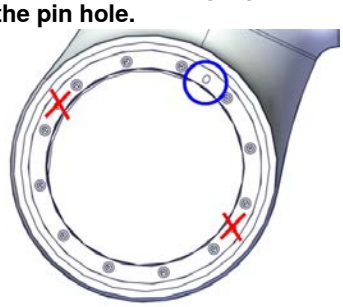
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the o-ring. Replace if damaged.	O-ring: 3HAC061327-036  xx2300000836

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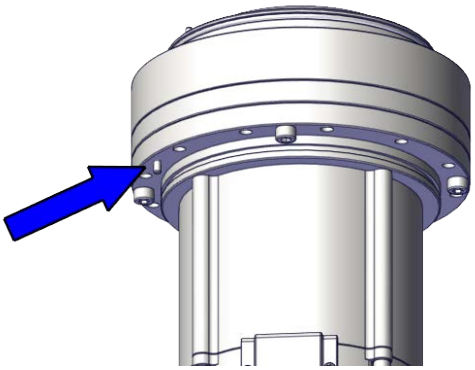
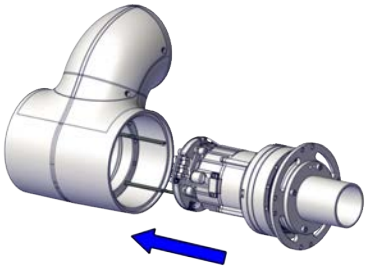
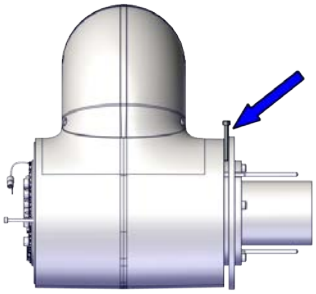
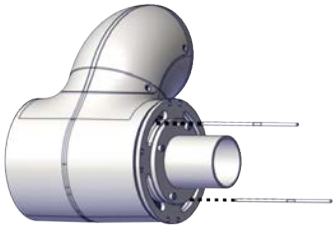
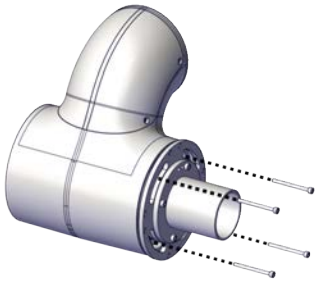
5.4.2 Replacing the housing

Continued

	Action	Note
3	Fit two guide pins to the housing.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2300000803
4	Fit the lifting aid to the joint unit, 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.  xx2300000777	Joint unit: 3HAC087474-001 Lifting aid: 3HAC087788-001 Screws: M4x30 (4 pcs)  xx2300000804 **Pay attention to the right position of the pin hole.**  xx2400001486

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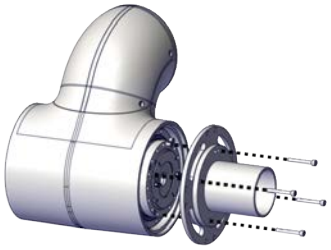
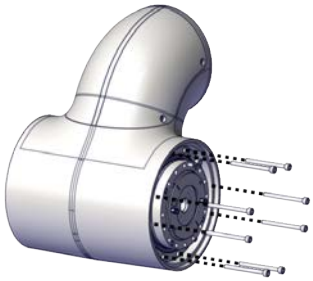
	Action	Note
5	Fit the joint unit to the housing, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  xx2300000780	 xx2300000806
6	Check the joint unit position by placing an M4 screw between the lifting aid and housing. The joint unit is properly placed when no gaps between the lifting aid and housing.	 xx2300000808
7	Remove the guide pins.	 xx2300000809
8	Secure with four attachment screws and pretighten the screws crosswise.	 xx2300000810

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5.4.2 Replacing the housing

Continued

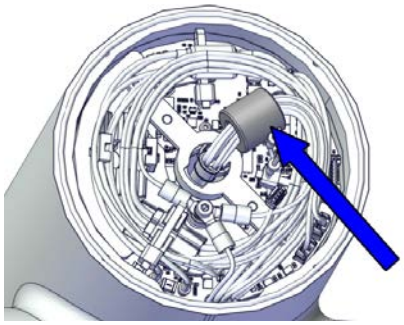
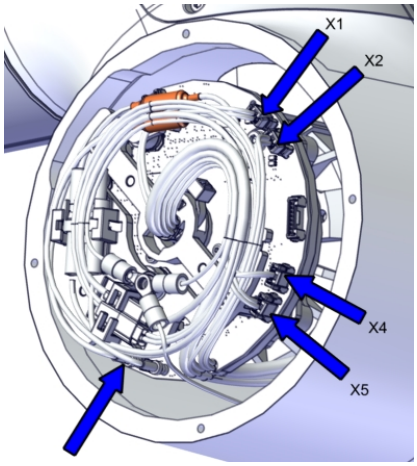
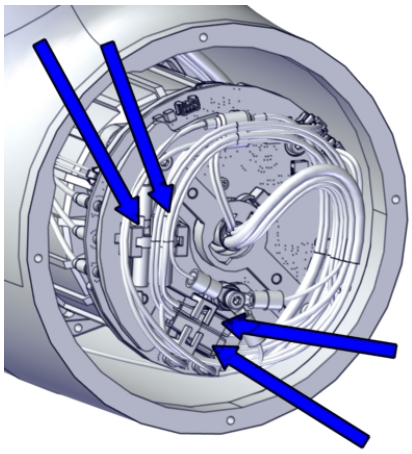
	Action	Note
9	Remove the lifting aid by removing the screws.	 xx2300000800
10	Secure the joint unit with the remaining attachment screws.	Hex socket head cap screw: 3HAB3409-262  xx2300000811
11	Torque tighten all screws crosswise.	M4x45 12.9 Lafre 2C2B/FC6.9, 12 pcs Tightening torque: 4.3 Nm.

Connecting the axis-3 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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484

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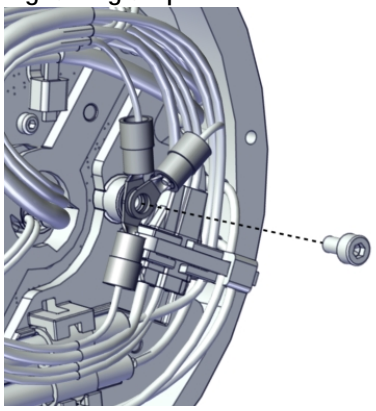
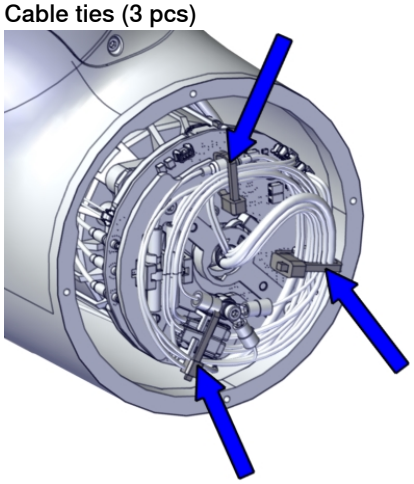
	Action	Note
3	Thread the cables D3.X4 and D3.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • D3.X1 to X1 • D3/4.DC+ to DC+ • D3/4.DC- to Ground • D3.X4 to X4 • D3/4.X2 to X2 • D3.X5 to X5	 xx2000002068
5	Connect the connectors to each other and snap them to the cable holders. • 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

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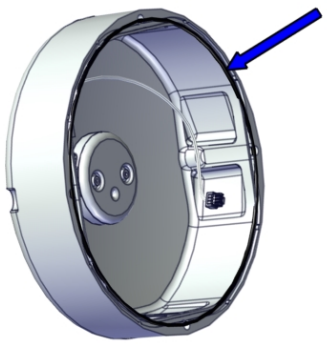
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5.4.2 Replacing the housing

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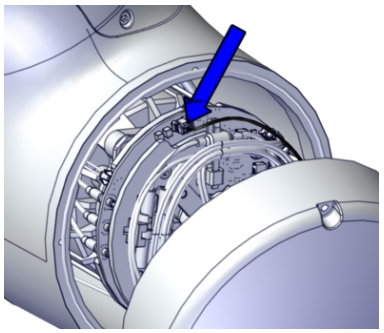
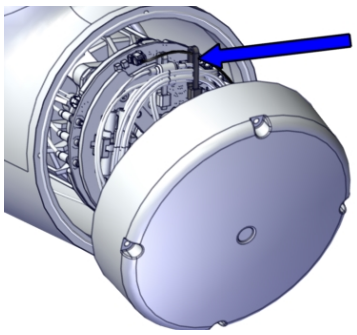
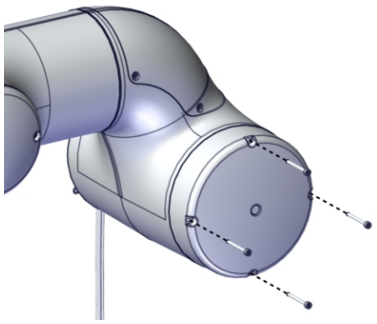
	Action	Note
6	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000001945
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002066

Refitting the housing cover (-5/0.95)

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

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	Action	Note
2	**For robots with RobotWare earlier than 7.10** 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	**For robots with RobotWare earlier than 7.10** 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

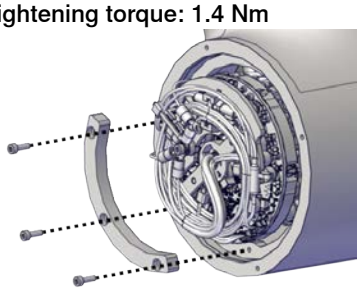
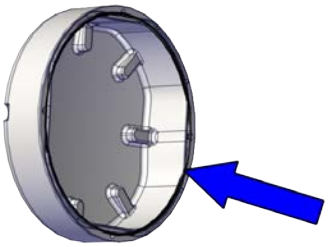
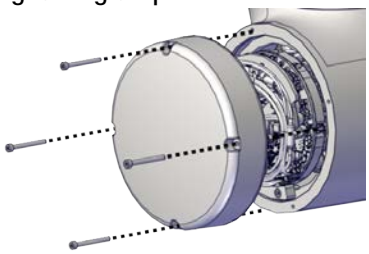
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5.4.2 Replacing the housing

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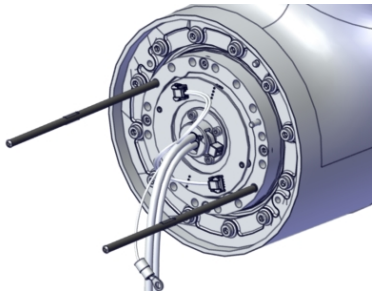
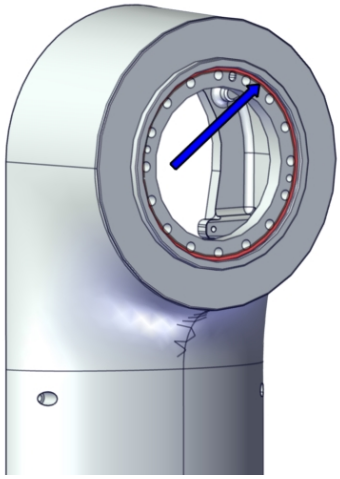
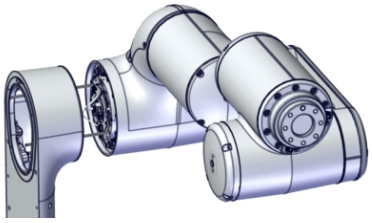
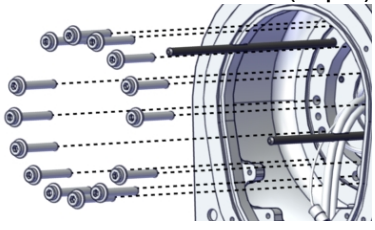
Refitting the housing cover and insert (-10/1.52 and -12/1.27)

	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000834
2	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2300000835
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000833

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Refitting the upper arm

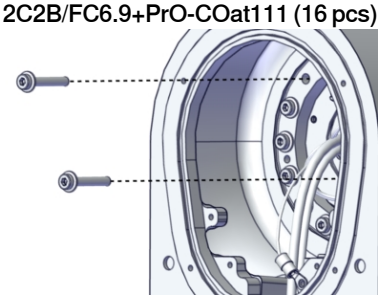
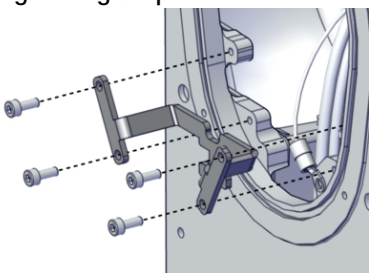
	Action	Note
1	Fit two guide pins to the axis-3 joint.	Guide pin, M4x120: 3HAC077786-001  xx2000001971
2	**Valid for CRB 15000-5/0.95** Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000001973
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

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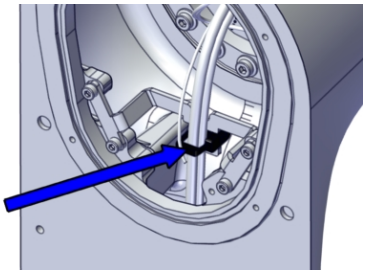
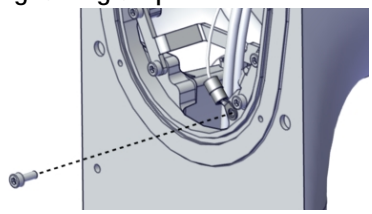
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5.4.2 Replacing the housing

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)  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

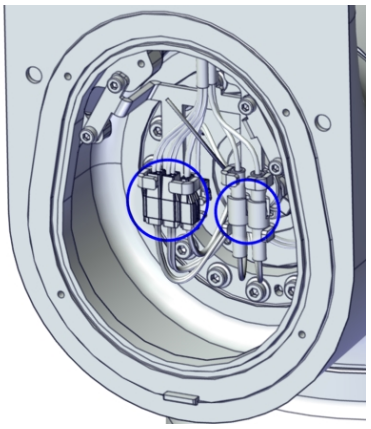
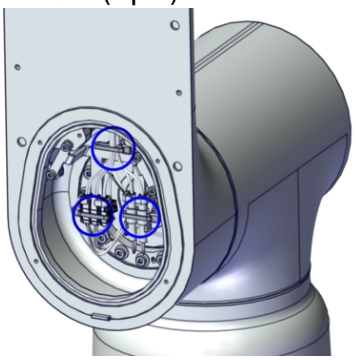
Fastening the cabling between the lower and upper arm

	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

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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

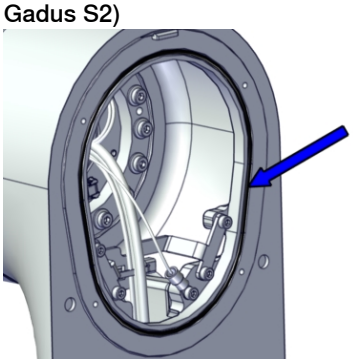
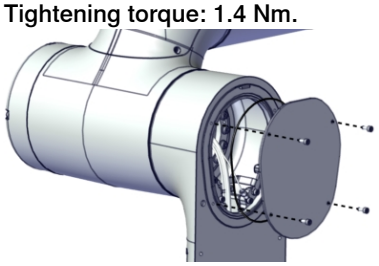
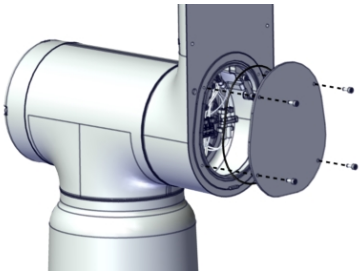
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5.4.2 Replacing the housing

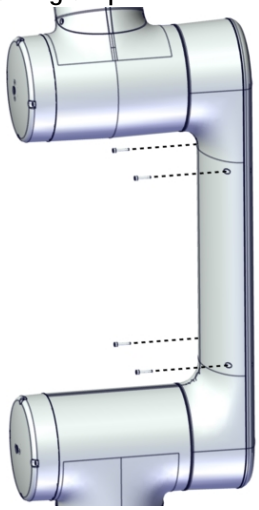
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Refitting the lower arm covers (-5/0.95)

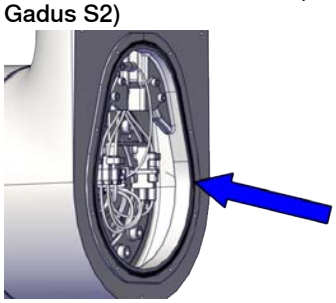
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001955  xx2000001954
2	Refit the inner covers with four screws each.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) Tightening torque: 1.4 Nm.  xx2000001947  xx2000001930

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	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.  xx2000001929
4	Secure the cover with four screws.	

Refitting the lower arm covers (-10/1.52 and -12/1.27)

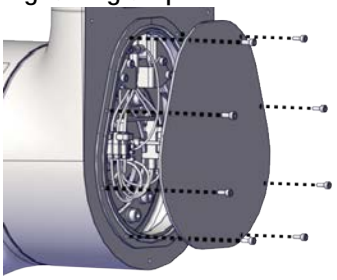
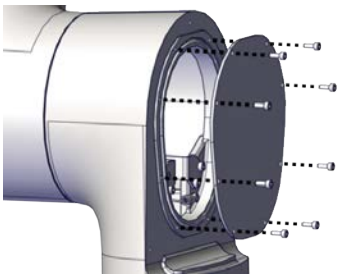
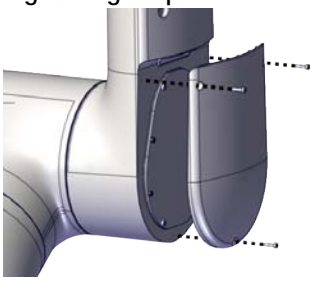
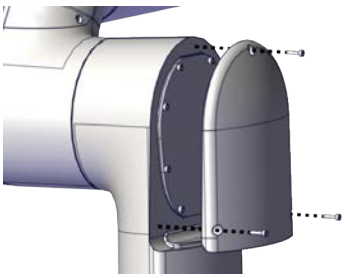
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-075 O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2300000832  xx2300000831

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5.4.2 Replacing the housing

Continued

	Action	Note
2	Refit the inner covers with eight screws each.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) x 2 Tightening torque: 1.4 Nm.  xx2300000813  xx2300000830
3	Snap the lower arm cover into place.	Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) x 2 Tightening torque: 1.4 Nm.  xx2300000812  xx2300000829
4	Secure the cover with three screws.	

Concluding procedure

	Action	Note
1	Calibrate the axis-3 joint unit torque sensor.	See *Calibration on page 1047*

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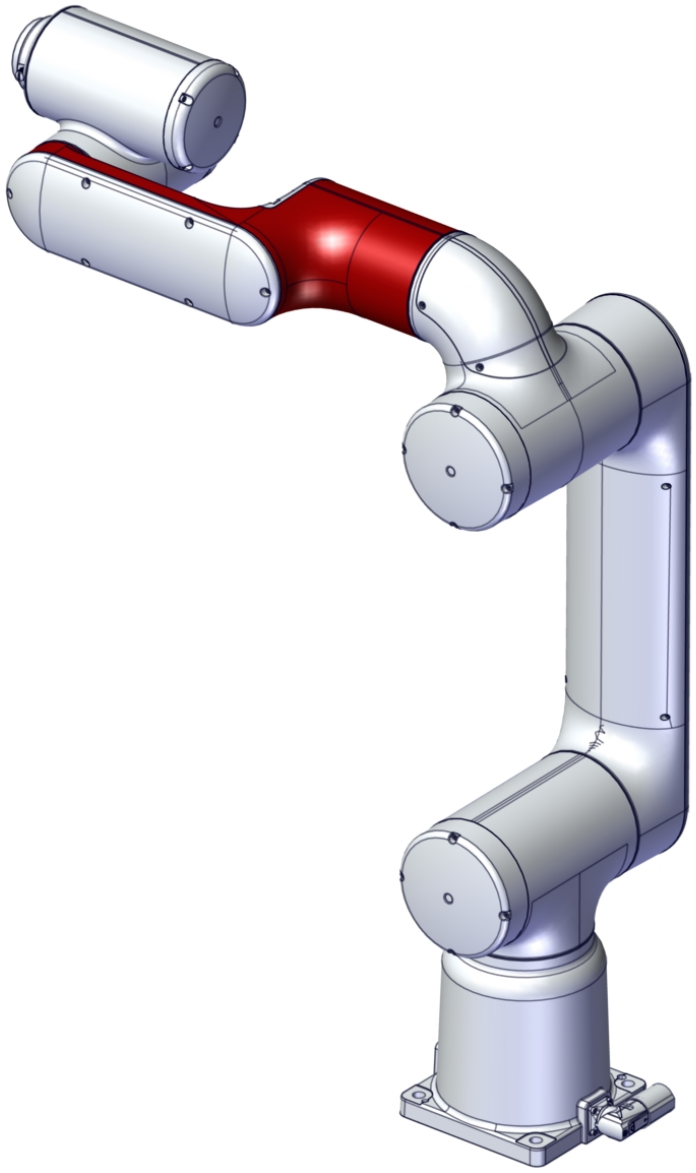
	Action	Note
2	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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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

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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	Used for CRB 15000-5/0.95. Also order new attachment screws for the axis-4 joint unit: 3HAB3413-330 (12 pcs).
Tubular, long	3HAC083685-001	Used for CRB 15000-10/1.52. Also order new attachment screws for the axis-4 joint unit: 3HAB3413-330 (12 pcs).
Tubular, short	3HAC081054-001	Used for CRB 15000-12/1.27. 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 of CRB 15000-5/0.95. 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 Used for joint unit of CRB 15000-5/0.95. 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.

Continues on next page

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5.4.3 Replacing the tubular
Continued

Equipment	Article number	Note
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 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Cable ties	-	
O-ring	3HAC061327-043	Tubular cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAB3772-166	Tubular cover, upper, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-076	Tubular cover, lower, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
Grease	3HAC042536-001	Shell Gadus S2
O-ring	3HAC061327-051	Axis-4 cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-051	Axis-4 cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
Gasket	3HAC075056-001	Cover inside housing Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-047	Housing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.

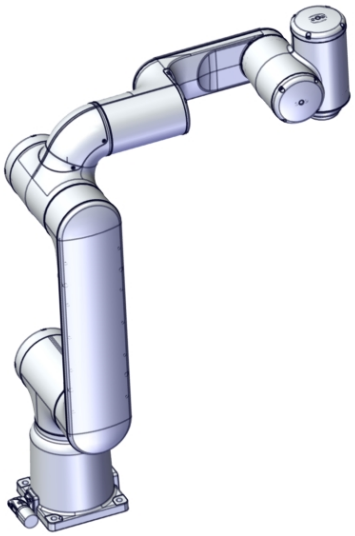
Removing the tubular

Use these procedures to remove the tubular.

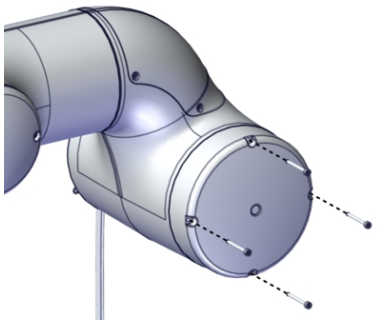
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Preparations before removing the tubular

	Action	Note
1	Jog the robot to the specified position: • Axis 1: No significance. • Axis 2: 0° • Axis 3: 0° • Axis 4: 0° • Axis 5: +90° • Axis 6: No significance.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000005
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

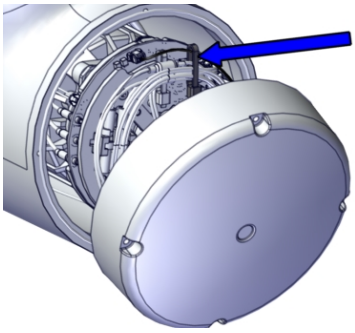
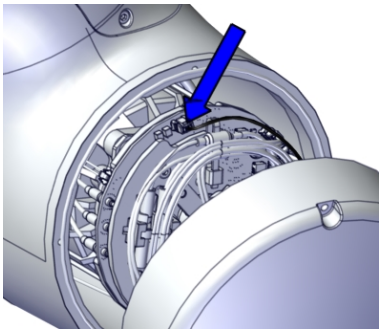
Removing the housing cover (-5/0.95)

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover screws.	 xx2000002021

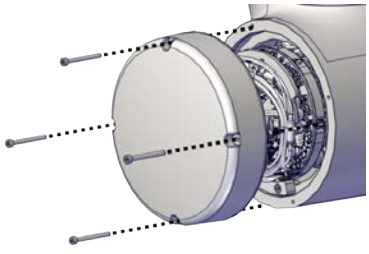
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5.4.3 Replacing the tubular
Continued

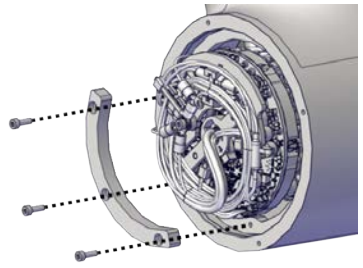
	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002022
5	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002023

Removing the housing cover and insert (-10/1.52 and -12/1.27)

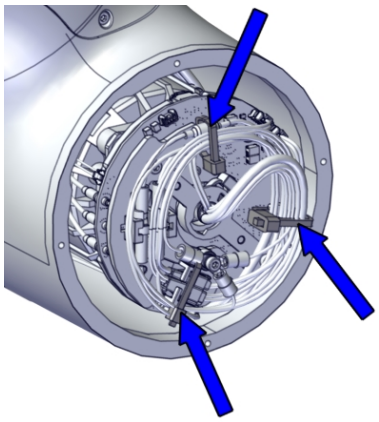
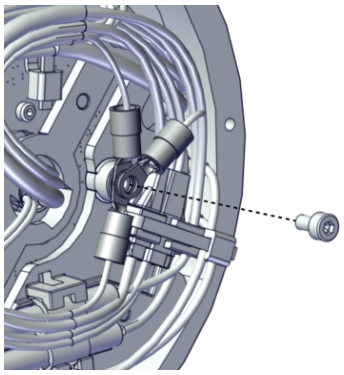
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000833

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	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	Remove the insert.	 xx2300000834

Separating the cabling between the housing and the tubular

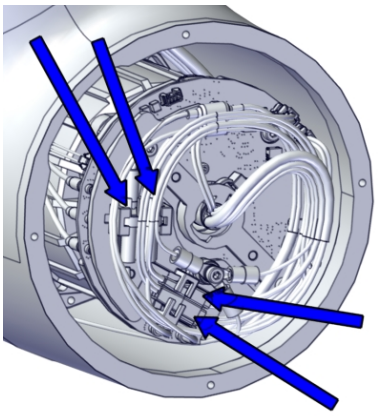
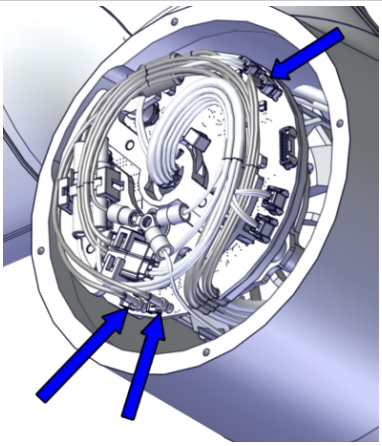
	Action	Note
1	Cut the cable ties.	 xx2000002066
2	Remove the functional and protective earth cables by removing the screw.	 xx2000001945

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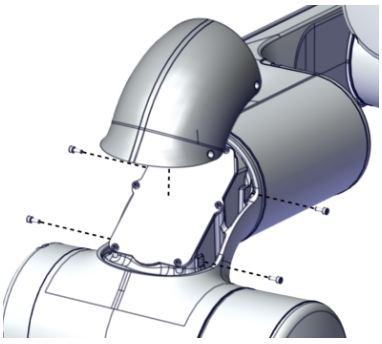
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5.4.3 Replacing the tubular

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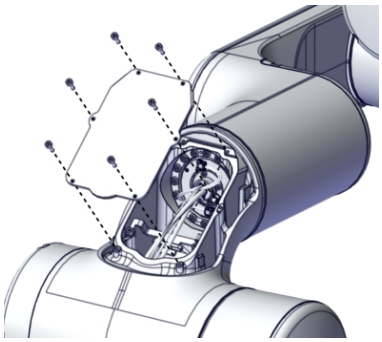
	Action	Note
3	Snap loose and disconnect the connectors: • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP	 xx2000002067
4	Disconnect the connectors from the drive board. • D3/4.X2 • D3/4.DC+ • D3/4.DC-	 xx2000002120

Opening the housing top cover

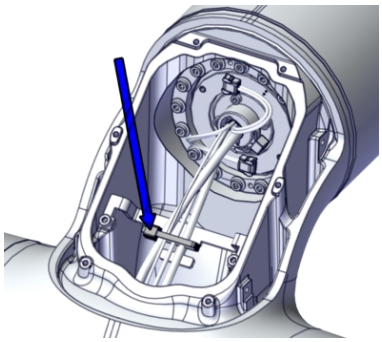
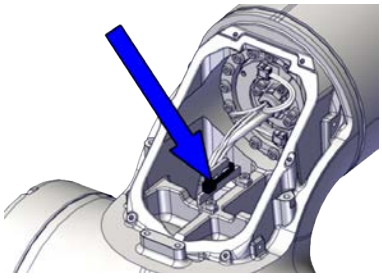
	Action	Note
1	Remove the cover by removing the four screws.	 xx2000002075

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	Action	Note
2	Remove the inner plate by removing the screws.	 xx2000002076

Removing the tubular

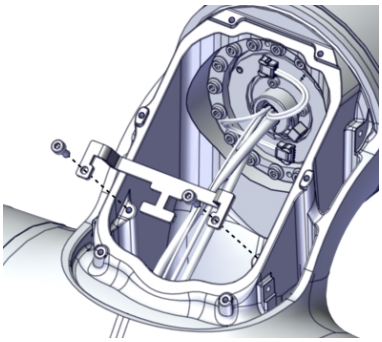
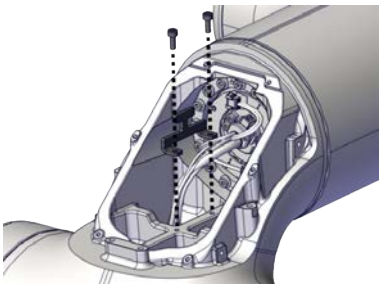
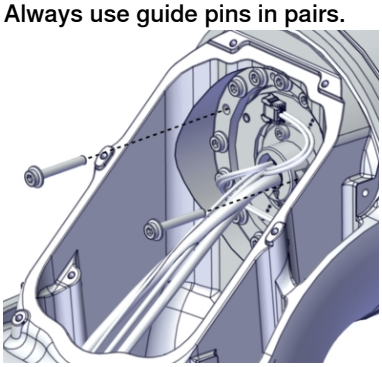
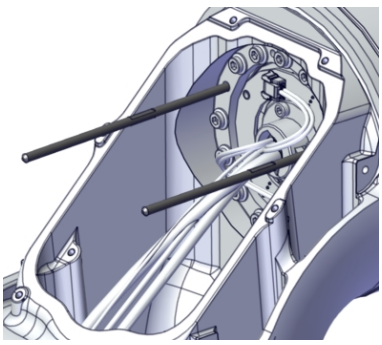
	Action	Note
1	Cut the cable tie.	**Valid for CRB 15000-5/0.95**  xx2000002077 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000839

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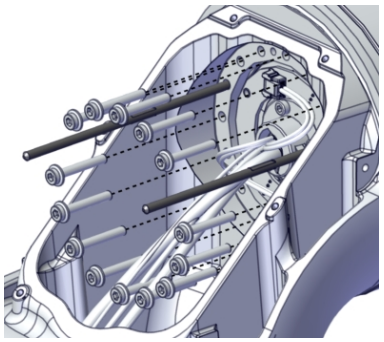
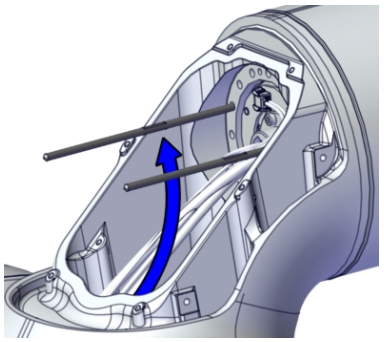
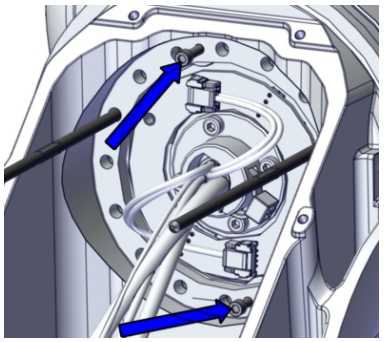
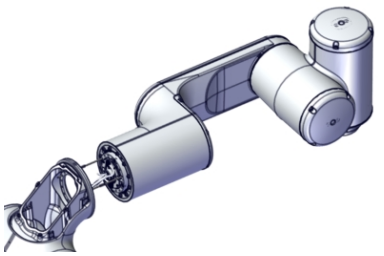
5.4.3 Replacing the tubular

Continued

	Action	Note
2	Remove the cable bracket by removing the two screws.	**Valid for CRB 15000-5/0.95**  xx2000002078 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000840
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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	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

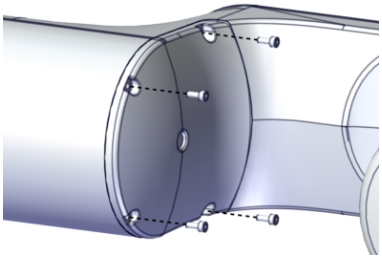
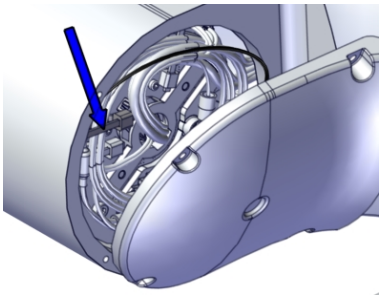
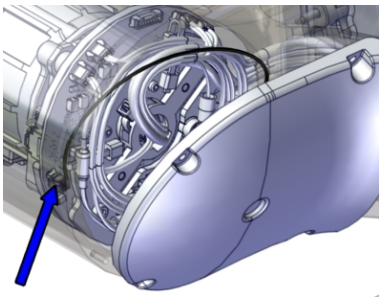
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5.4.3 Replacing the tubular

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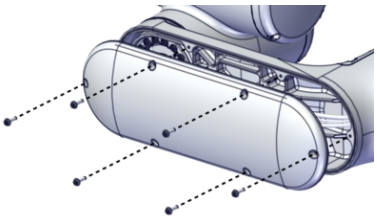
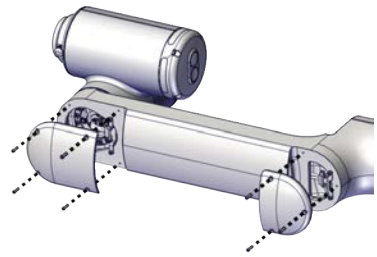
Removing the axis-4 cover

	Action	Note
1	Remove the cover screws.	 xx2000002083
2	**CAUTION** **Valid for CRB 15000-5/0.95** 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	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002084
4	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	Tweezers  xx2000002085

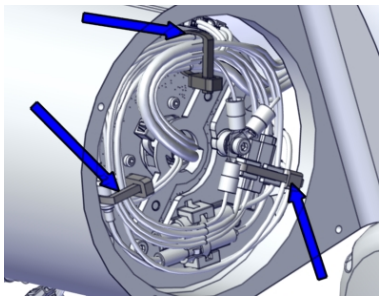
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Removing the tubular cover

	Action	Note
1	**Valid for CRB 15000-5/0.95** 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
2	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the covers by removing the screws.	 xx2300000841

Separating the cabling between the tubular and the tilt

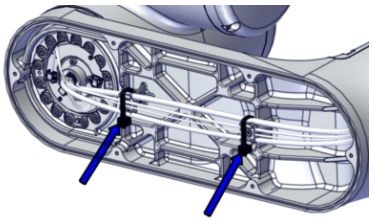
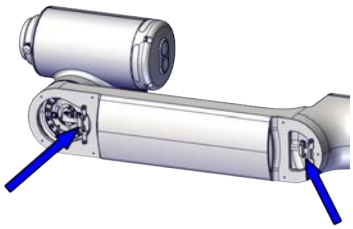
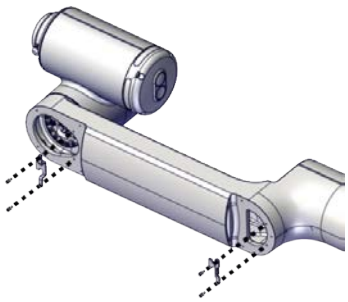
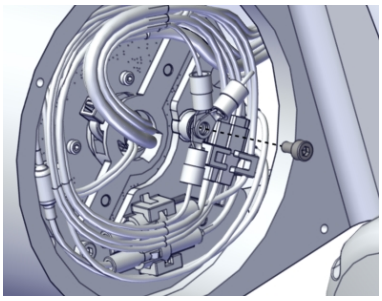
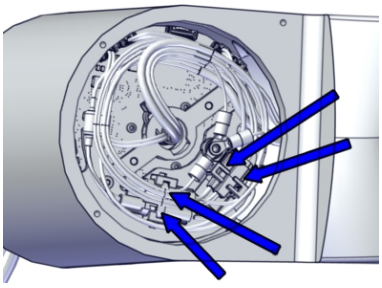
	Action	Note
1	Cut the cable ties on joint unit.	 xx2000002086

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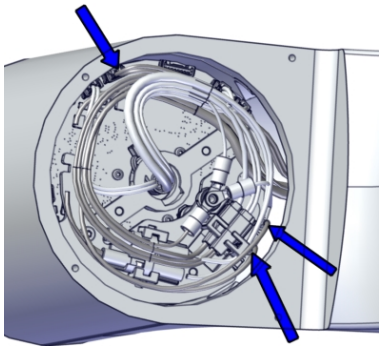
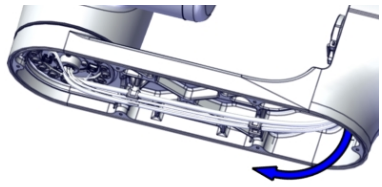
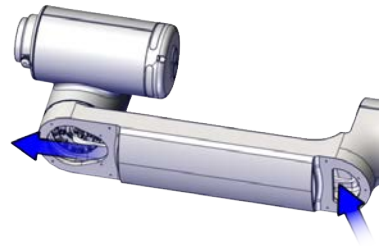
5.4.3 Replacing the tubular

Continued

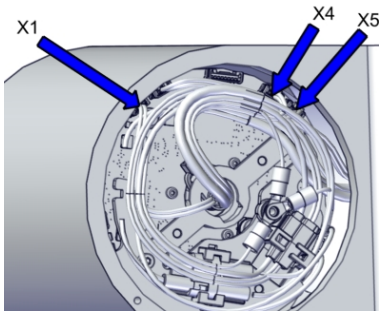
	Action	Note
2	Cut the cable ties on tubular, if needed.	**Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842
3	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the cable brackets.	 xx2300000843
4	Remove the functional and protective earth cables by removing the screw.	 xx2000002087
5	Snap loose and disconnect the connectors: • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP	 xx2000002089

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	Action	Note
6	Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board: • D3/4.X2 • D3/4.DC- • D3/4.DC+ Use tweezers, if needed.	Tweezers  xx2000002125
7	Pull out the cabling carefully from the tubular.	**Valid for CRB 15000-5/0.95**  xx2000002126 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000844

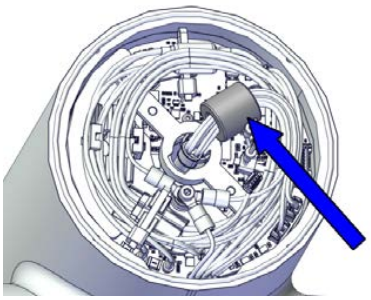
Disconnecting the axis-4 joint unit cabling

	Action	Note
1	Disconnect the connectors from the drive board. **CAUTION** Use tweezers to unlock connectors and pull them off. • D4/5.X1 • D4/5.X4 • D4/5.X5	Tweezers  xx2000002088

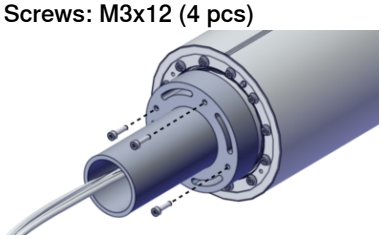
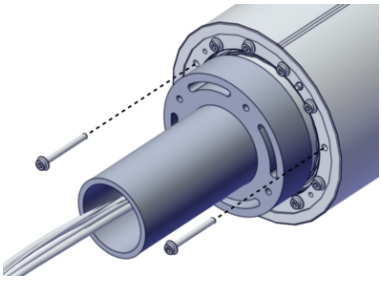
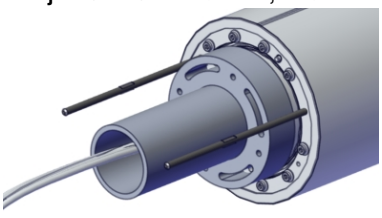
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5.4.3 Replacing the tubular
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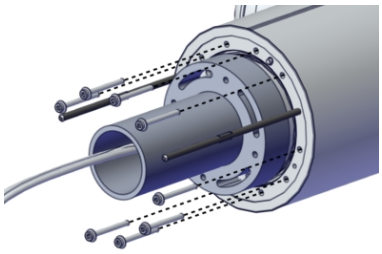
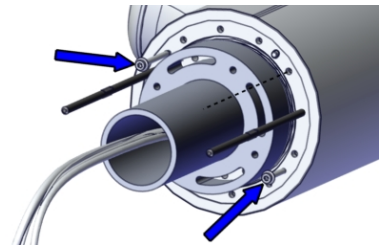
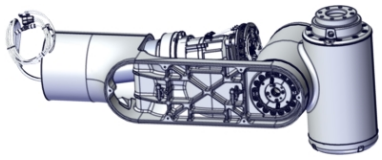
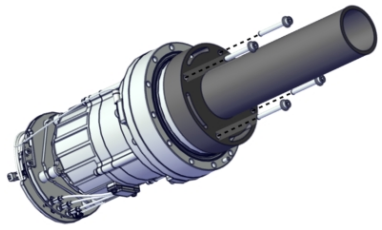
	Action	Note
2	Remove the ferrite core by pulling the cables D4/5.X4 and D4/5.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-4 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)  xx2000002090
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2000002091
3	Fit two guide pins to the axis-4 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2000002578

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	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.	 xx2100000326
5	Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2100000327
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.	 xx2000002116
7	Remove the lifting aid and guide pins.	 xx2000001957

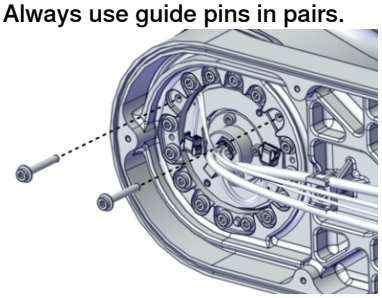
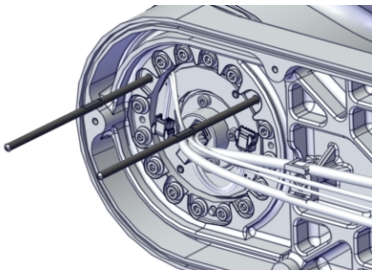
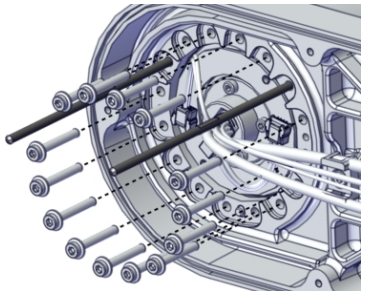
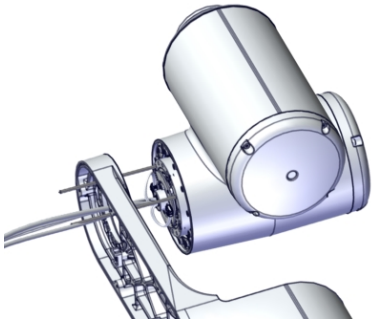
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5.4.3 Replacing the tubular

Continued

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.	
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

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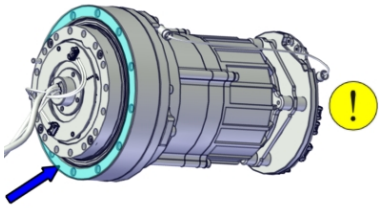
Replacing the tubular

	Action	Note
1	Replace the tubular.	Tubular: 3HAC074509-001 (for CRB 15000-5/0.95) Tubular: 3HAC083685-001 (for CRB 15000-10/1.52) Tubular: 3HAC081054-001 (for CRB 15000-12/1.27)

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 53*.	
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 (or equivalent)  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 53*.	

Refitting the axis-4 joint unit

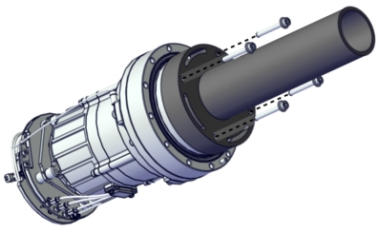
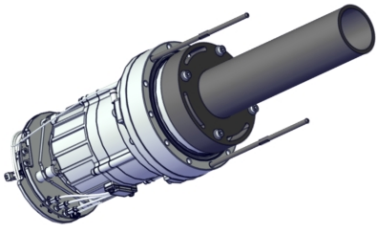
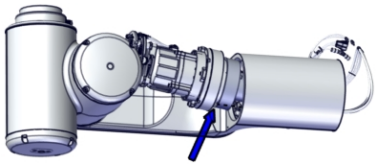
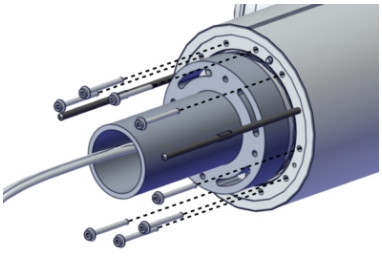
	Action	Note
1	**CAUTION** Axis-4 joint unit used for CRB 15000-5/0.95 has the same appearance as that used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Do not mix the joint units for different manipulator variants. Always check the mark or label on the joint units before refitting.	

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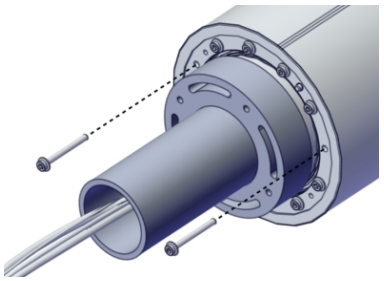
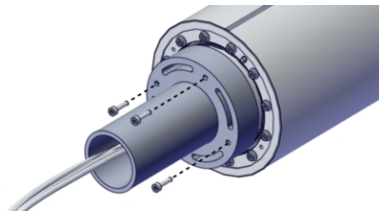
5.4.3 Replacing the tubular

Continued

	Action	Note
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: 3HAC079143-001 (for CRB 15000-5/0.95) / 3HAC087546-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
3	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
4	Fit the joint unit to the tubular, 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.	 xx2000002117
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.  xx2100000326

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	Action	Note
6	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002091
7	Pre-tighten the screws crosswise.	
8	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm (for CRB 15000-5/0.95) / 1.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)
9	Remove the lifting aid by removing the screws.	 xx2000002090
10	Clean pushed-out flange sealant, if any.	

Connecting the axis-4 joint unit cabling

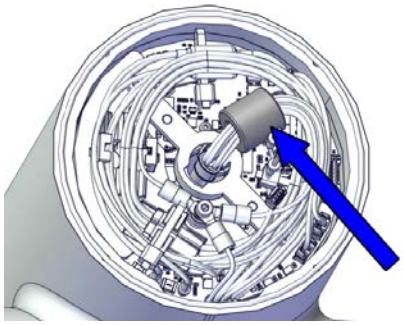
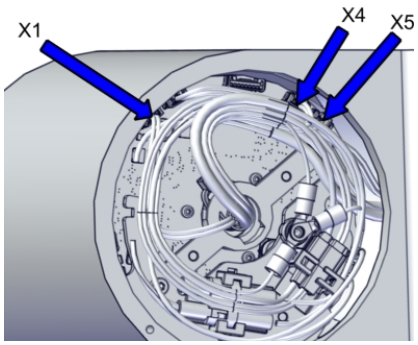
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484

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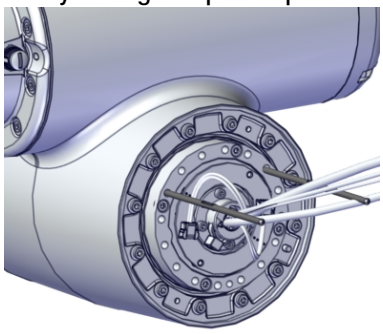
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5.4.3 Replacing the tubular

Continued

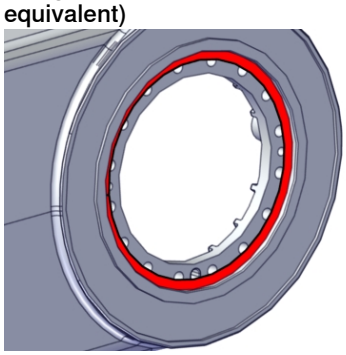
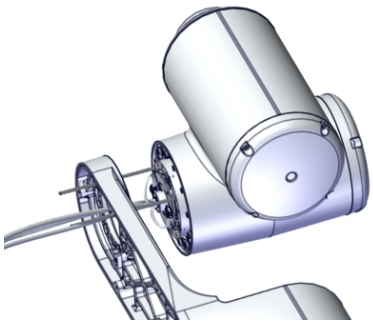
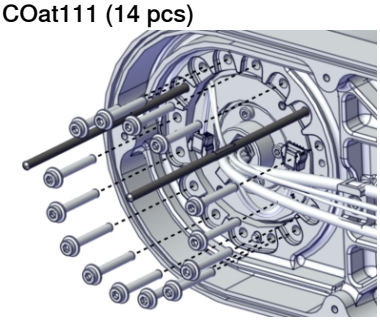
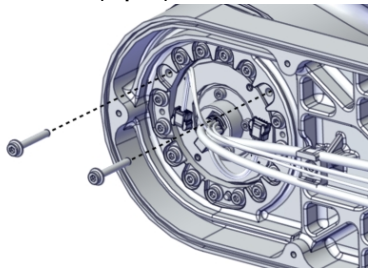
	Action	Note
3	Thread the cables D4/5.X4 and D4/5.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • D4/5.X1 to X1 • D4/5.X4 to X4 • D4/5.X5 to X5	 xx2000002088

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

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	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 (or equivalent)  xx2000002147
3	Lift the tilt into mounting position while inserting the cabling into the tubular.	 xx2000002131
4	Slide the tilt into place on the guide pins.	
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

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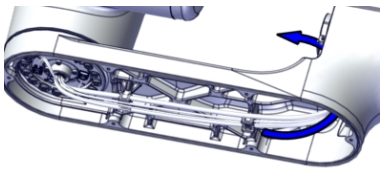
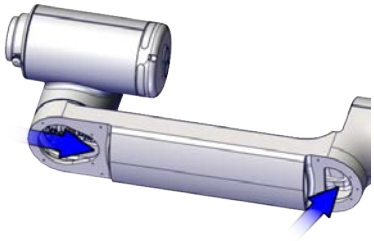
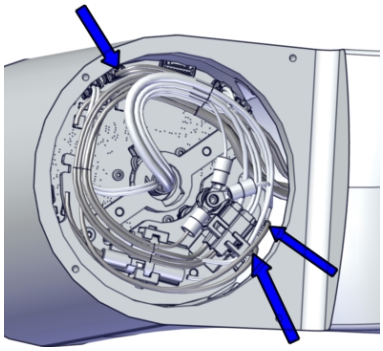
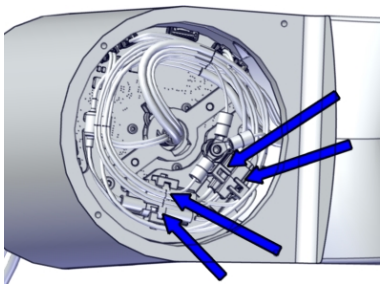
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5.4.3 Replacing the tubular

Continued

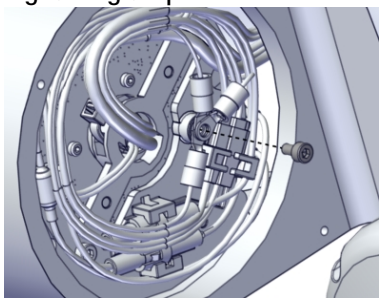
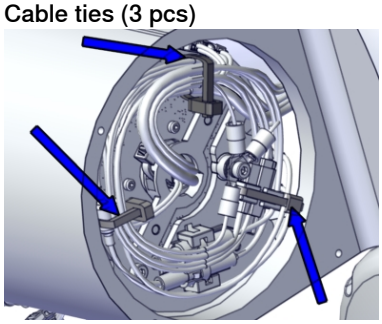
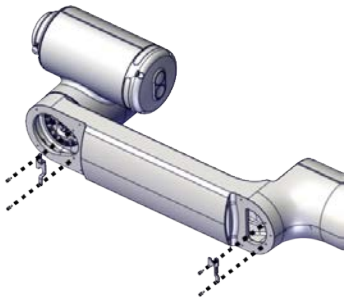
	Action	Note
7	Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.

Connecting the tilt cabling

	Action	Note
1	Insert the cabling into the tubular.	**Valid for CRB 15000-5/0.95**  xx2000002148 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000845
2	Reconnect the connectors to the drive board. • 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. • 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

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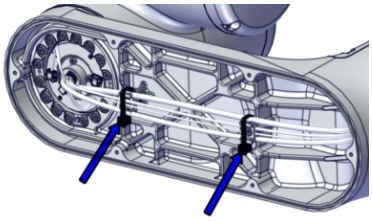
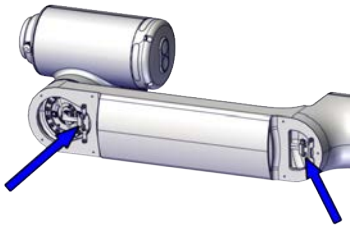
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	Action	Note
4	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002087
5	Secure the cabling to joint unit with cable ties.	Cable ties (3 pcs)  xx2000002086
6	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Refit the cable brackets.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs for each). Tightening torque: 0.8 Nm.  xx2300000843

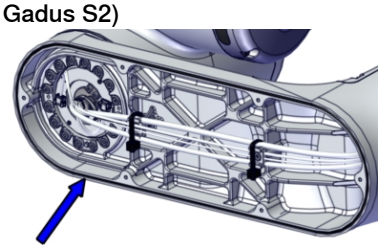
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5.4.3 Replacing the tubular
Continued

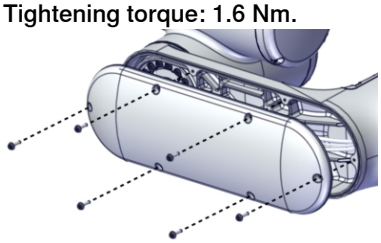
	Action	Note
7	Secure the cabling to tubular with cable ties.	Cable ties (2 pcs) **Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842

Refitting the tubular cover (-5/0.95)

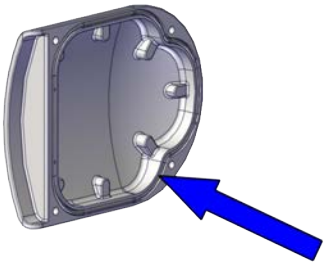
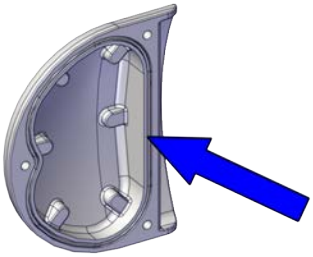
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-043 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002149

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	Action	Note
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 of CRB 15000-5/0.95. 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 tubular cover (-10/1.52 and -12/1.27)

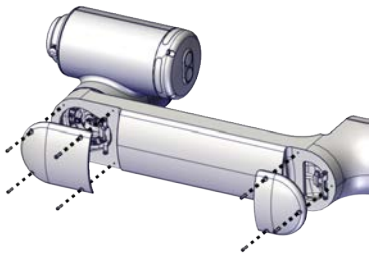
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damged.	O-ring: 3HAC061327-076 O-ring: 3HAB3772-166 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2300000846  xx2300000847

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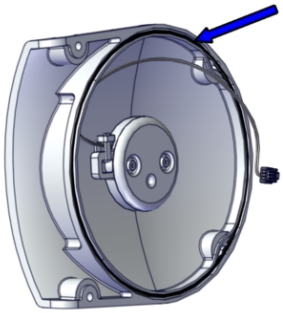
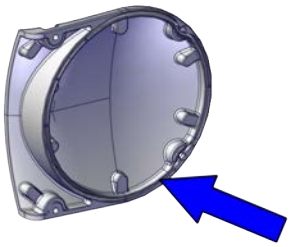
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5.4.3 Replacing the tubular

Continued

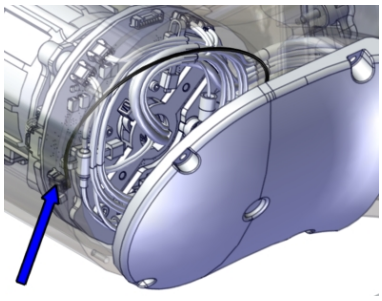
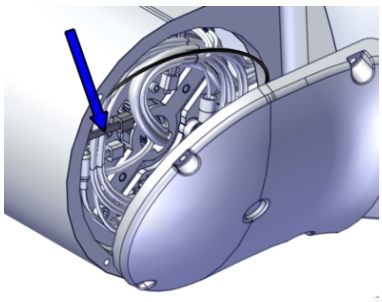
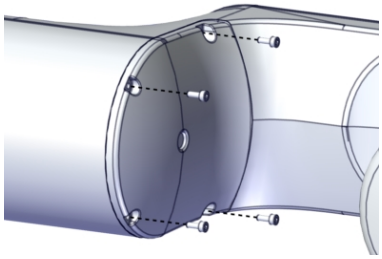
	Action	Note
2	Refit the covers with new attachment screws.	Hex socket head cap screw:M3x12 12.9 Lafre 2C2B/FC6.9 (7 pcs in total) Tightening torque: 1.4 Nm.  xx2300000841

Refitting the axis-4 cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	**Valid for CRB 15000-5/0.95** O-ring: 3HAC061327-051  xx2000002092 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 O-ring: 3HAC061327-051  xx2300000848

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	Action	Note
2	**For robots with RobotWare earlier than 7.10** Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	Tweezers  xx2000002085
3	**For robots with RobotWare earlier than 7.10** 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 (for CRB 15000-5/0.95) / 0.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Tightening torque: 0.9 Nm  xx2000002083

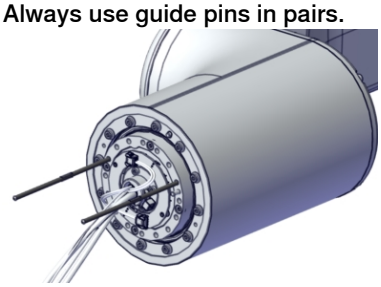
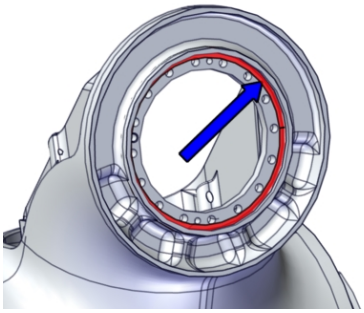
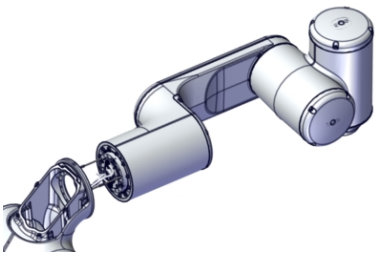
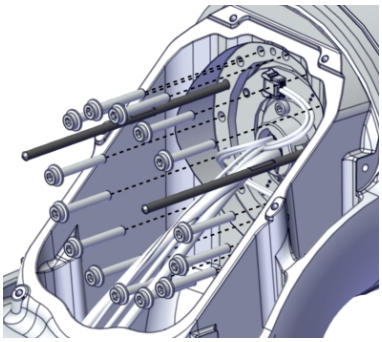
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5.4.3 Replacing the tubular

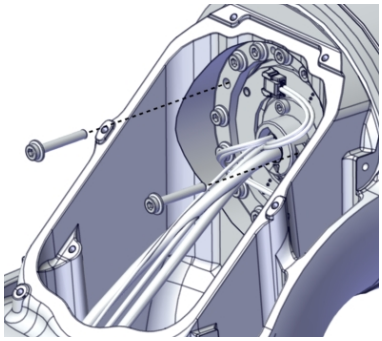
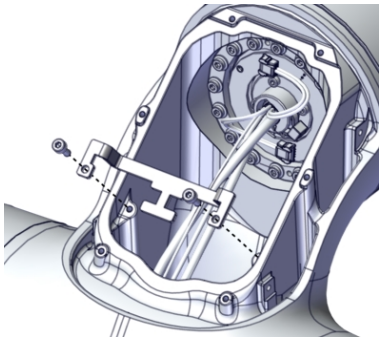
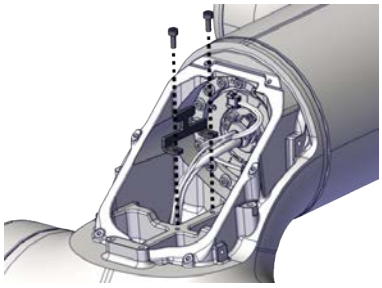
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Refitting the tubular

	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 (or equivalent)  xx2000002094
3	Lift the tubular into mounting position while inserting the cabling into the housing.	 xx2000002082
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.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111  xx2000002081

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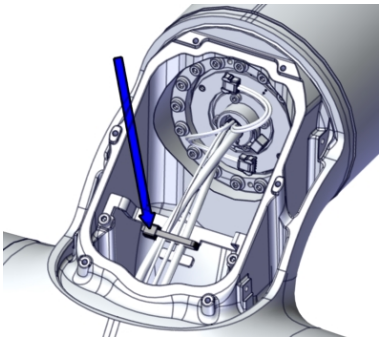
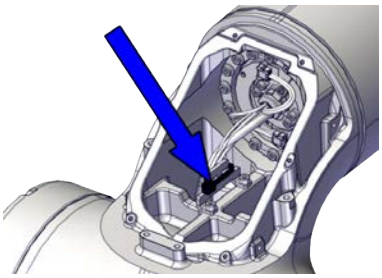
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	Action	Note
6	Remove the guide pins and fasten the remaining two screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111  xx2000002079
7	Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.
8	Refit the cable bracket with the two screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm **Valid for CRB 15000-5/0.95**  xx2000002078 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27  xx2300000840

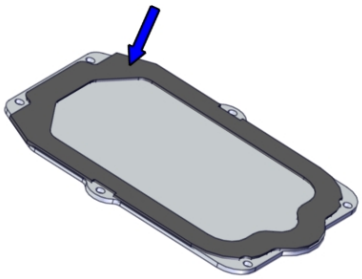
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5.4.3 Replacing the tubular
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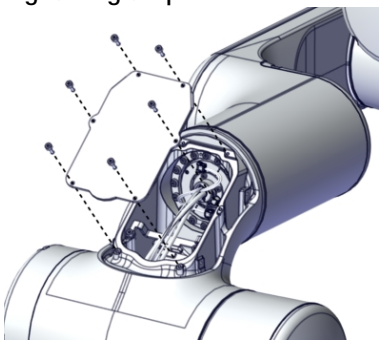
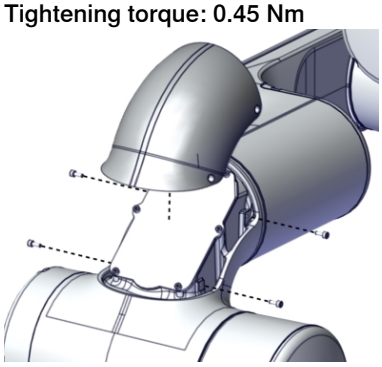
	Action	Note
9	Secure the cabling with a cable tie.	Cable ties (1 pcs) **Valid for CRB 15000-5/0.95**  xx2000002077 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27  xx2300000839

Closing the housing top cover

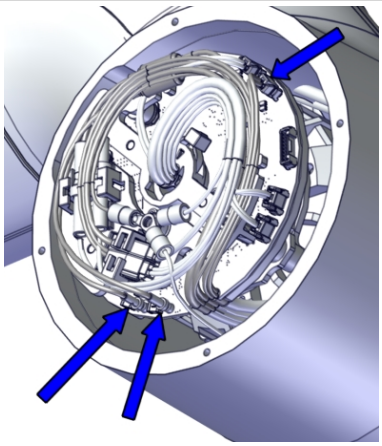
	Action	Note
1	Check the inner plate gasket. Replace if damaged.	Gasket: 3HAC075056-001  xx2000002095

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	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

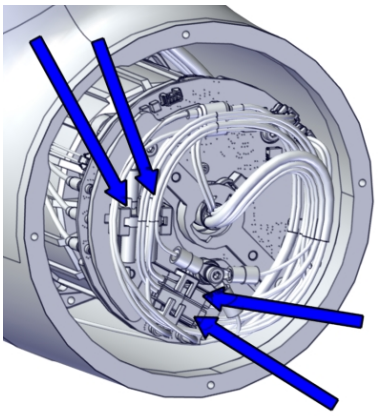
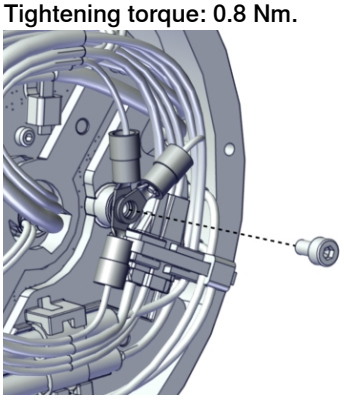
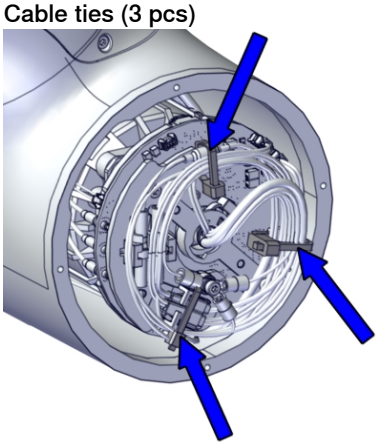
	Action	Note
1	Reconnect the connectors to the drive board. • D3/4.DC+ to DC+ • D3/4.DC- to Ground • D3/4.X2 to X2	 xx2000002120

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5.4.3 Replacing the tubular

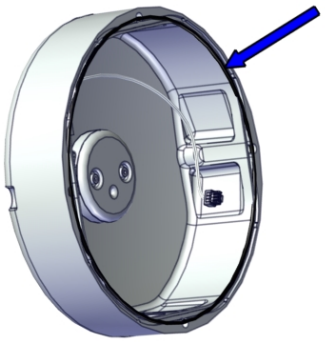
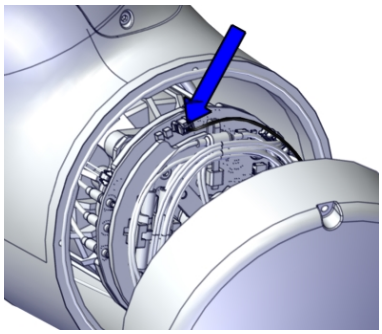
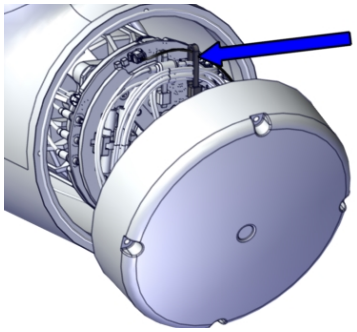
Continued

	Action	Note
2	Connect the connectors to each other and snap them to the cable holders. • J3.DC+ to J3.DC+ • J3.DC- to J3.DC- • J3.CS to J3.CS • J3.CP to J3.CP	 xx2000002067
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.  xx2000001945
4	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002066

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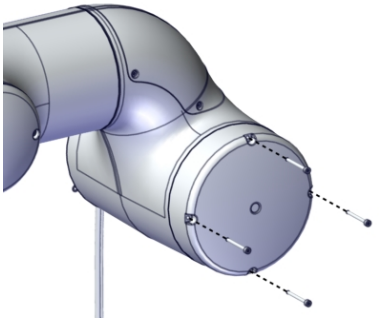
Refitting the housing cover (-5/0.95)

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2	**For robots with RobotWare earlier than 7.10** 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	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000002022

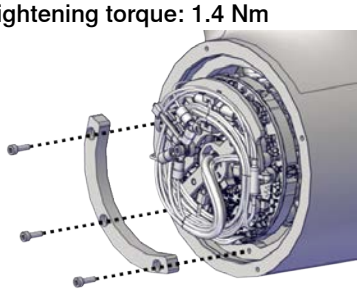
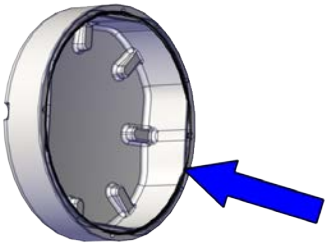
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5.4.3 Replacing the tubular
Continued

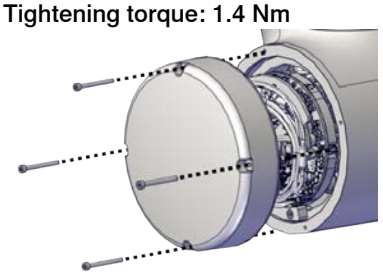
	Action	Note
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002021

Refitting the housing cover and insert (-10/1.52 and -12/1.27)

	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000834
2	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2300000835

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	Action	Note
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000833

Concluding procedure

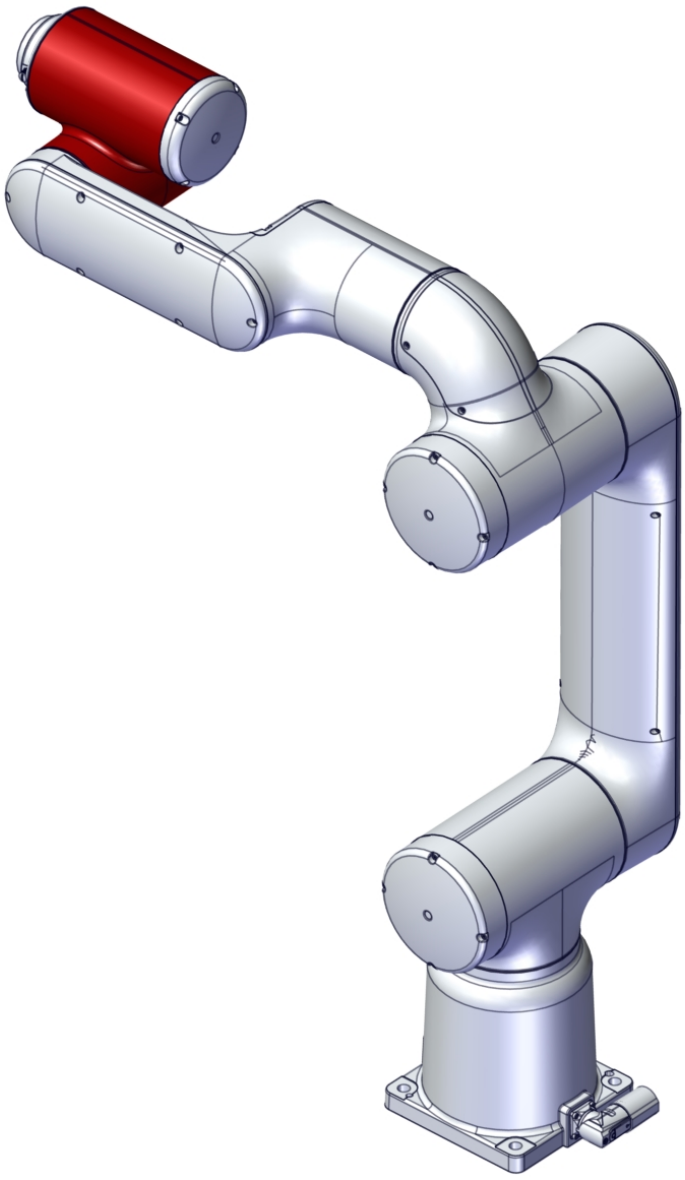
	Action	Note
1	Calibrate the axis-4 joint unit torque sensor.	See *Calibration on page 1047*
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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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

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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 Used for joint unit of CRB 15000-5/0.95. 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 Used for joint unit of CRB 15000-5/0.95. 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 of CRB 15000-5/0.95. 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.

Continues on next page

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5.4.4 Replacing the wrist housing
Continued

Equipment	Article number	Note
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 units of CRB 15000-5/0.95.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Tweezers	-	Used to handle drive board connectors.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Grease	3HAC042536-001	Shell Gadus S2
Cable ties	-	
O-ring	3HAC061327-051	Axis-5 cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-051	Axis-5 cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-051	Arm-side interface Replace if damaged.
O-ring	3HAC061327-043	Tubular cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAB3772-166	Tubular cover, upper, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-076	Tubular cover, lower, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.

Removing the wrist housing

Use these procedures to remove the wrist.

Preparations before removing the wrist

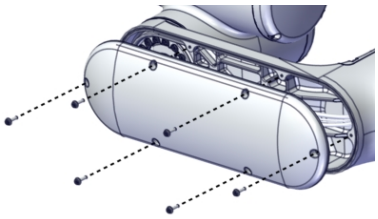
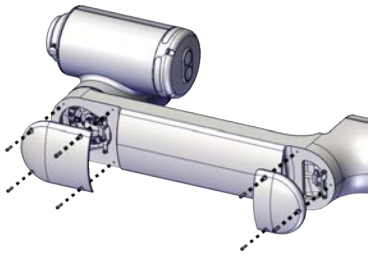
	Action	Note
1	Jog the robot to the synchronization position.	

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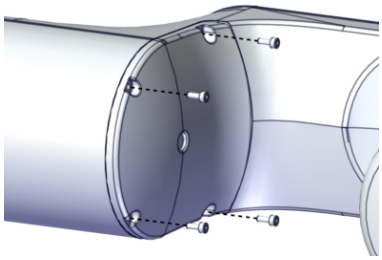
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	Action	Note
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the tubular cover

	Action	Note
1	**Valid for CRB 15000-5/0.95** 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
2	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the covers by removing the screws.	 xx2300000841

Removing the axis-4 cover

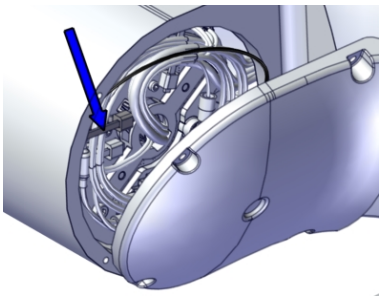
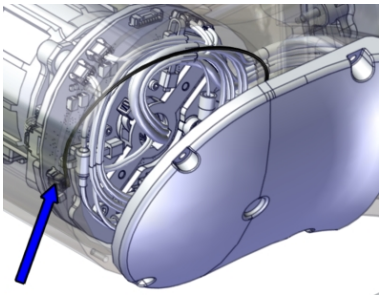
	Action	Note
1	Remove the cover screws.	 xx2000002083
2	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	

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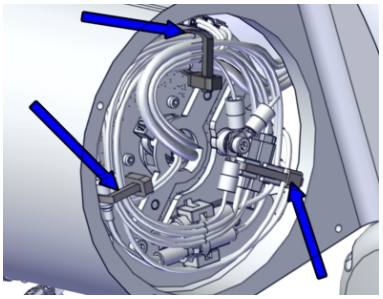
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5.4.4 Replacing the wrist housing

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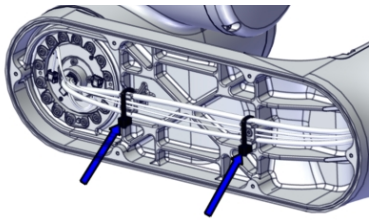
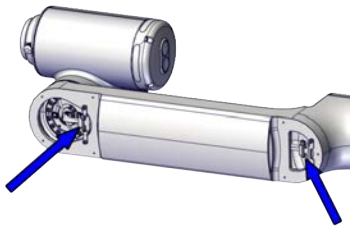
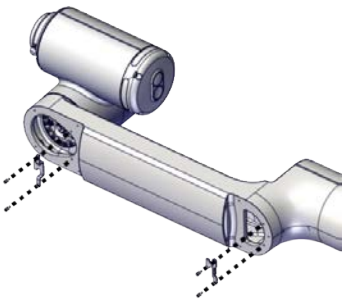
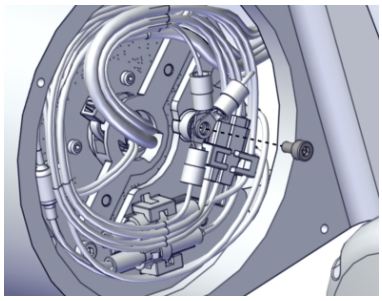
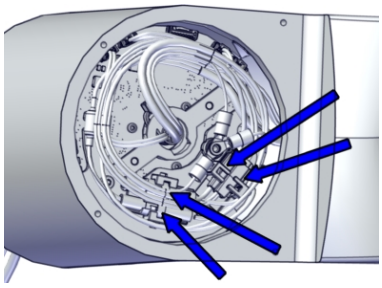
	Action	Note
3	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002084
4	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	Tweezers  xx2000002085

Separating the cabling between the tubular and the tilt

	Action	Note
1	Cut the cable ties on joint unit.	 xx2000002086

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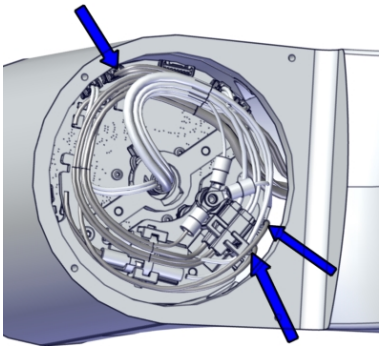
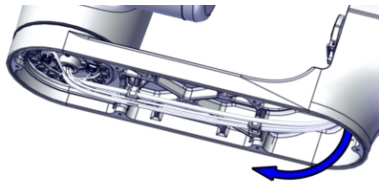
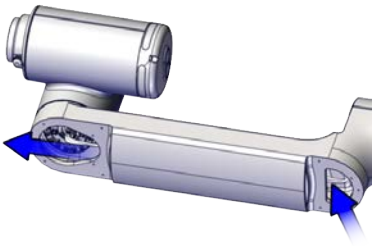
	Action	Note
2	Cut the cable ties on tubular, if needed.	**Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842
3	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the cable brackets.	 xx2300000843
4	Remove the functional and protective earth cables by removing the screw.	 xx2000002087
5	Snap loose and disconnect the connectors: • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP	 xx2000002089

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5.4.4 Replacing the wrist housing

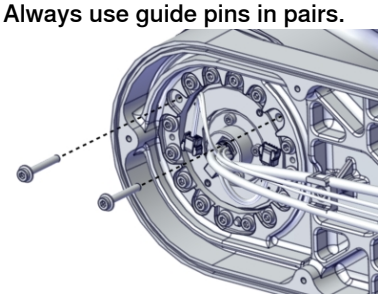
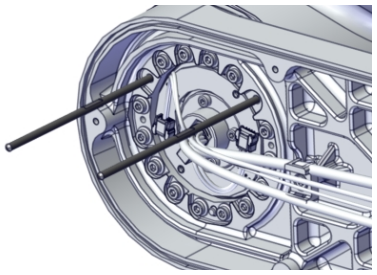
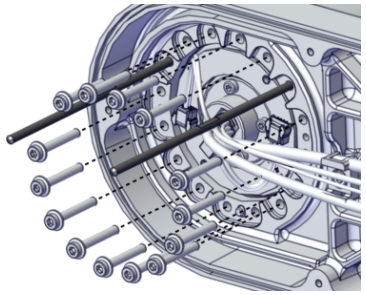
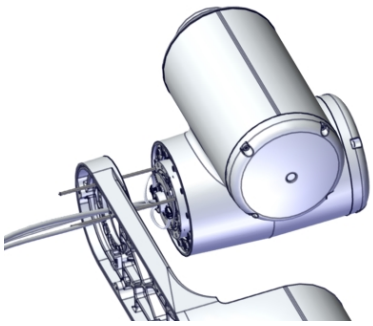
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	Action	Note
6	Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board: • D3/4.X2 • D3/4.DC- • D3/4.DC+ Use tweezers, if needed.	Tweezers  xx2000002125
7	Pull out the cabling carefully from the tubular.	**Valid for CRB 15000-5/0.95**  xx2000002126 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000844

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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.	
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

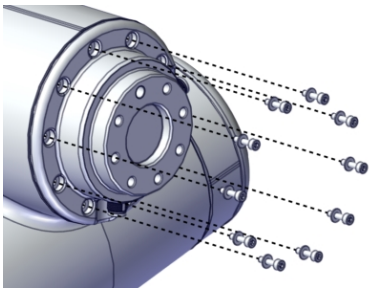
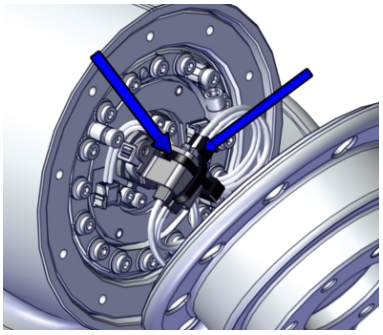
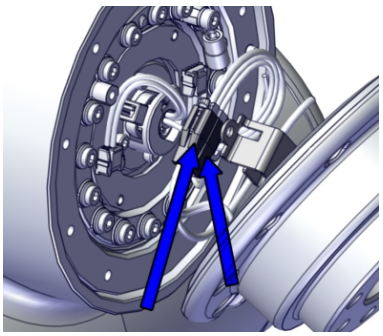
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5.4.4 Replacing the wrist housing

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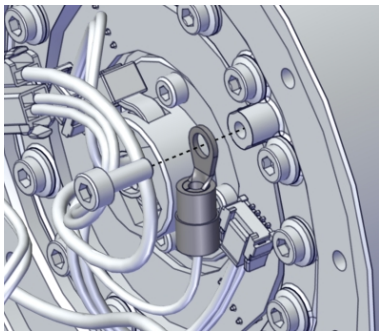
Removing the tool flange

	Action	Note
1	Remove the tool flange screws and washers.	 xx2000002155
2	**CAUTION** **Valid for CRB 15000-5/0.95** 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	Cut the cable ties.	 xx2000002157
4	Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

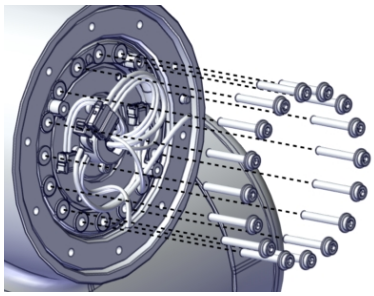
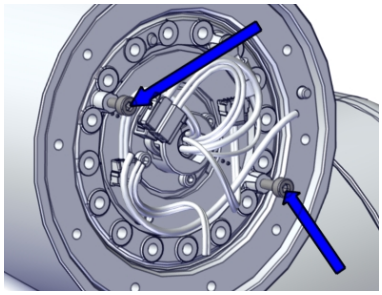
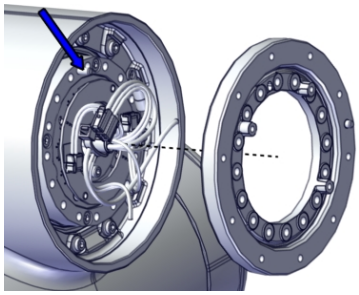
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Disconnecting the tool flange functional earth cable

	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
3	Remove the tool flange adapter.	 xx2000002167

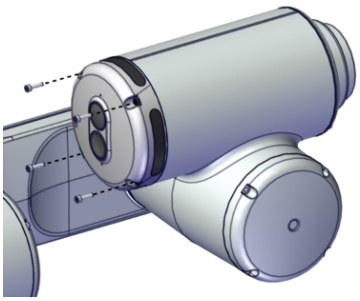
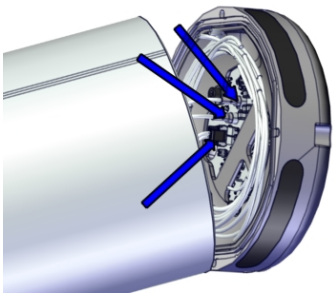
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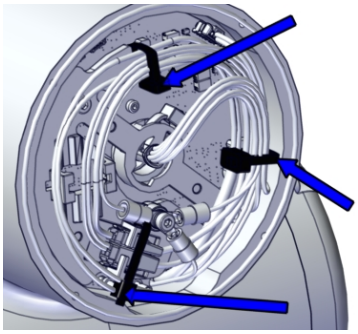
5.4.4 Replacing the wrist housing

Continued

Removing the arm-side interface

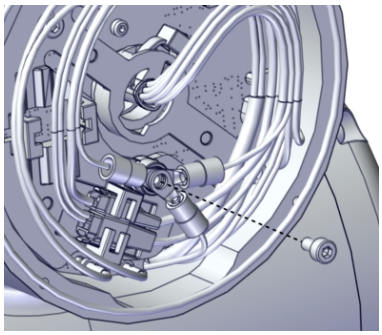
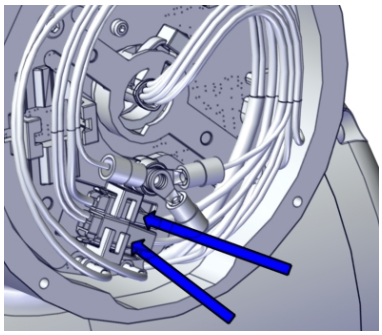
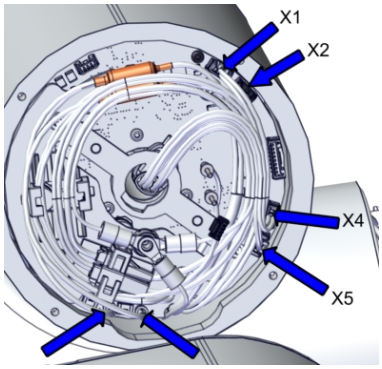
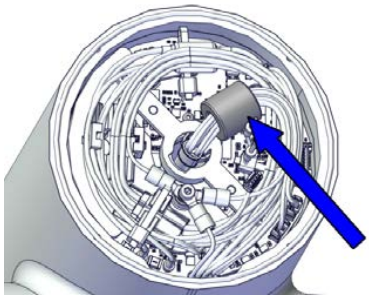
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	**CAUTION** There is cabling connected between the arm-side interface and the joint unit drive board. Open the arm-side interface with care to avoid damage to the cabling or the connector(s). Do not leave the 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. • ASI.DC+ • ASI.DC- • ASI.X1	 xx2100000335

Disconnecting the axis-6 joint unit cabling

	Action	Note
1	Cut the cable ties.	 xx2000002161

Continues on next page

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	Action	Note
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002162
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 **CAUTION** Use tweezers to unlock connectors and pull them off.	Tweezers  xx2000002164
5	Remove the ferrite core by pulling the cables D6.X4 and D6.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

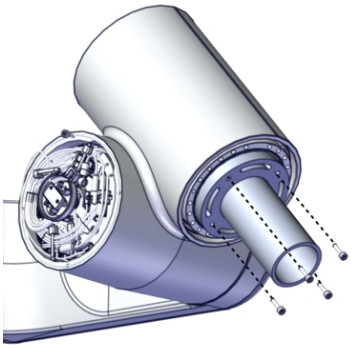
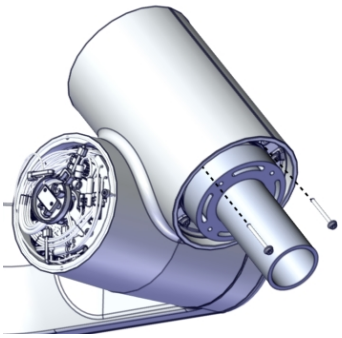
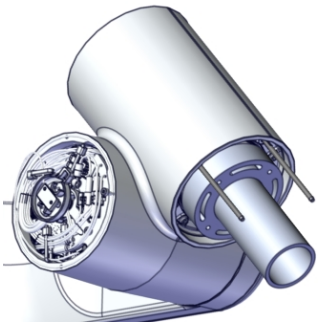
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5.4.4 Replacing the wrist housing

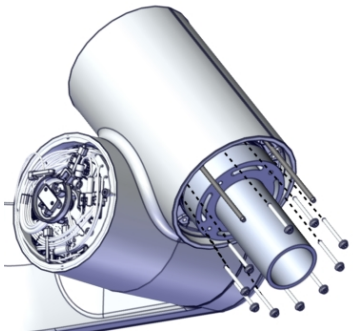
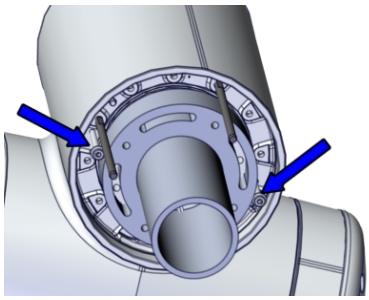
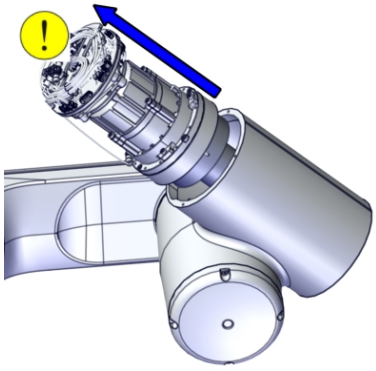
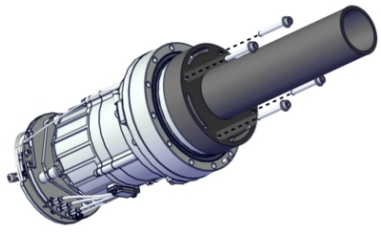
Continued

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.
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

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	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.	 xx2100000329
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

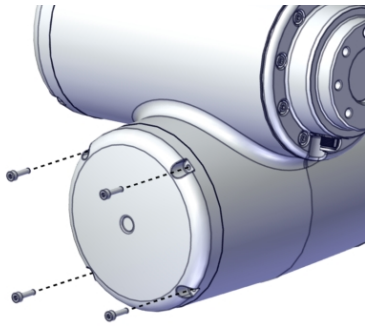
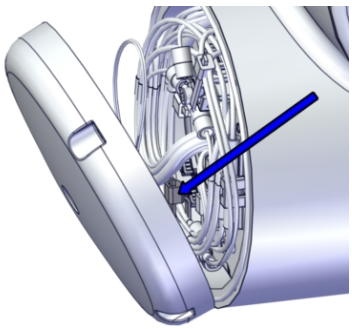
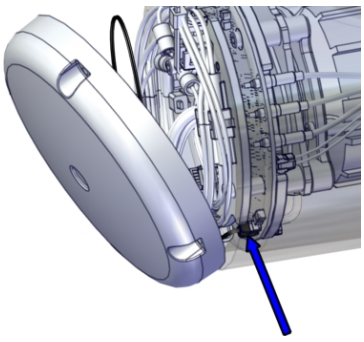
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5.4.4 Replacing the wrist housing

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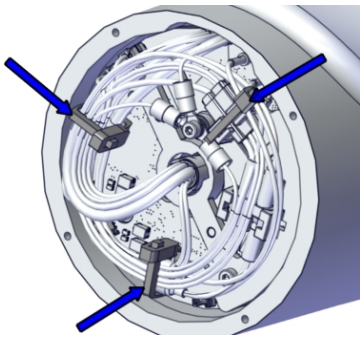
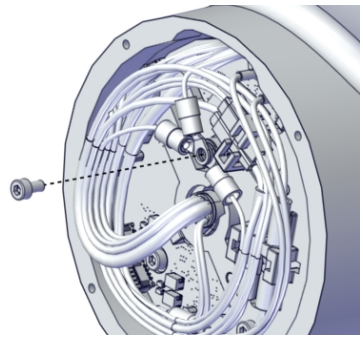
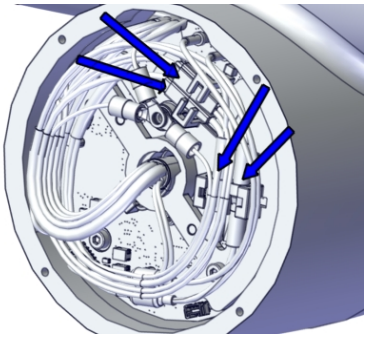
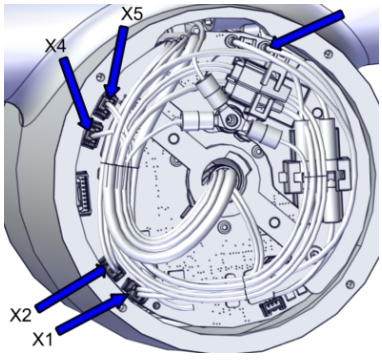
Removing the axis-5 cover

	Action	Note
1	Remove the cover by removing the four screws.	 xx2000002132
2	**CAUTION** **Valid for CRB 15000-5/0.95** 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	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002133
4	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002134

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Disconnecting the axis-5 joint unit cabling

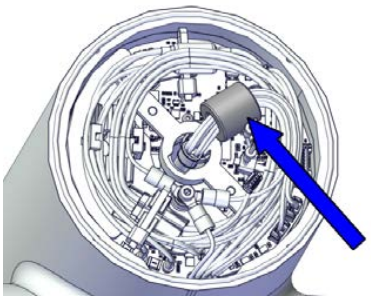
	Action	Note
1	Cut the cable ties.	 xx2000002135
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002136
3	Snap loose and disconnect the connectors: • J5/6.DC+ • J5/6.DC- • J5/6.CS • J5/6.CP	 xx2000002137
4	Disconnect the connectors from the drive board. • D4/5.X1 • D5.DC+ • D5.DC- • D4/5.X4 • D5.X2 • D4/5.X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	Tweezers  xx2000002138

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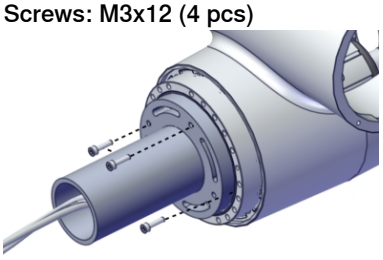
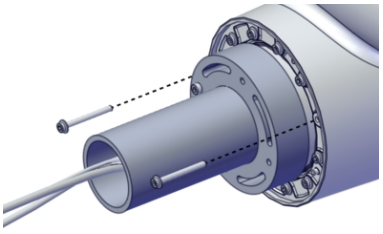
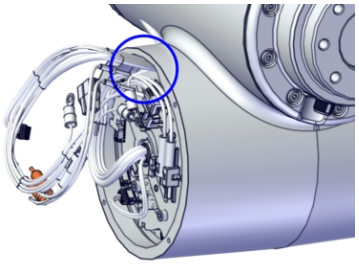
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5.4.4 Replacing the wrist housing

Continued

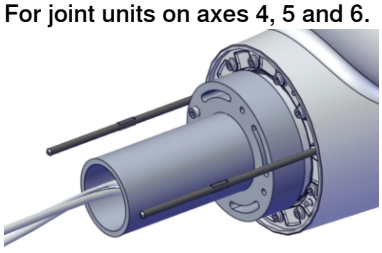
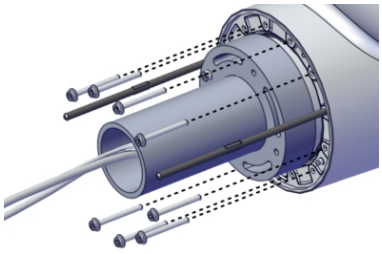
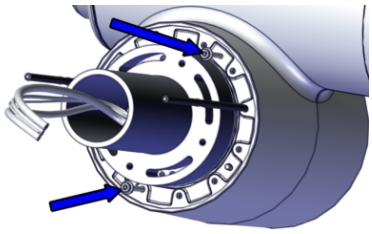
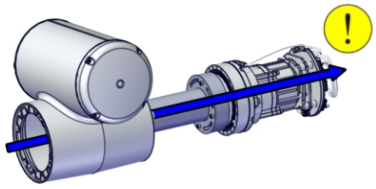
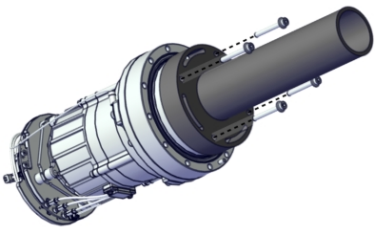
	Action	Note
5	Remove the ferrite core by pulling the cables D4/5.X4 and D4/5.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2000002140
3	Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 xx2100000284

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	Action	Note
4	Fit two guide pins to the axis-5 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2100000332
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.	 xx2100000333
6	Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2100000334
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

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5.4.4 Replacing the wrist housing
Continued

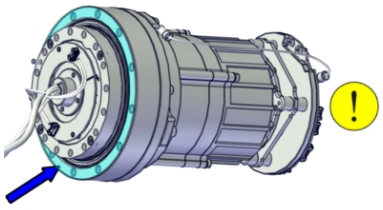
Replacing the wrist

	Action	Note
1	Replace the writ unit.	Wrist housing: 3HAC073951-001 (for CRB 15000-5/0.95) / 3HAC073951-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)

Refitting the wrist housing

Use these procedures to refit the wrist.

Preparations before fitting the joint unit

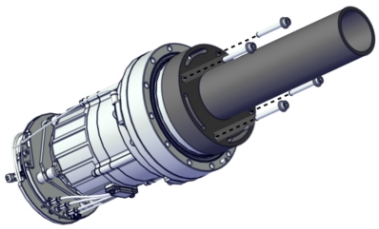
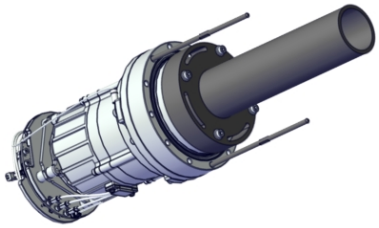
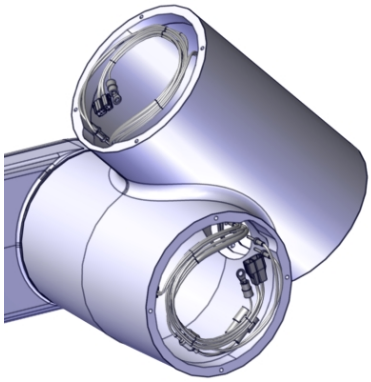
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  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 53*.	

Refitting the axis-5 joint unit and transition cabling

	Action	Note
1	**CAUTION** Axis-5 joint unit used for CRB 15000-5/0.95 has the same appearance as that used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Do not mix the joint units for different manipulator variants. Always check the mark or label on the joint units before refitting.	

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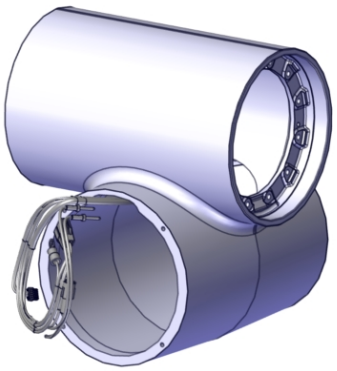
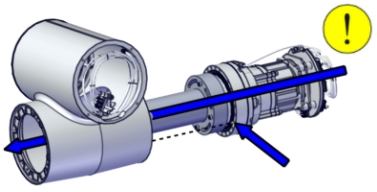
	Action	Note
2	Fit the lifting aid to the joint unit. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079143-001 (for CRB 15000-5/0.95) / 3HAC087546-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
3	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
4	Fit the transition cable between axis-5 and axis-6 joint units into the tilt.	Cable harness, transition joint-5 and joint-6: 3HAC083726-001  xx2100000040

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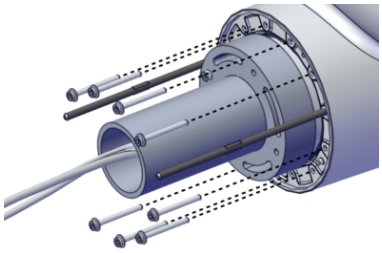
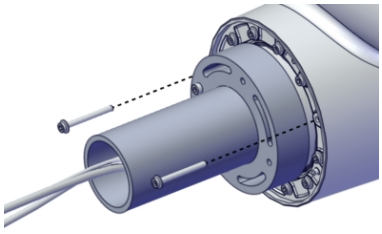
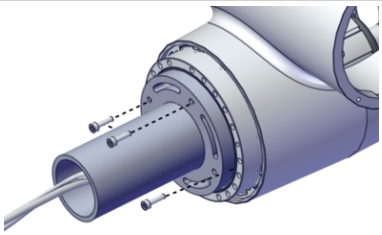
5.4.4 Replacing the wrist housing

Continued

	Action	Note
5	Place the cabling at the slot before refitting the joint unit.	 xx2100000041  xx2100000285
6	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.	 xx2000002142

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	Action	Note
7	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 Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000333
8	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002140
9	Pre-tighten the screws crosswise.	
10	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm (for CRB 15000-5/0.95) / 1.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)
11	Remove the lifting aid by removing the screws.	 xx2000002139
12	Clean pushed-out flange sealant, if any.	

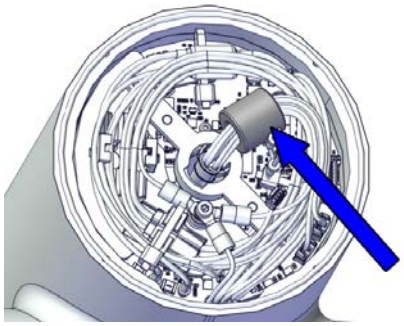
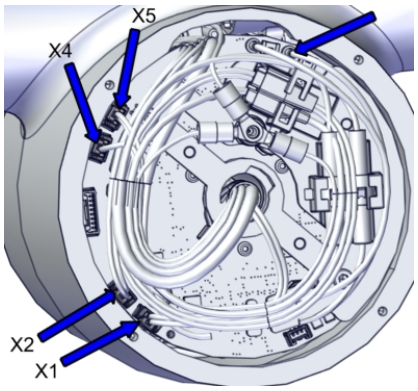
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5.4.4 Replacing the wrist housing

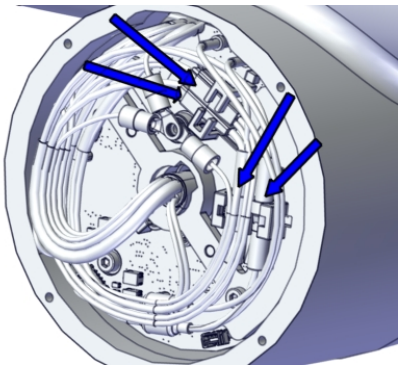
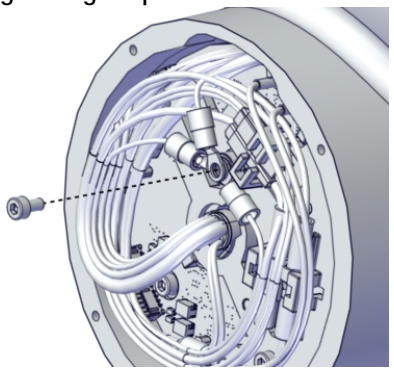
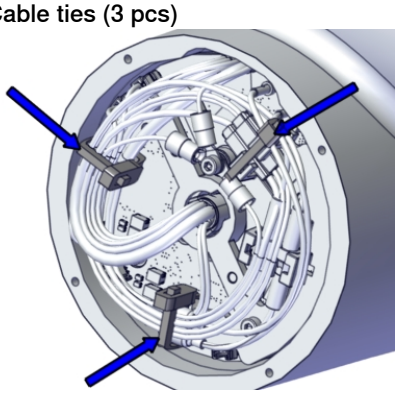
Continued

Connecting the axis-5 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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D4/5.X4 and D4/5.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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

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	Action	Note
5	Connect the connectors to each other and snap them to the cable holders. • 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
6	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
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002135

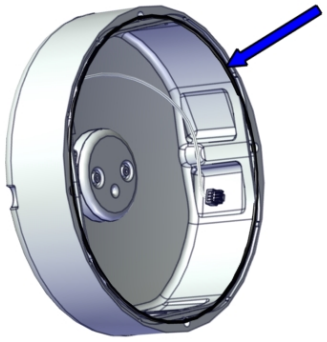
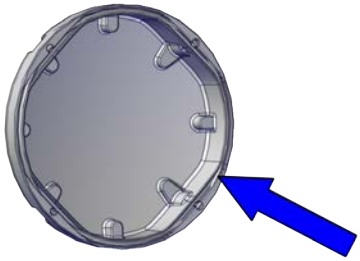
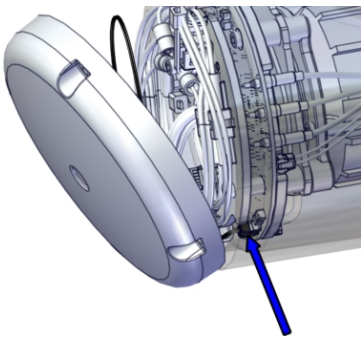
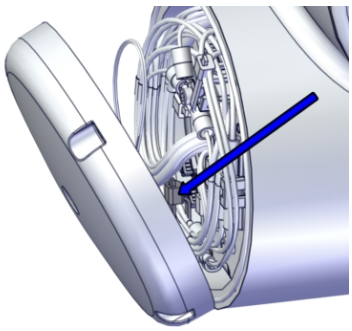
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5.4.4 Replacing the wrist housing

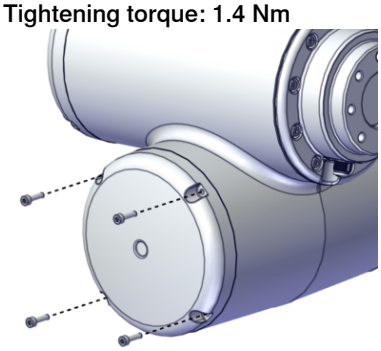
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Refitting the axis-5 cover

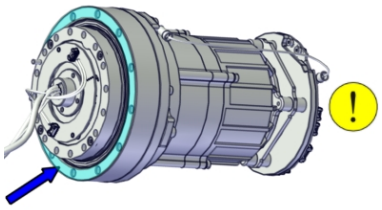
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	**Valid for CRB 15000-5/0.95** O-ring: 3HAC061327-051  xx2000001962 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 O-ring: 3HAC061327-051  xx2300000849
2	**For robots with RobotWare earlier than 7.10** Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	 xx2000002134
3	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000002133

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	Action	Note
4	Refit the cover with the four screws.	**Valid for CRB 15000-5/0.95** Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.2 Nm **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 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 53*.	
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 (or equivalent)  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 53*.	

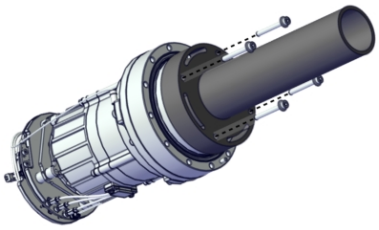
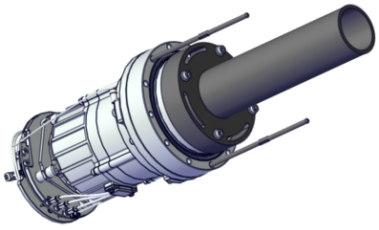
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5.4.4 Replacing the wrist housing

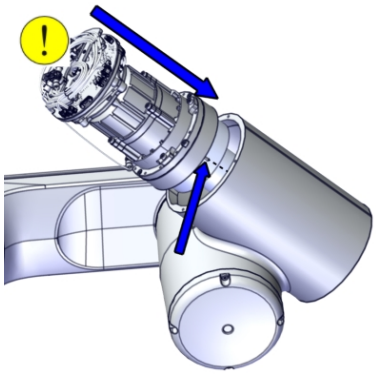
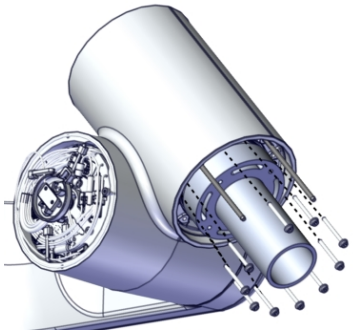
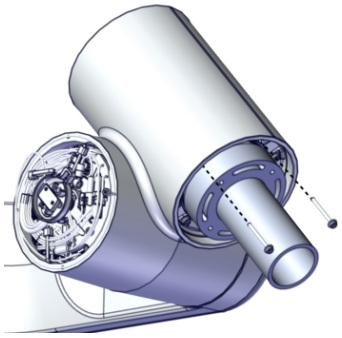
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Refitting the axis-6 joint unit

	Action	Note
1	**CAUTION** Axis-6 joint unit used for CRB 15000-5/0.95 has the same appearance as that used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Do not mix the joint units for different manipulator variants. Always check the mark or label on the joint units before refitting.	
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: 3HAC079143-001 (for CRB 15000-5/0.95) / 3HAC087546-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
3	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
4	Place the cabling at the slot before refitting the joint unit.	 xx2100000041

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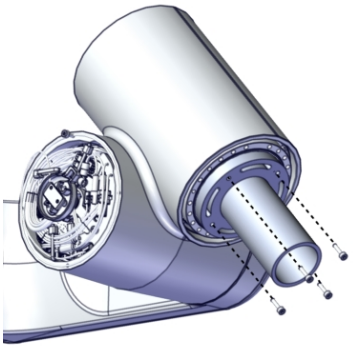
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	Action	Note
5	Fit the joint unit to the tilt, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002195
6	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000329
7	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002170
8	Pre-tighten the screws crosswise.	
9	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm (for CRB 15000-5/0.95) / 1.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)

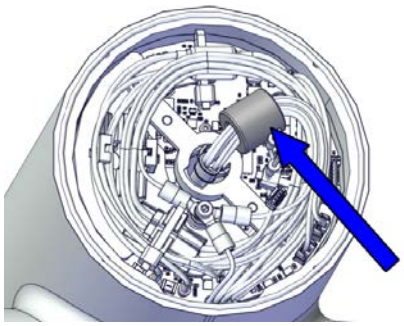
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5.4.4 Replacing the wrist housing
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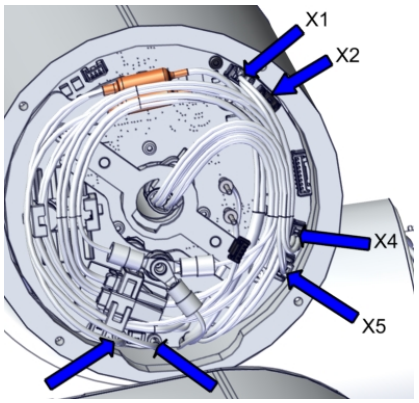
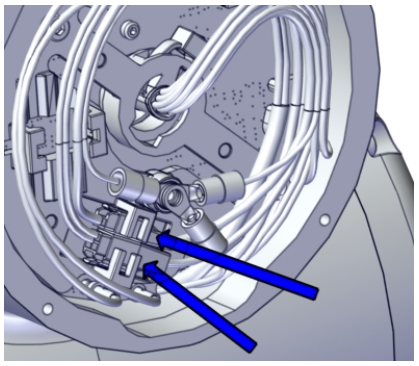
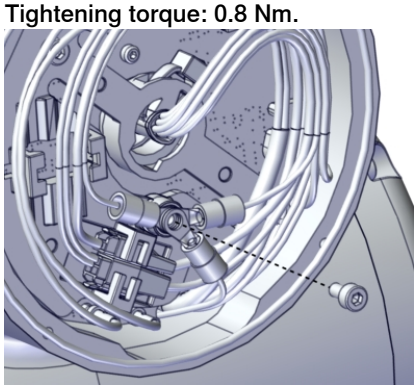
	Action	Note
10	Remove the lifting aid by removing the screws.	 xx2000002168
11	Clean pushed-out flange sealant, if any.	

Connecting the axis-6 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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D6.X4 and D6.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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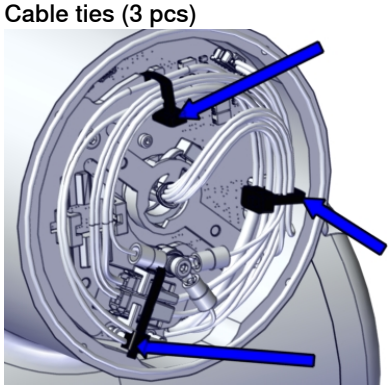
	Action	Note
4	Reconnect the connectors to the drive board. • D6.X1 to X1 • D6.DC+ to +DC • D6.DC- to Ground • D6.X4 to X4 • D6.X2 to X2 • D6.X5 to X5	 xx2000002164
5	Connect the connectors to each other and snap them to the cable holders. • J7.CS to J7.CS • J7.CP to J7.CP	 xx2000002163
6	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002162

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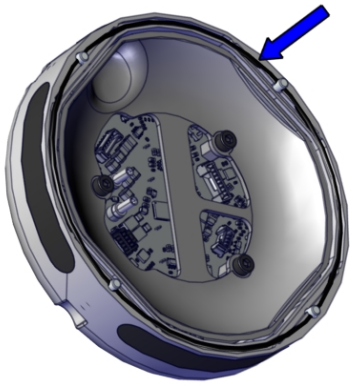
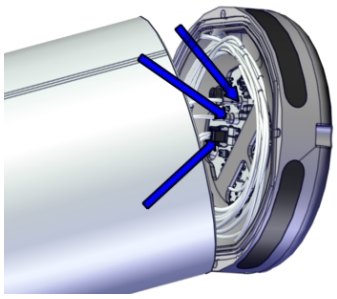
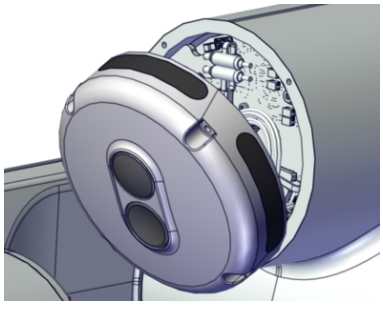
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5.4.4 Replacing the wrist housing

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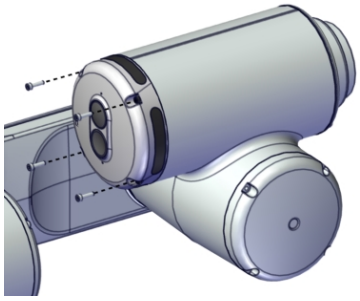
	Action	Note
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002161

Refitting the arm-side interface

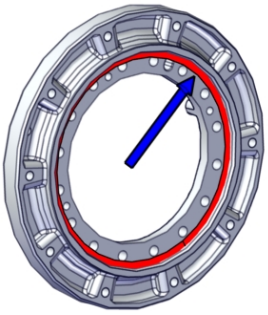
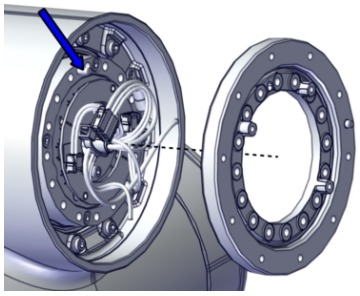
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002551
2	Place the arm-side interface at mounting position and reconnect the connectors. • ASI.DC+ • ASI.DC- • ASI.X1 The correct orientation of the arm-side interface is with the convex button in upper position. **Note** Do not leave the arm-side interface in location without being secured with the attachment screws.	 xx2100000335  xx2100000336

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	Action	Note
3	Refit the arm-side interface with four screws.	**Valid for CRB 15000-5/0.95** Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002550

Refitting the tool flange adapter

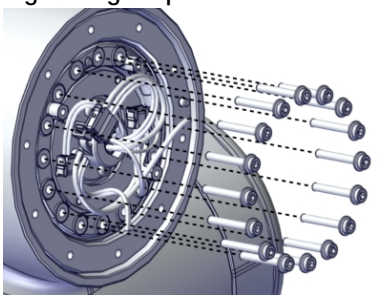
	Action	Note
1	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the adapter mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000002196
2	Refit the tool flange adapter, aligning the pin with the pin hole.	Tool flange adapter: 3HAC073952-001  xx2000002167

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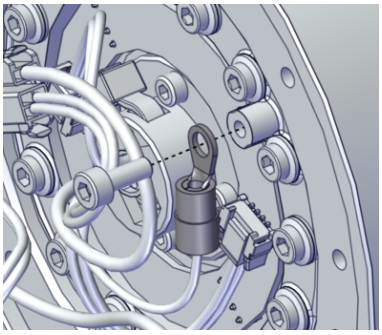
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5.4.4 Replacing the wrist housing

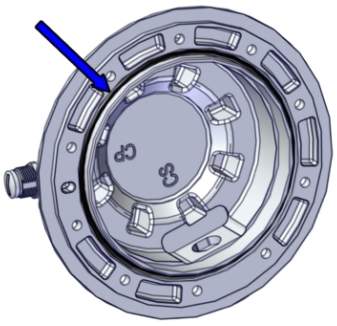
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	Action	Note
3	Secure with screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) Tightening torque: 1.8 Nm.  xx2000002165

Connecting the tool flange functional earth cable

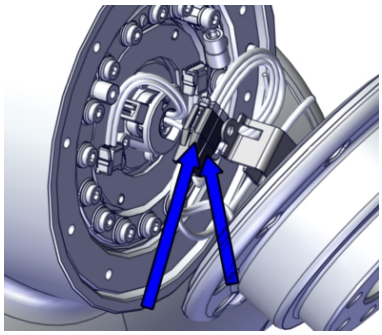
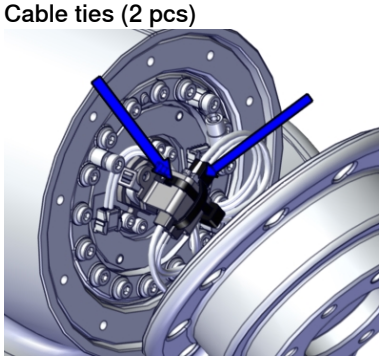
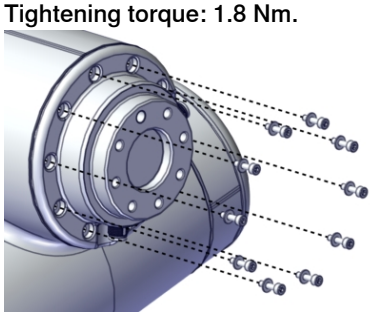
	Action	Note
1	Secure the cable for functional earth to the tool flange adapter with a screw.	 xx2000002159

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

Continues on next page

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	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 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

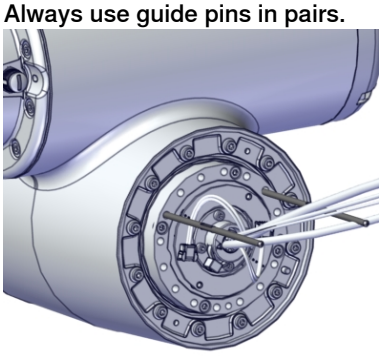
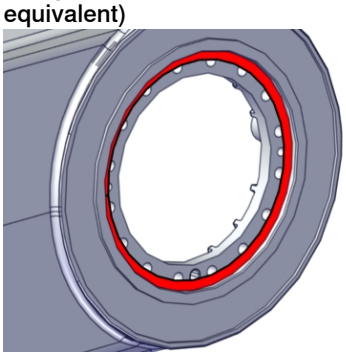
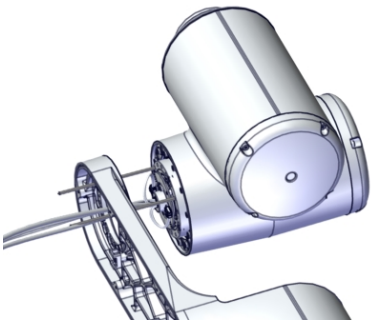
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5.4.4 Replacing the wrist housing

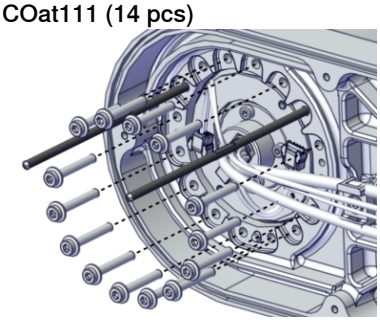
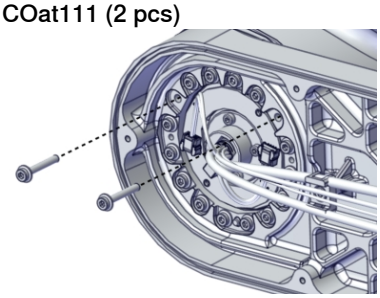
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Refitting the tilt

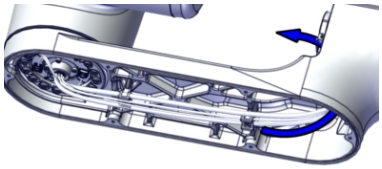
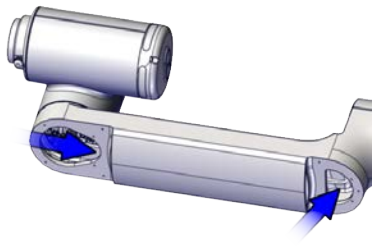
	Action	Note
1	Fit two guide pins to the axis-5 joint.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002146
2	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the tubular mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000002147
3	Lift the tilt into mounting position while inserting the cabling into the tubular.	 xx2000002131
4	Slide the tilt into place on the guide pins.	

Continues on next page

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	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

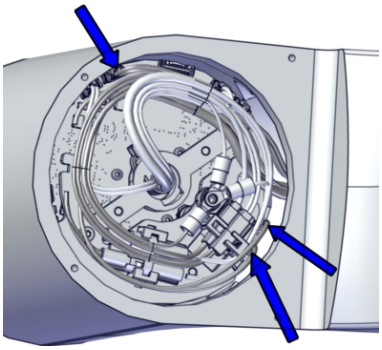
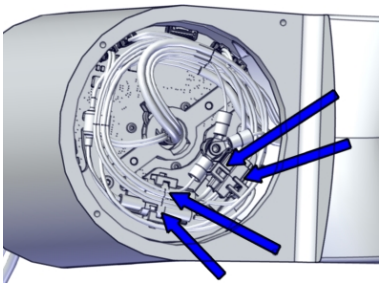
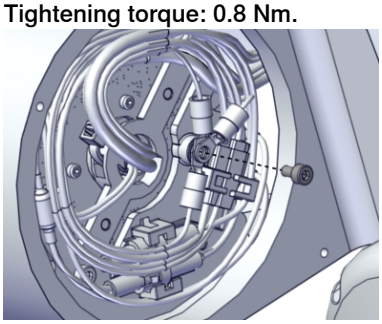
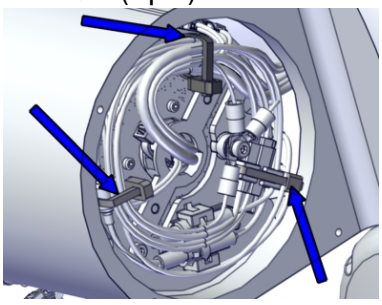
	Action	Note
1	Insert the cabling into the tubular.	**Valid for CRB 15000-5/0.95**  xx2000002148 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000845

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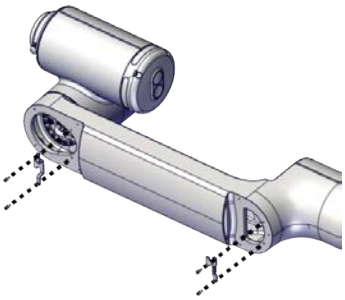
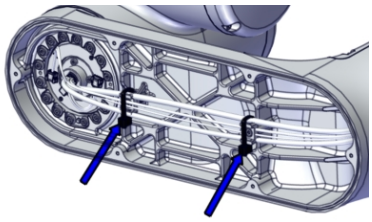
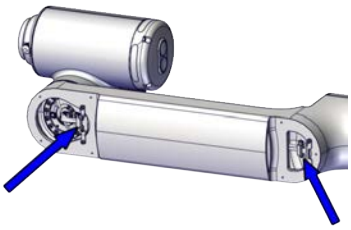
5.4.4 Replacing the wrist housing

Continued

	Action	Note
2	Reconnect the connectors to the drive board. • 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. • 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 to joint unit with cable ties.	Cable ties (3 pcs)  xx2000002086

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	Action	Note
6	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Refit the cable brackets.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs for each). Tightening torque: 0.8 Nm.  xx2300000843
7	Secure the cabling to tubular with cable ties.	Cable ties (2 pcs) **Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842

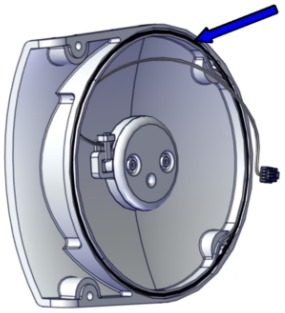
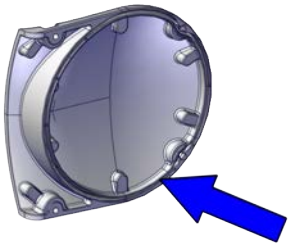
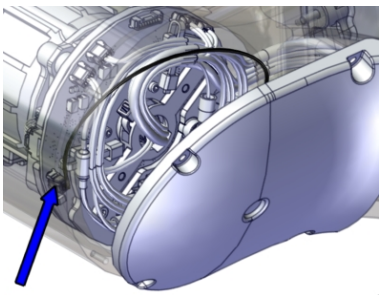
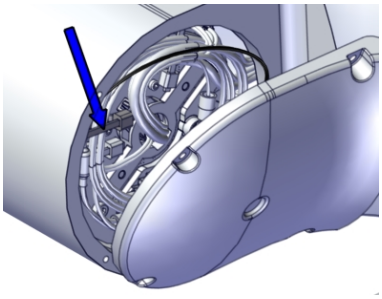
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5.4.4 Replacing the wrist housing

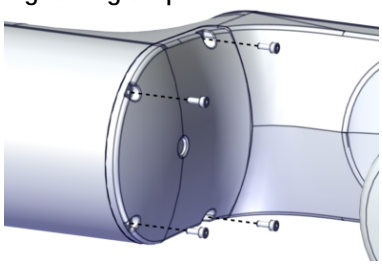
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Refitting the axis-4 cover

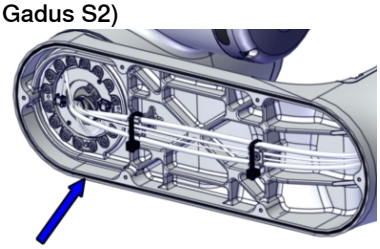
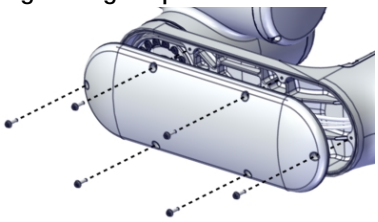
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	**Valid for CRB 15000-5/0.95** O-ring: 3HAC061327-051  xx2000002092 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 O-ring: 3HAC061327-051  xx2300000848
2	**For robots with RobotWare earlier than 7.10** Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	Tweezers  xx2000002085
3	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000002084

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	Action	Note
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 (for CRB 15000-5/0.95) / 0.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Tightening torque: 0.9 Nm  xx2000002083

Refitting the tubular cover (-5/0.95)

	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 of CRB 15000-5/0.95. 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

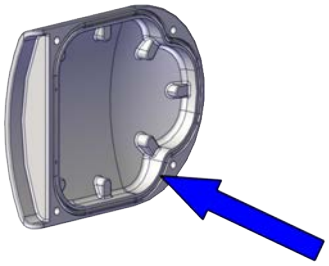
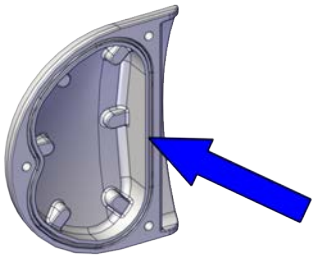
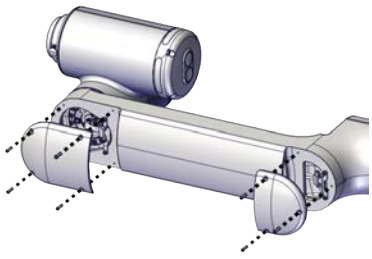
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5.4.4 Replacing the wrist housing

Continued

Refitting the tubular cover (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-076 O-ring: 3HAB3772-166 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2300000846  xx2300000847
2	Refit the covers with new attachment screws.	Hex socket head cap screw:M3x12 12.9 Lafre 2C2B/FC6.9 (7 pcs in total) Tightening torque: 1.4 Nm.  xx2300000841

Concluding procedure

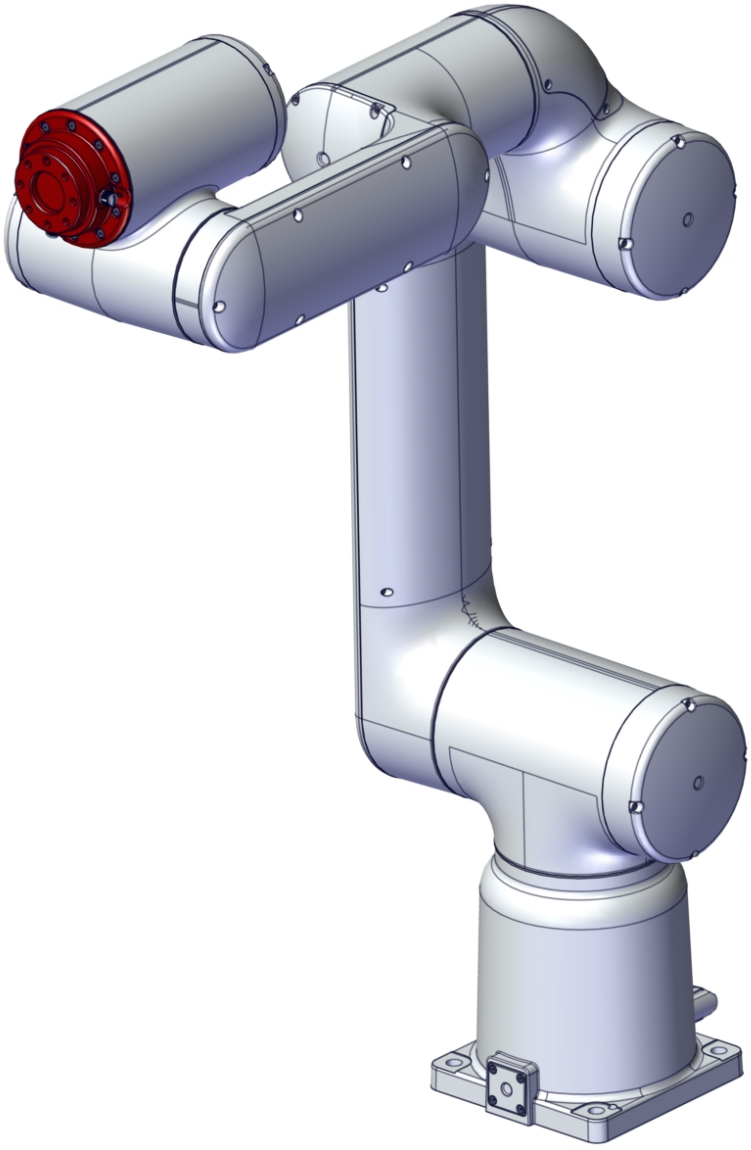
	Action	Note
1	Calibrate the axis-5 and axis-6 joint unit torque sensor.	See *Calibration on page 1047*
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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5.4.5 Replacing the tool flange and tool flange adapter

Location of the tool flange and tool flange adapter

The tool flange is located as shown in the figure. The tool flange adapter 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*.

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5.4.5 Replacing the tool flange and tool flange adapter
Continued

Spare part	Article number	Note
Axis-6 flange	3HAC073953-001	
Tool flange adapter	3HAC073952-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Grease	3HAC042536-001	Shell Gadus S2
O-ring	3HAB3772-182	Tool flange
Cable ties	-	

Removing the tool flange and tool flange adapter

Use these procedures to remove the tool flange and tool flange adapter.

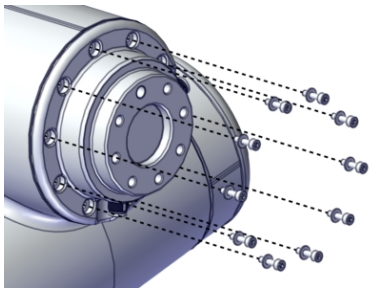
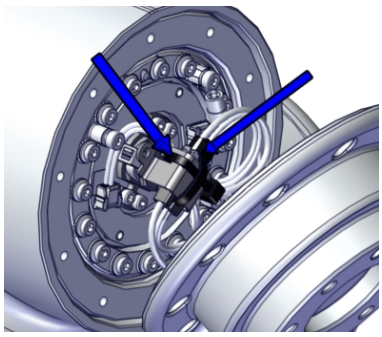
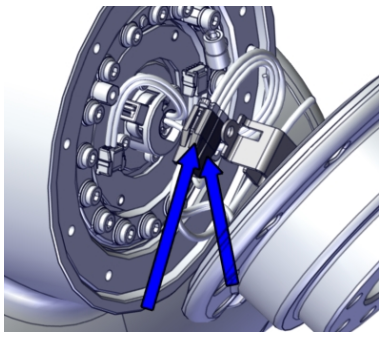
Preparations before removing the flanges

	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: • 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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Removing the tool flange

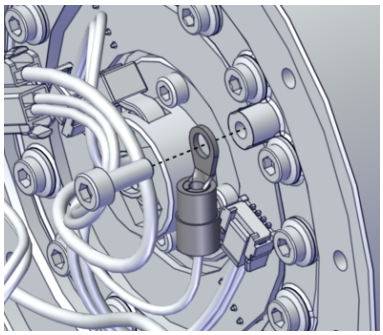
	Action	Note
1	Remove the tool flange screws and washers.	 xx2000002155
2	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
3	Cut the cable ties.	 xx2000002157
4	Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

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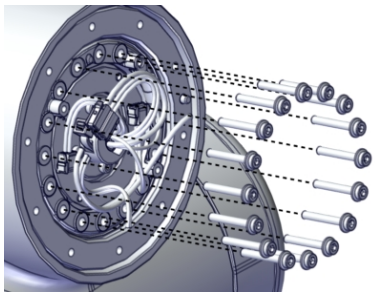
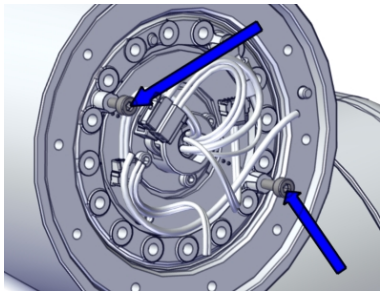
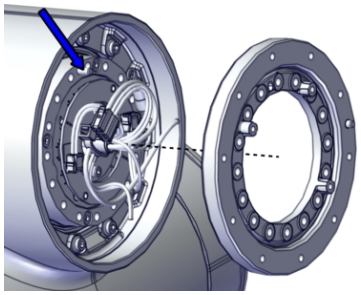
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5.4.5 Replacing the tool flange and tool flange adapter
Continued

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
3	Remove the tool flange adapter.	 xx2000002167

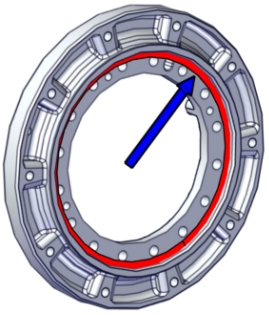
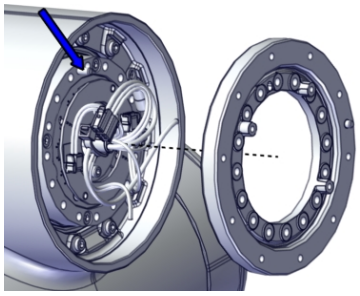
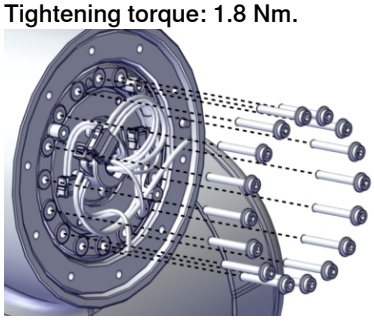
Refitting the flanges

Use these procedures to refit the tool flange and tool flange adapter.

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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 (or equivalent)  xx2000002196
2	Refit the tool flange adapter, aligning the pin with the pin hole.	Tool flange adapter: 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

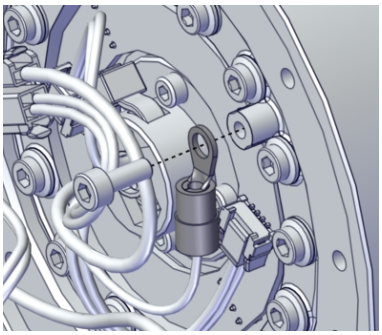
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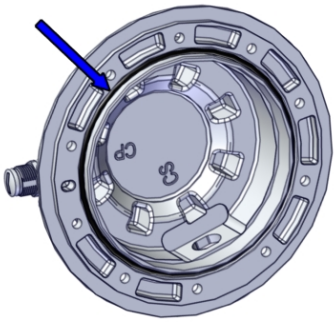
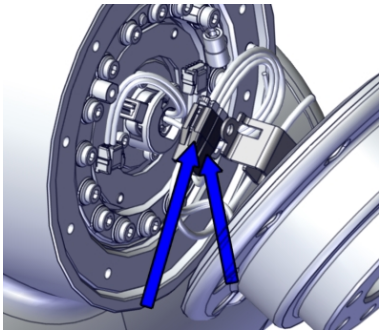
5.4.5 Replacing the tool flange and tool flange adapter

Continued

Connecting the tool flange functional earth cable

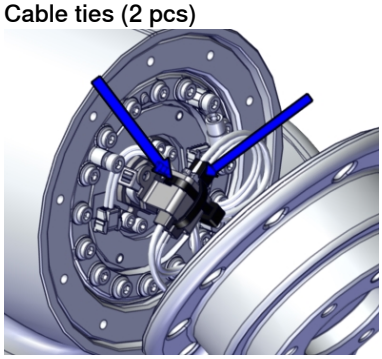
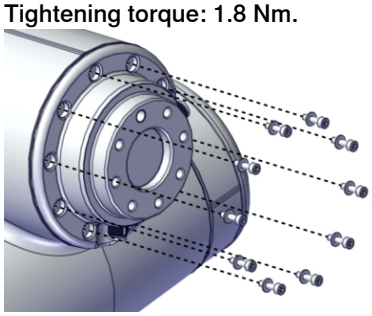
	Action	Note
1	Secure the cable for functional earth to the tool flange adapter with a screw.	 xx2000002159

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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	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 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

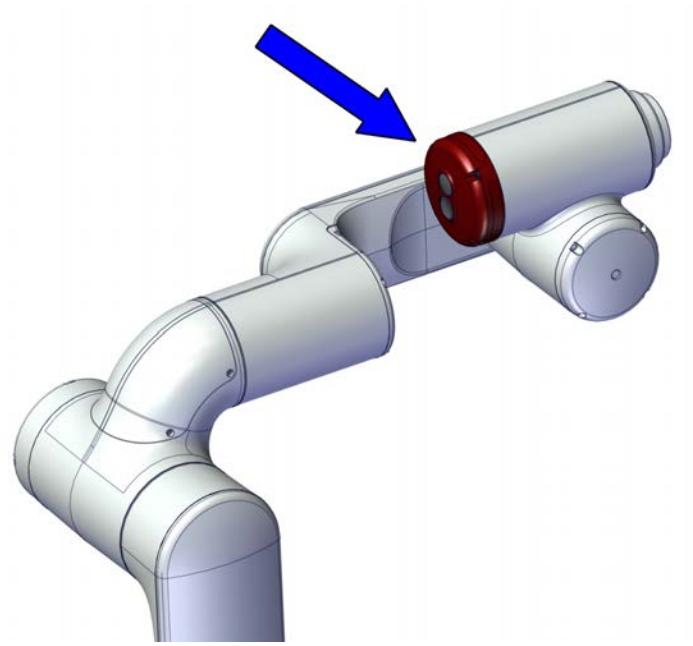
	Action	Note
1	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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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 1083*.

Required consumables

Consumable	Article number	Note
O-ring	3HAC061327-051	Arm-side interface Replace if damaged.
Cable ties	-	

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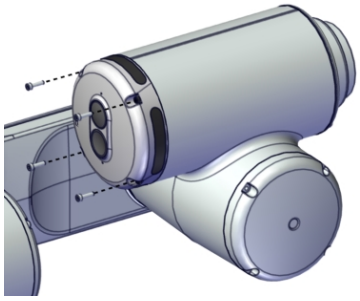
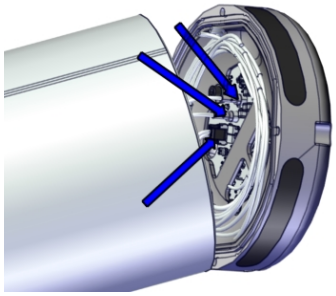
Removing the arm-side interface

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. • ASI.DC+ • ASI.DC- • ASI.X1	 xx2100000335

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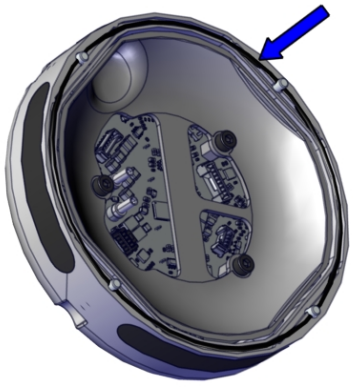
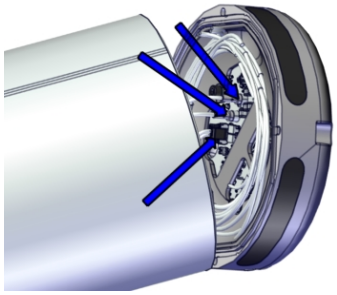
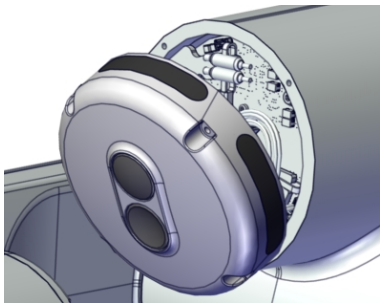
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5.4.6 Replacing the arm-side interface
Continued

Refitting the arm-side interface

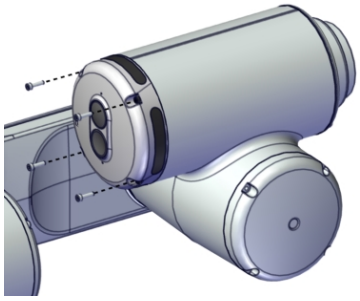
Use these procedures to refit the arm-side interface.

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. • 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  xx2100000336

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	Action	Note
3	Refit the arm-side interface with four screws.	**Valid for CRB 15000-5/0.95** Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002550

Concluding procedure

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

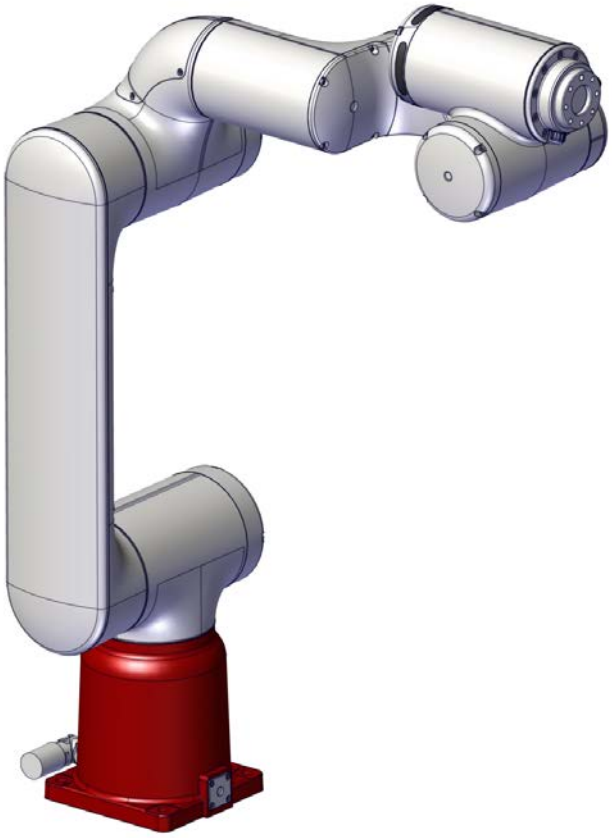
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5.5 Swing and base

5.5.1 Replacing the base

Location of the base

The base is located as shown in the figure.



xx2100000422

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.

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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Base	3HAC073922-001	Used for CRB 15000-5/0.95. Also order new attachment screws for the axis-1 and axis-2 joint unit: 3HAB3413-435 (24 pcs).
Base	3HAC081047-001	Used for CRB 15000-10/1.52 and CRB 15000-12/1.27.
Flange socket head screw with glue	3HAB3413-435	M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. 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 Used for joint unit of CRB 15000-5/0.95. 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 of CRB 15000-5/0.95. Attachment screws M4x35 (4 pcs) are enclosed.
Lifting aid	3HAC087787-001	For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27. A plate, a beam, a pair of semicircular blocks and attachment screws M5x30 (2 pcs) are enclosed.

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5.5.1 Replacing the base
Continued

Equipment	Article number	Note
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M5x125	3HAC087786-001	Always use guide pins in pairs. For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint units of CRB 15000-5/0.95.
Protection plate	3HAC087789-001	For protection of drive board during cabling installation on joint units of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M5x75	3HAC087786-002	Always use guide pins in pairs.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Grease	3HAC031695-001	Harmonic Grease 4B No.2 Used to lubricate the seals.
Grease	3HAC042536-001	Shell Gadus S2
O-ring	3HAB3772-119	Axis-1 brake release unit Replace if damaged.
O-ring	3HAC061327-044	Axis-1 and -2 joint unit, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAB3772-64	Base cover, used for CRB 15000-5/0.95.
O-ring	3HAC061327-072	Base cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27.
O-ring	3HAC061327-044	Lower arm, inner cover of CRB 15000-5/0.95. 1 pcs / cover. Replace if damaged.
O-ring	3HAC061327-075	Lower arm, lower inner cover of CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.

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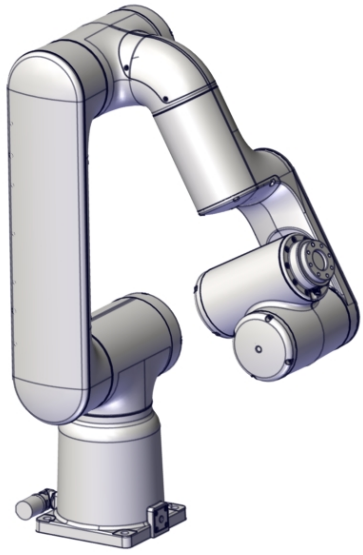
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Consumable	Article number	Note
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-074	Swing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-073	Swing flange, big side, used for CRB 15000-10/1.52. Replace if damaged.
O-ring	3HAC061327-044	Swing flange, small side, used for CRB 15000-10/1.52. Replace if damaged.
Cable tie	3HAC075545-001	For securing joint unit cable.
Cable ties	-	

Removing the base (-5/0.95)

Use these procedures to remove the base.

Preparations before removing the base

	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 0° • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. **CAUTION** 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.	 xx2100000044
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

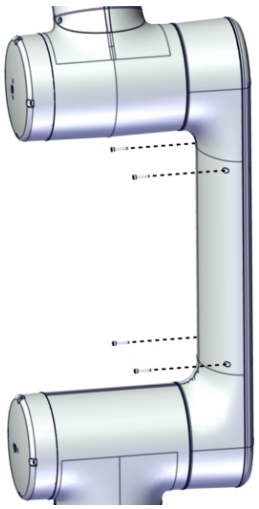
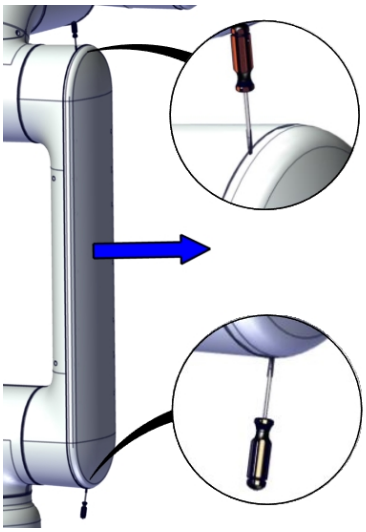
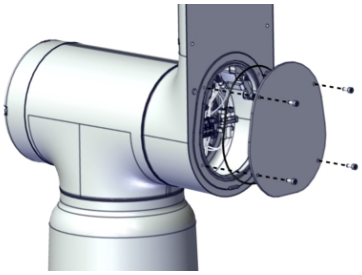
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5.5.1 Replacing the base

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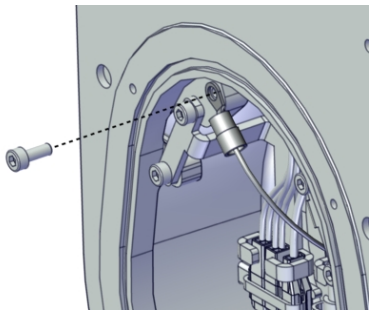
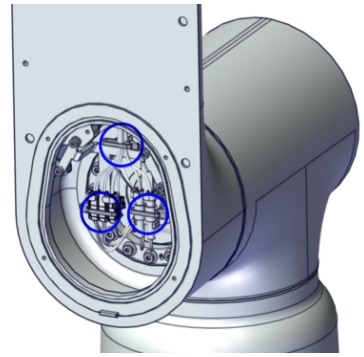
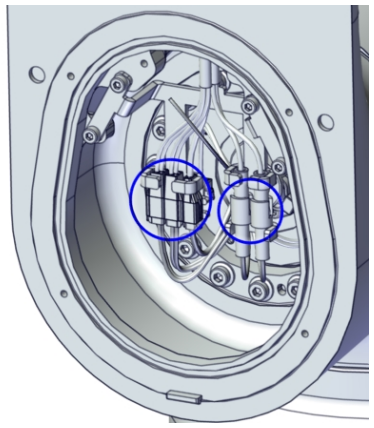
Removing the lower arm covers (-5/0.95)

	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

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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

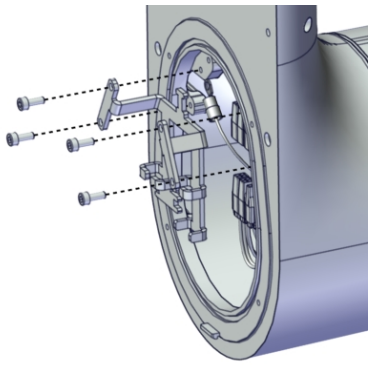
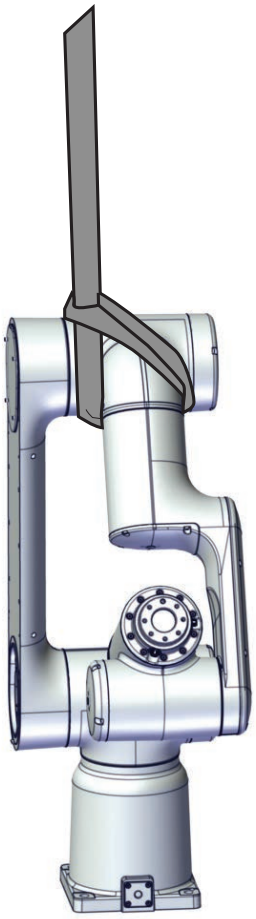
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5.5.1 Replacing the base

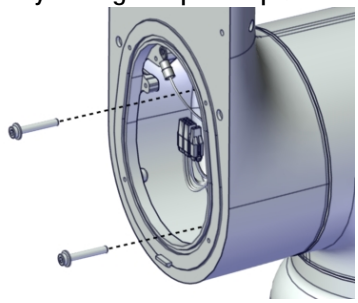
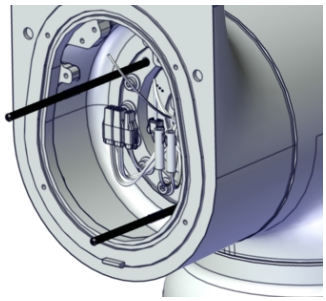
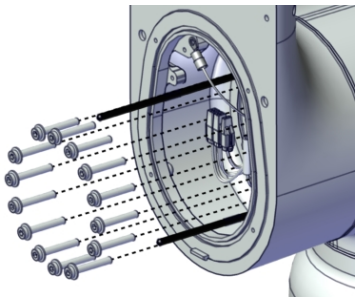
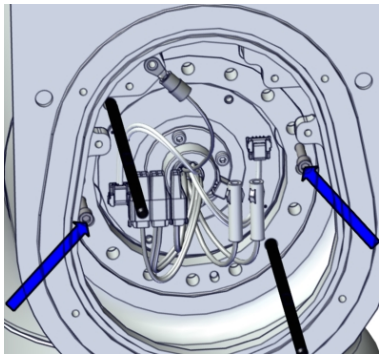
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Removing the lower and upper arm assembled

	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. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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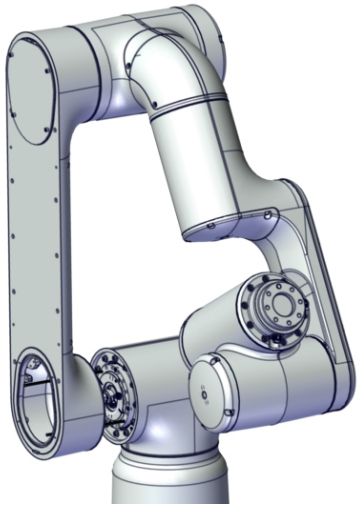
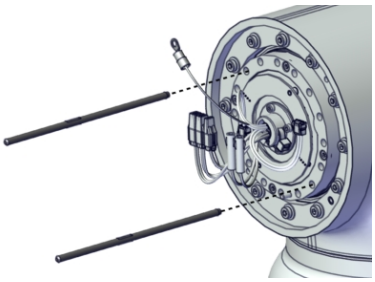
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	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

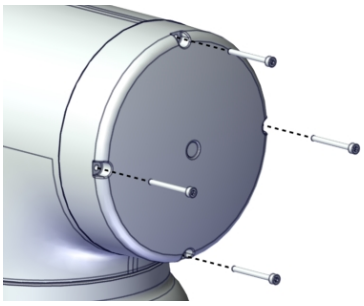
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5.5.1 Replacing the base
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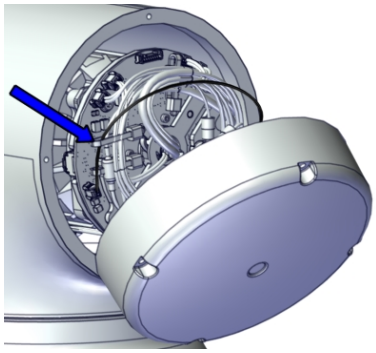
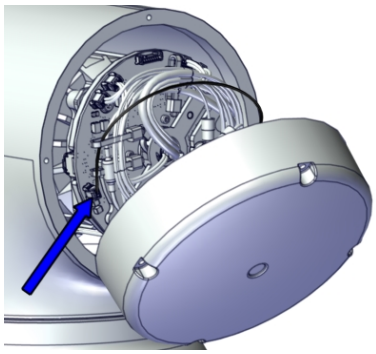
	Action	Note
6	Remove the complete arm system from the swing.	 xx2000001941
7	Remove the guide pins.	 xx2000002432

Removing the swing cover (-5/0.95)

	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

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	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000001931
5	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000001932

Disconnecting the axis-2 joint unit cabling

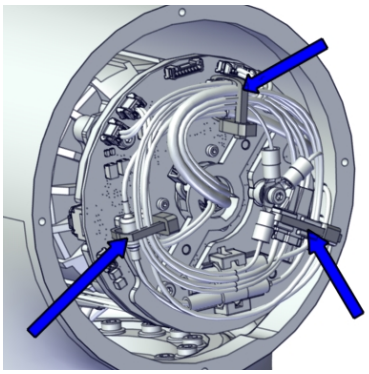
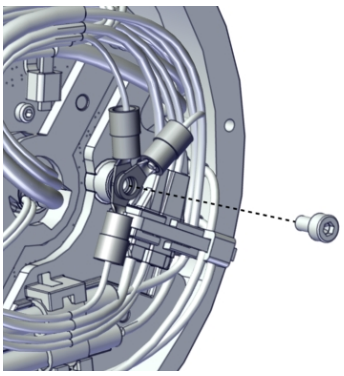
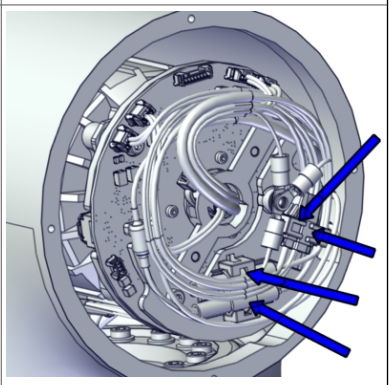
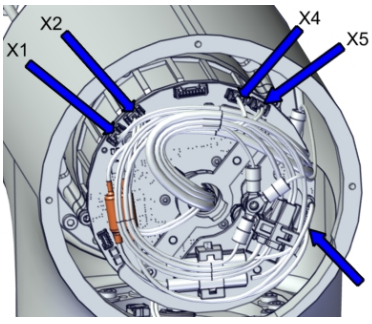
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	

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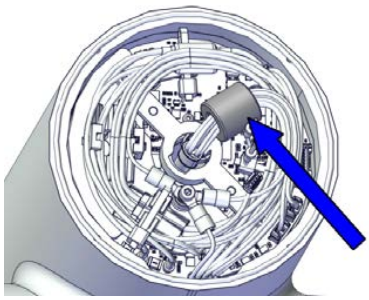
5.5.1 Replacing the base

Continued

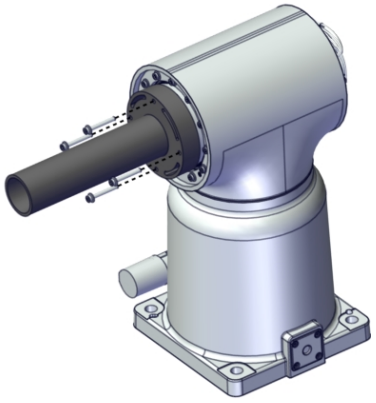
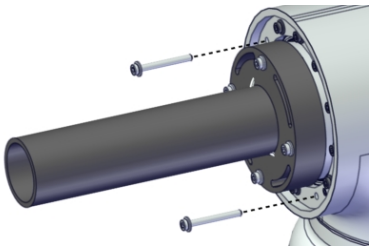
	Action	Note
2	Cut the cable ties.	 xx2000001946
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: • J2.DC+ • J2.DC- • J2.CS • J2.CP	 xx2000001944
5	Disconnect the connectors from the drive board. • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002013

Continues on next page

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	Action	Note
6	Remove the ferrite core by pulling the cables D2.X4 and D2.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-2 joint unit (-5/0.95)

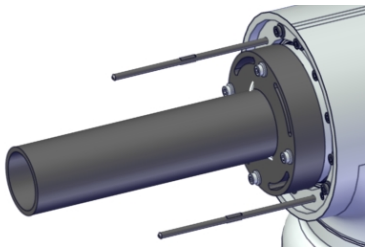
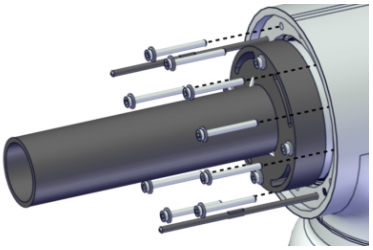
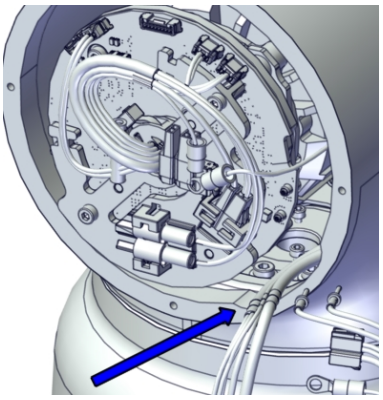
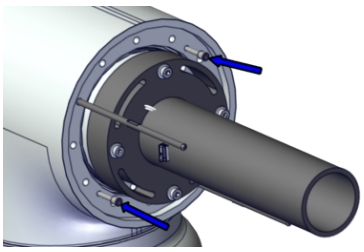
	Action	Note
1	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001956
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000295

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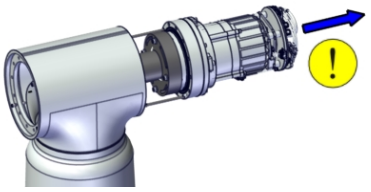
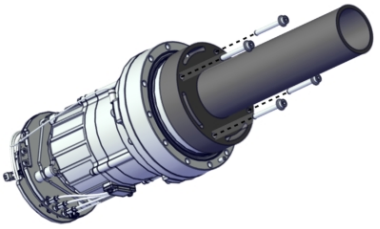
5.5.1 Replacing the base

Continued

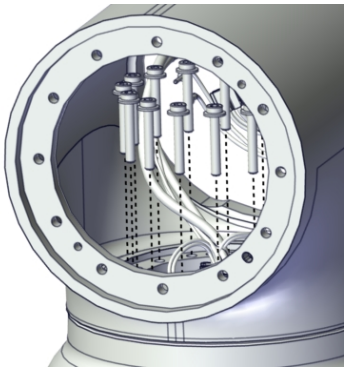
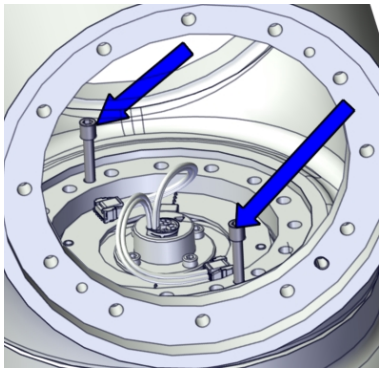
	Action	Note
3	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002433
4	Remove the remaining attachment screws. Use two screws 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.	 xx2000001943
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

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	Action	Note
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 swing (-5/0.95)

	Action	Note
1	Remove the swing attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001987
2	Use two fully threaded attachment screws as removal tools to press the swing out of position. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000002152
3	Lift away the swing. **CAUTION** The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	

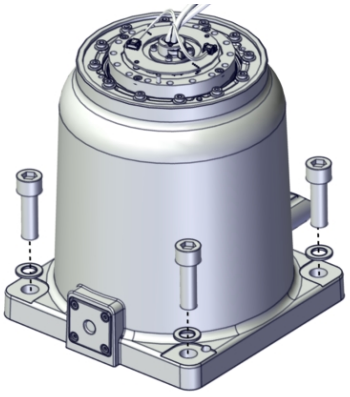
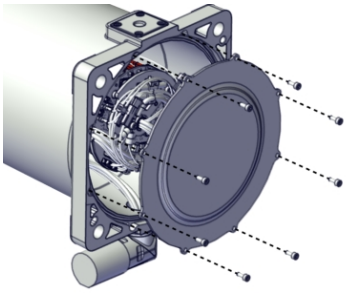
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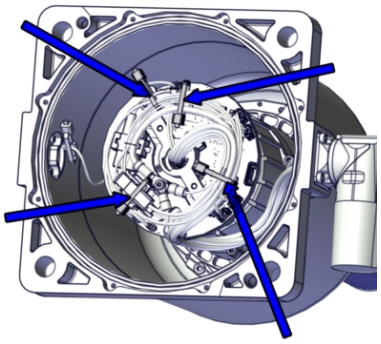
5.5.1 Replacing the base

Continued

Loosening the base and removing the base cover

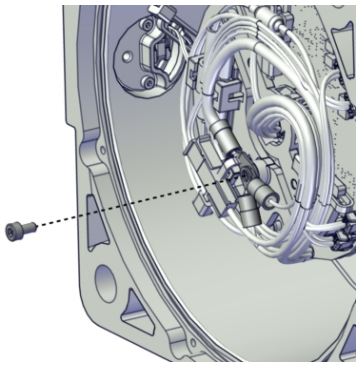
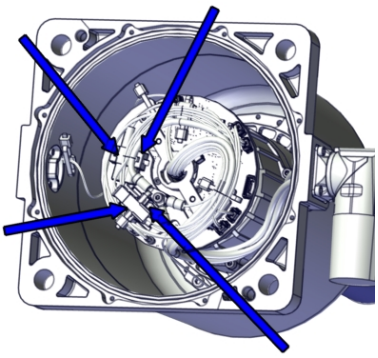
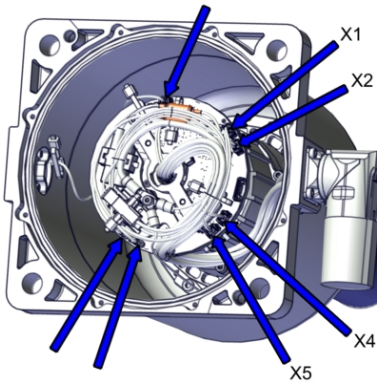
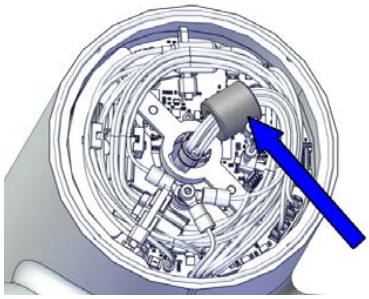
	Action	Note
1	Loosen the base from the foundation by removing the attachment screws and washers.	 xx2000002006
2	Tilt the base on to its side and remove the bottom cover by removing the attachment screws.	 xx2000002007

Disconnecting the axis-1 joint unit cabling

	Action	Note
1	Cut the cable ties.	 xx2000002012

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	Action	Note
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
4	Disconnect the connectors from the drive board. • 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 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002009
5	Remove the ferrite core by pulling the cables D1.X4 and D1.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

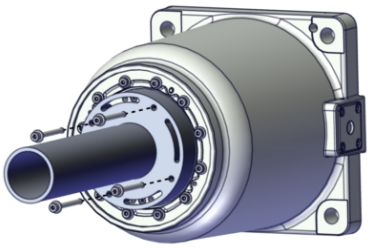
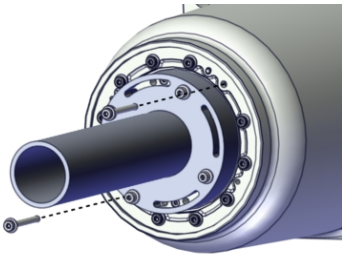
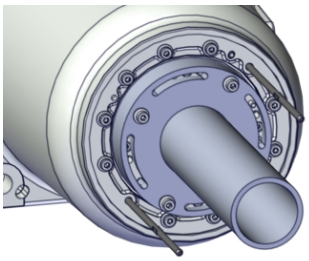
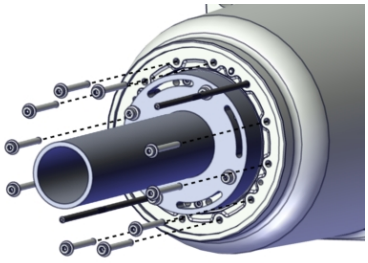
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5.5.1 Replacing the base

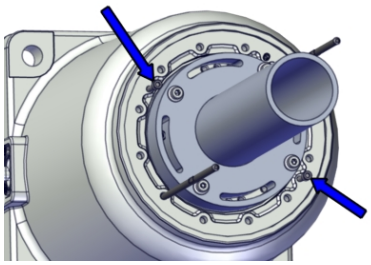
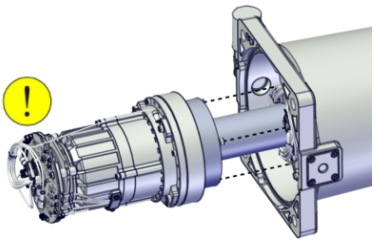
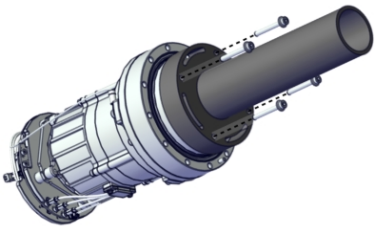
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Removing the axis-1 joint unit (-5/0.95)

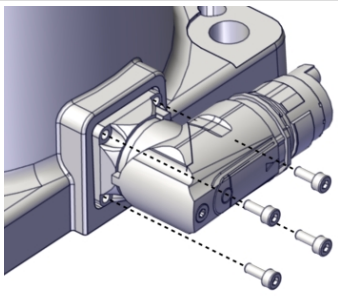
	Action	Note
1	Fit the lifting aid to the joint unit. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001994
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000296
3	Fit two guide pins to the axis-1 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002435
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

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	Action	Note
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

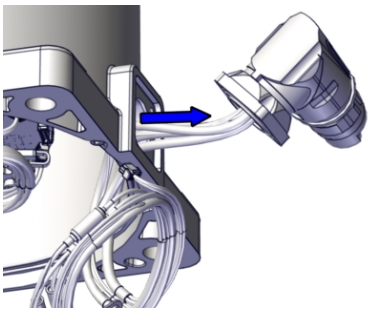
Removing the base cabling

	Action	Note
1	Remove the attachment screws.	 xx2100000406

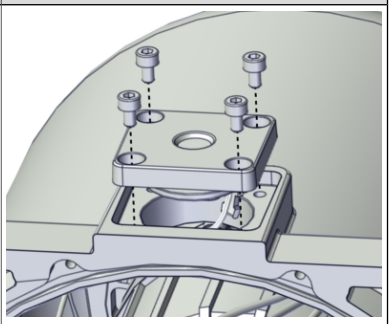
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5.5.1 Replacing the base
Continued

	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

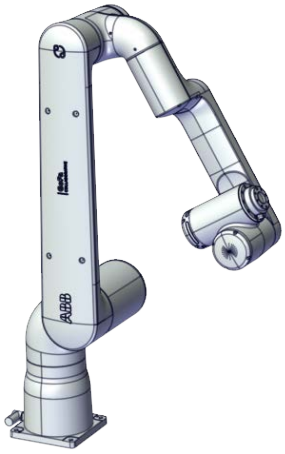
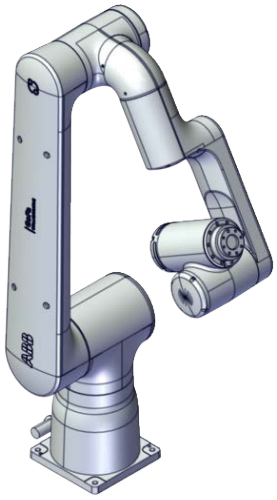
Removing the base (-10/1.52 and -12/1.27)

Use these procedures to remove the base.

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Preparations before removing the base

	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 0° • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. **CAUTION** 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.	**Valid for CRB 15000-10/1.52**  xx2300001062 **Valid for CRB 15000-12/1.27**  xx2300001063
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the lower arm covers (-10/1.52 and -12/1.27)

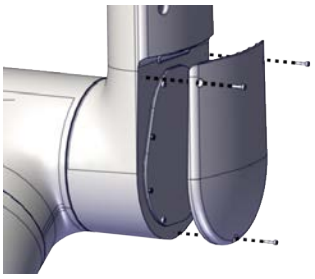
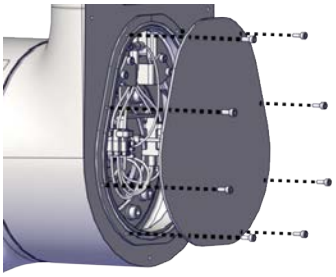
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	

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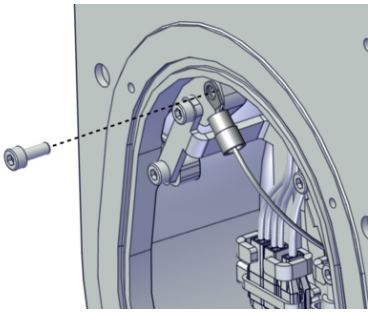
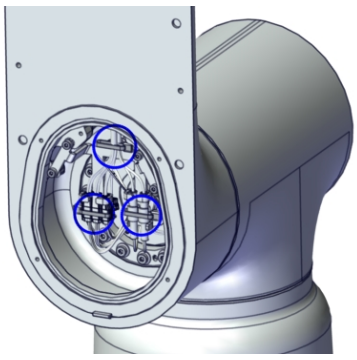
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5.5.1 Replacing the base

Continued

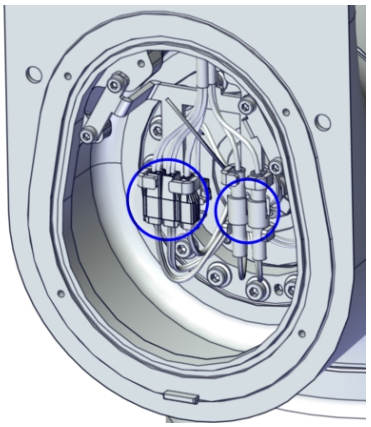
	Action	Note
2	Remove the lower cover of lower arm by removing the screws.	 xx2300000812
3	Remove the lower inner cover by removing the screws.	 xx2300000813

Disconnecting the cabling between the lower arm and the swing

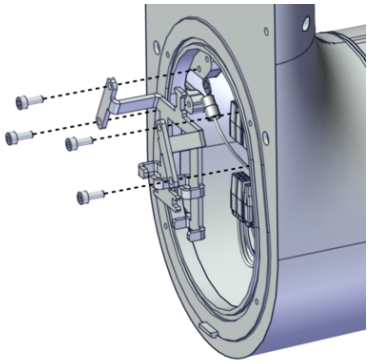
	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936
2	Cut the cable ties.	 xx2000001937

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	Action	Note
3	Snap loose and disconnect all connectors.	 xx2000001938

Removing the lower and upper arm assembled

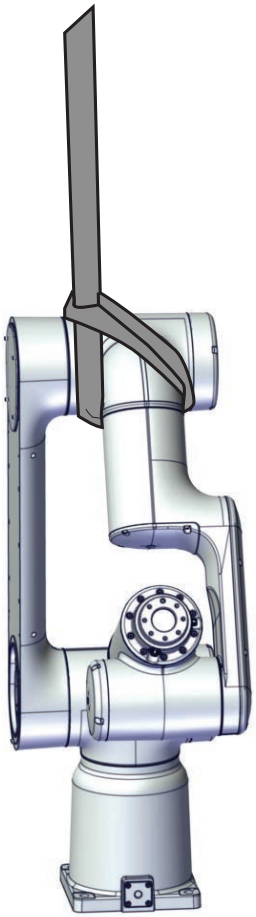
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939

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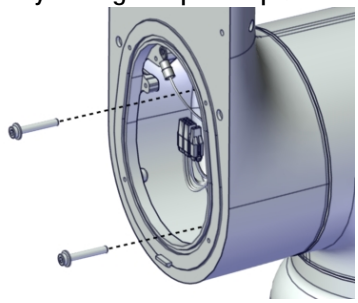
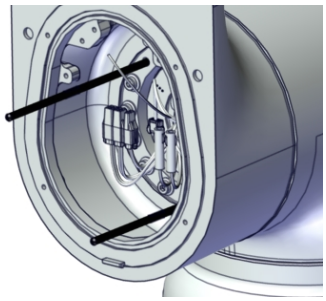
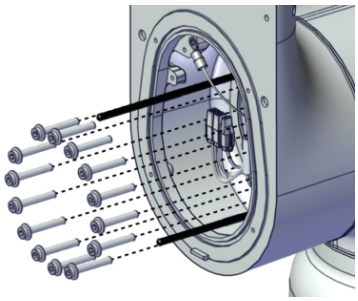
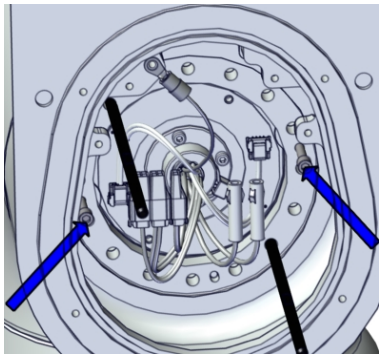
5.5.1 Replacing the base

Continued

	Action	Note
2	Secure the weight of the upper and lower arm. **CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	Suggestion with lifting sling and an overhead crane. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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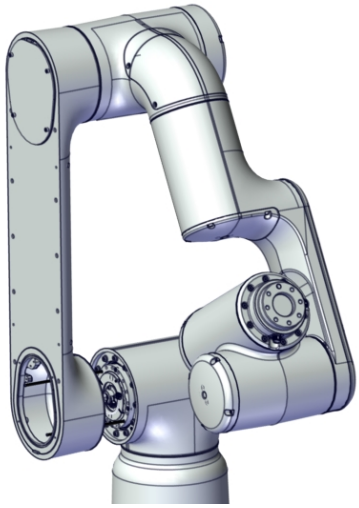
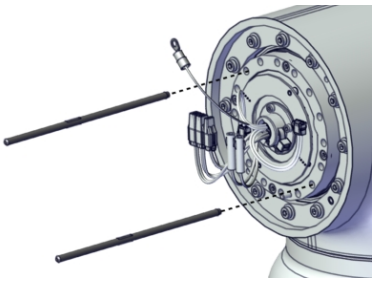
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	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

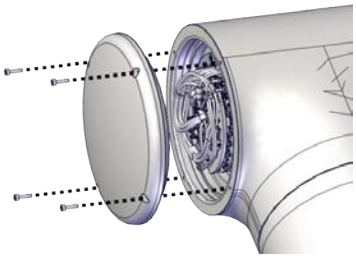
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5.5.1 Replacing the base
Continued

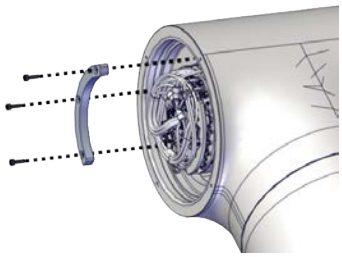
	Action	Note
6	Remove the complete arm system from the swing.	 xx2000001941
7	Remove the guide pins.	 xx2000002432

Removing the swing cover and insert (-10/1.52 and -12/1.27)

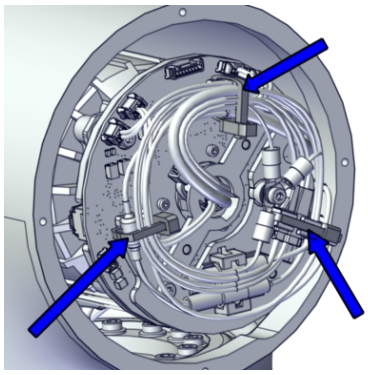
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000814

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	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	Remove the insert.	 xx2300000815

Disconnecting the axis-2 joint unit cabling

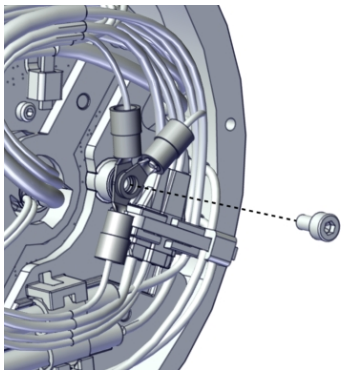
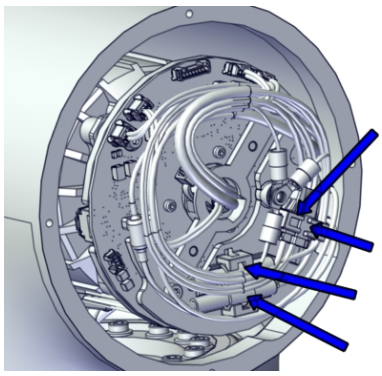
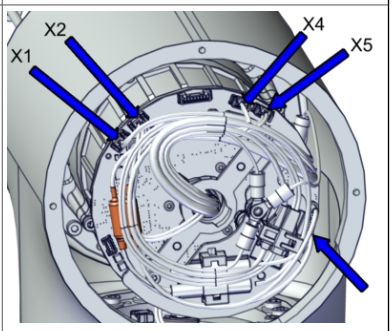
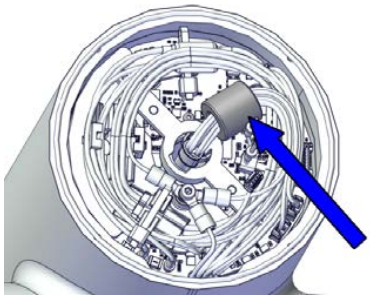
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Cut the cable ties.	 xx2000001946

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5.5.1 Replacing the base

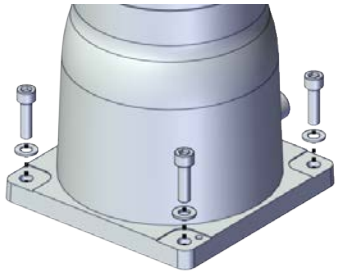
Continued

	Action	Note
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: • J2.DC+ • J2.DC- • J2.CS • J2.CP	 xx2000001944
5	Disconnect the connectors from the drive board. • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002013
6	Remove the ferrite core by pulling the cables D2.X4 and D2.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

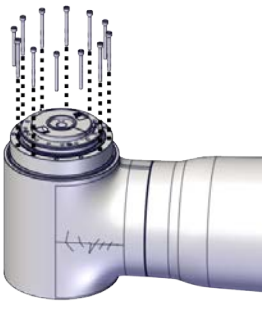
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Removing the base from foundation (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** The weight of the complete swing and base together is up to 25 kg	
2	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
3	Loosen the robot base from the foundation by removing the foundation attachment screws.	 xx2300001060
4	Lay the robot down with the torque sensor side upwards on a working bench. Do not damage the base socket. Caution with the cabling. **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.	

Removing the axis-2 joint unit

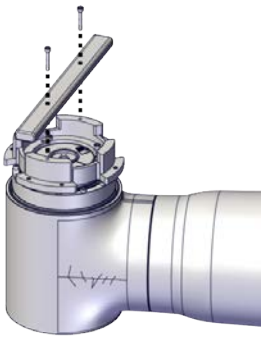
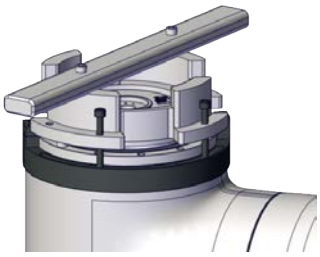
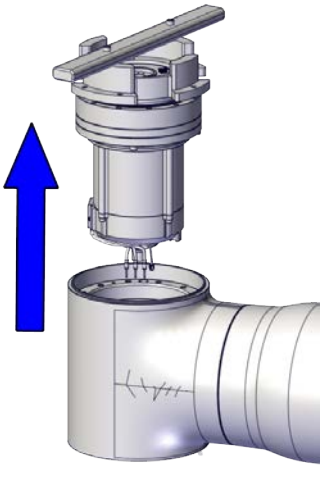
	Action	Note
1	Removing the attachment screws.	 xx2300000786

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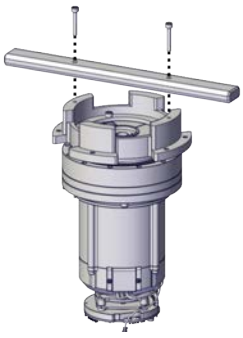
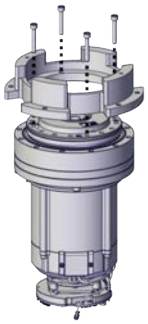
5.5.1 Replacing the base

Continued

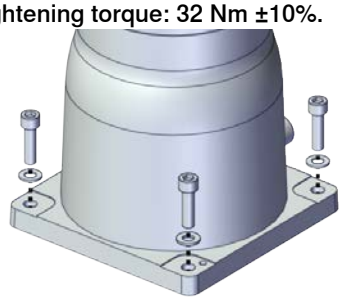
	Action	Note
2	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000787  xx2300000788
3	Place the two semicircular blocks surrounding the joint unit, and use two fully threaded attachment screws as removal tools to press the joint unit out of position.	 xx2300000789
4	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.	 xx2300000790

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	Action	Note
5	Remove the lifting aid.	 xx2300000778  xx2300000776

Securing the base (-10/1.52 and -12/1.27)

	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: 32 Nm ±10%.  xx2300001060

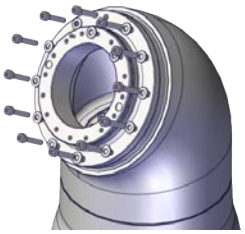
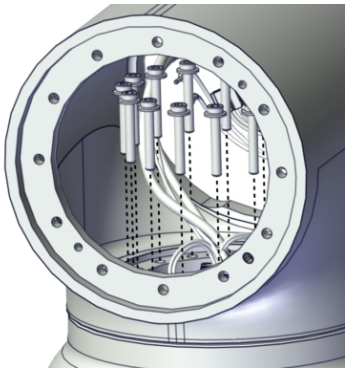
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5.5.1 Replacing the base

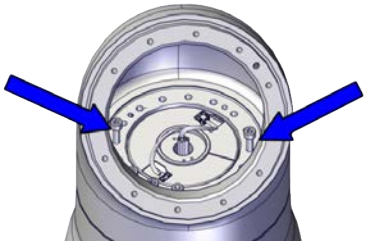
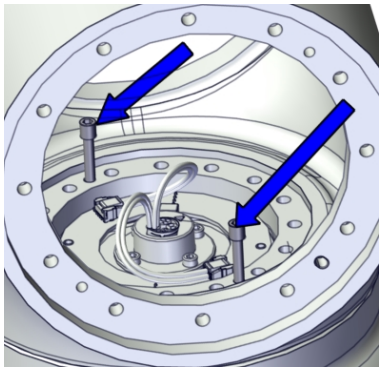
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Removing the swing (-10/1.52 and -12/1.27)

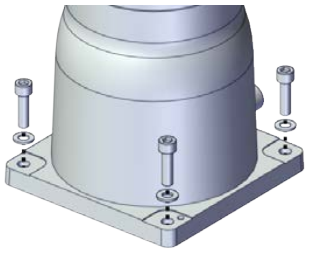
	Action	Note
1	**Valid for CRB 15000-10/1.52** Remove the swing transition.	 xx2300000817
2	**Valid for CRB 15000-10/1.52** Remove the swing flange.	 xx2300000818
3	Remove the swing attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	**Valid for CRB 15000-10/1.52**  xx2300000819 **Valid for CRB 15000-12/1.27**  xx2000001987

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	Action	Note
4	Use two fully threaded attachment screws as removal tools to press the swing out of position. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	**Valid for CRB 15000-10/1.52**  xx2300000822 **Valid for CRB 15000-12/1.27**  xx2000002152
5	Lift away the swing. **CAUTION** The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	

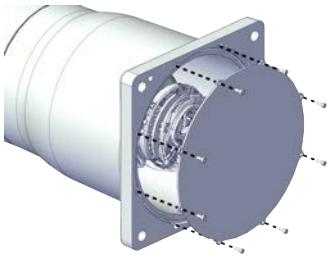
Loosening the base and removing the base cover

	Action	Note
1	Loosen the base from the foundation by removing the attachment screws and washers.	 xx2300001060

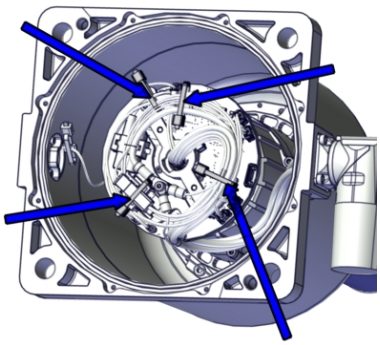
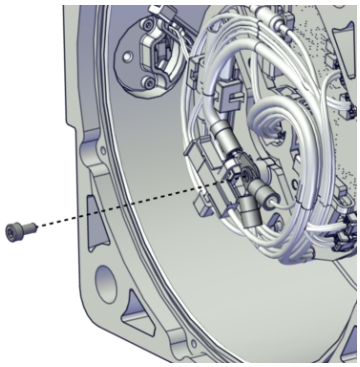
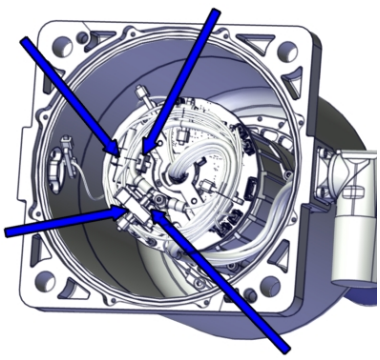
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5.5.1 Replacing the base
Continued

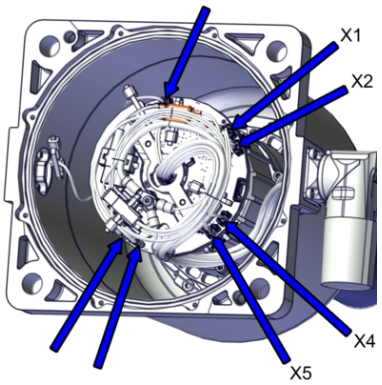
	Action	Note
2	Tilt the base on to its side and remove the bottom cover by removing the attachment screws.	 xx2300000760

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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	Action	Note
4	Disconnect the connectors from the drive board. • 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 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002009
5	Remove the ferrite core by pulling the cables D1.X4 and D1.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-1 joint unit (-10/1.52 and -12/1.27)

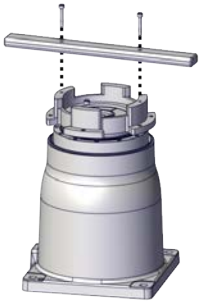
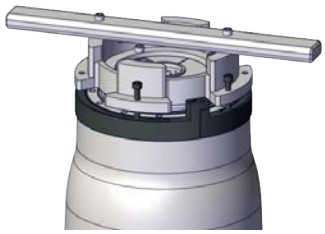
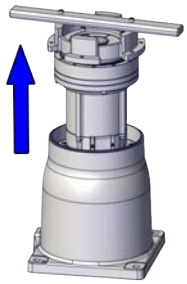
	Action	Note
1	Removing the attachment screws.	 xx2300000770

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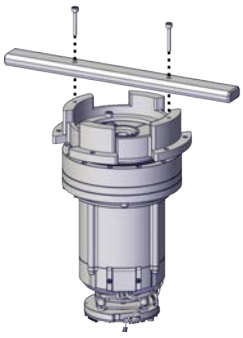
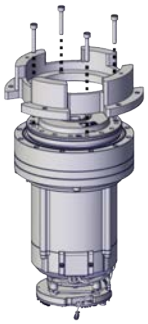
5.5.1 Replacing the base

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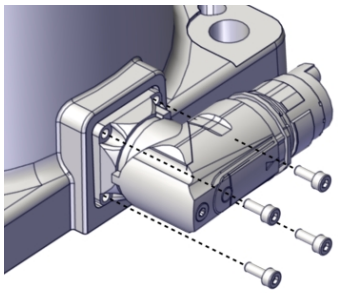
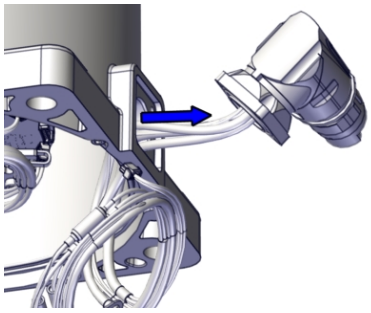
	Action	Note
2	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000771  xx2300000772
3	Place the two semicircular blocks surrounding the joint unit, and use two fully threaded attachment screws as removal tools to press the joint unit out of position.	 xx2300000773
4	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.	 xx2300000774

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	Action	Note
5	Remove the lifting aid.	 xx2300000778  xx2300000776

Removing the base cabling

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

Refitting the base (-5/0.95)

Use these procedures to refit the base.

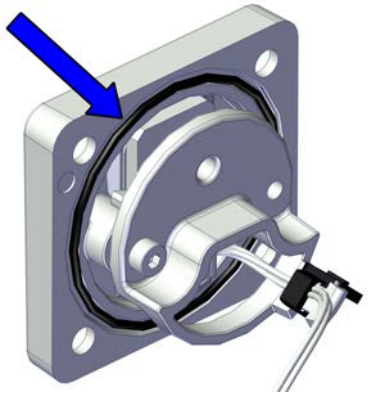
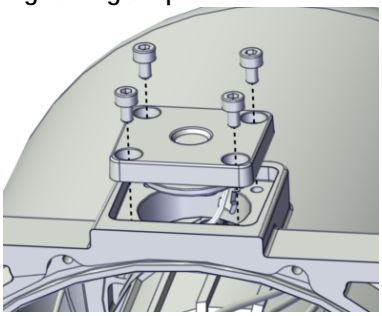
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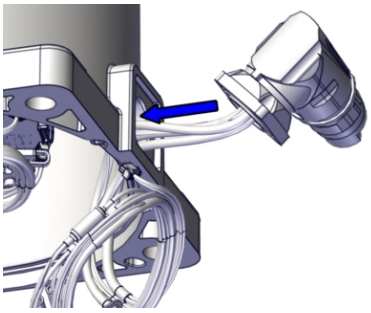
5.5.1 Replacing the base

Continued

Refitting the brake release unit

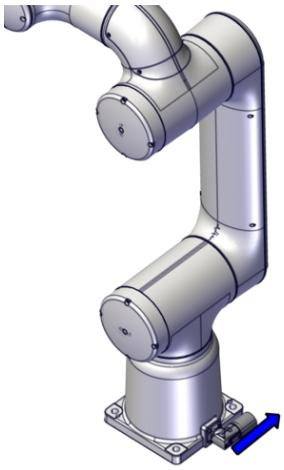
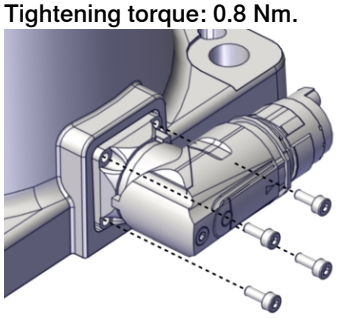
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAB3772-119 Grease: 3HAC031695-001 Harmonic Grease 4B No.2 Used to lubricate the seals.  xx2100000423
2	Refit the brake release unit to the new base with the screws.	Base: 3HAC073922-001 Screws: M3x5 12.9 Lafre 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

Continues on next page

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	Action	Note
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.	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 (-5/0.95)

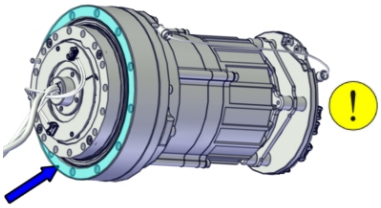
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	

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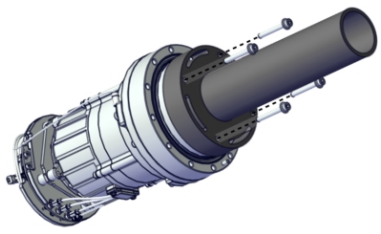
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5.5.1 Replacing the base

Continued

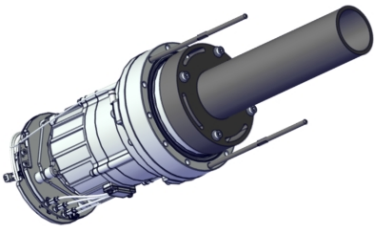
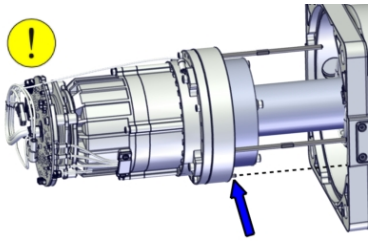
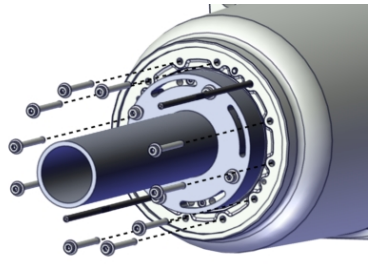
	Action	Note
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000001860
3	Apply a thin layer of flange sealant to 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 53*.	

Refitting the axis-1 joint unit (-5/0.95)

	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 53*.	
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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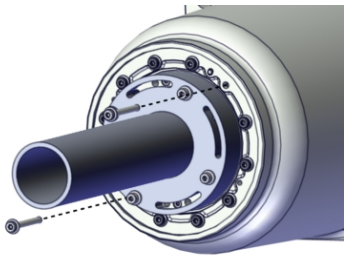
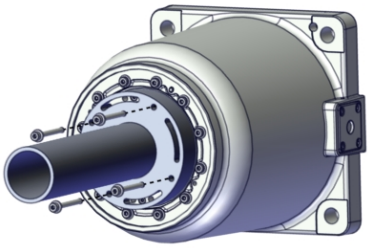
	Action	Note
3	Fit two guide pins to the joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002438
4	Fit the joint unit to the base, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002015
5	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 Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2000002008

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5.5.1 Replacing the base

Continued

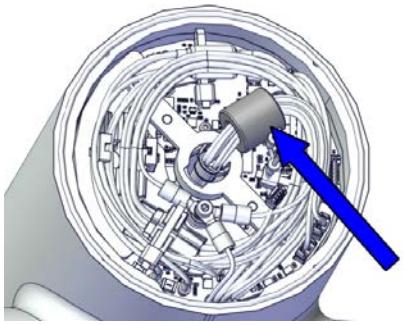
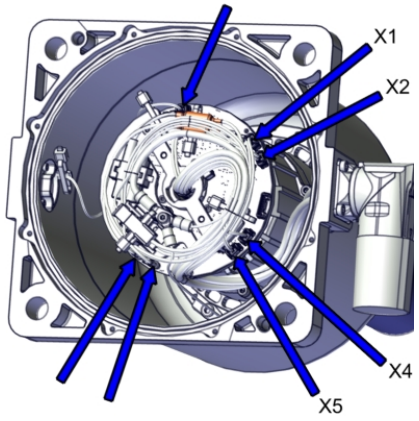
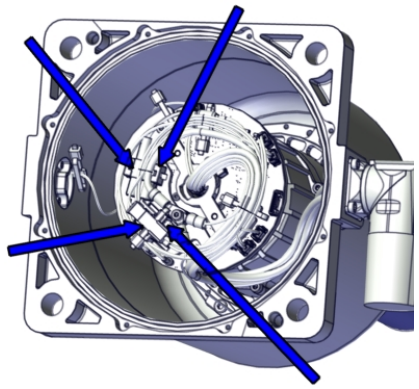
	Action	Note
6	Remove the guide pins and secure the remaining two attachment screws.	 xx2100000296
7	Pre-tighten the screws crosswise.	
8	Torque tighten all screws crosswise.	Tightening torque: 4.3 Nm.
9	Remove the lifting aid by removing the screws.	 xx2000001994
10	Clean pushed-out flange sealant, if 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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484

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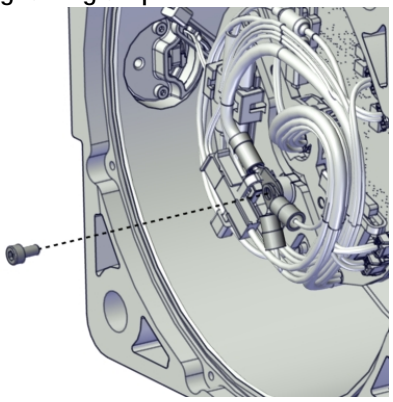
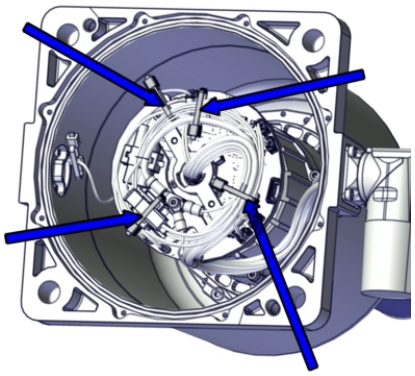
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	Action	Note
3	Thread the cables D1.X4 and D1.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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
5	Connect the connectors to each other and snap them to the cable holders. • J1.DC+ to J1.DC+ • J1.DC- to J1.DC- • J1.CS to J1.CS • J1.CP to J1.CP	 xx2000002010

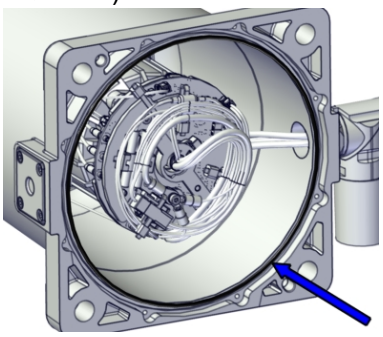
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5.5.1 Replacing the base
Continued

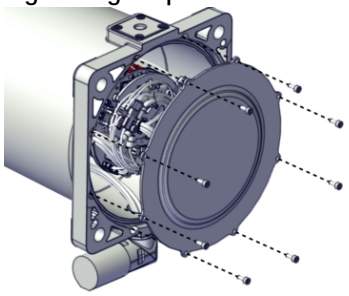
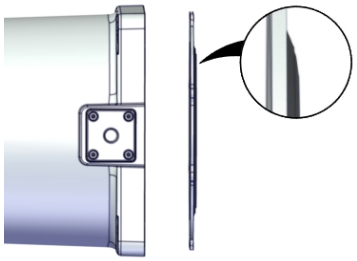
	Action	Note
6	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002011
7	Secure the cabling with cable ties.	Cable ties (4 pcs)  xx2000002012

Refitting the base cover (-5/0.95)

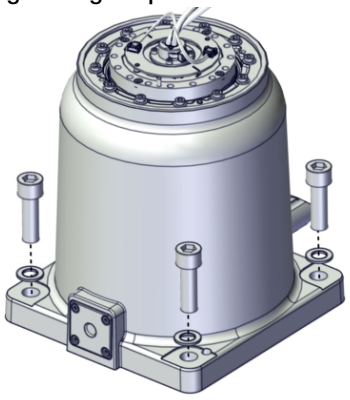
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAB3772-64 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016

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	Action	Note
2	Refit the bottom cover with the attachment screws. **Note** For CRB 15000-5/0.95, 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

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: 32 Nm ±10%.  xx2000002006

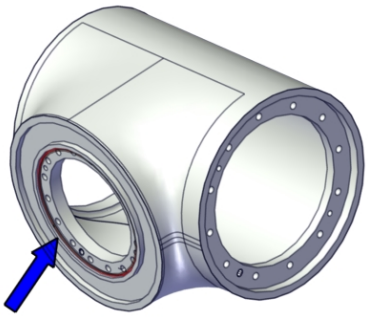
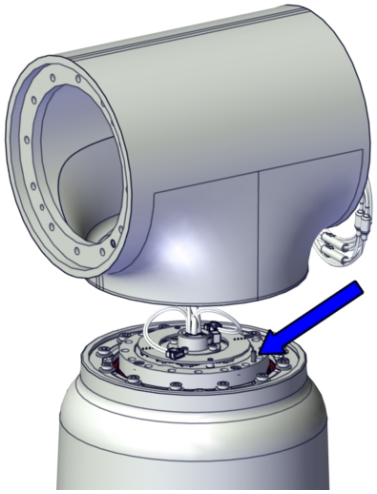
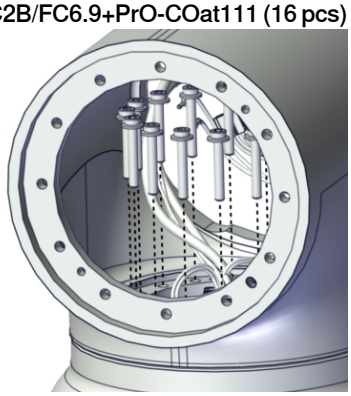
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5.5.1 Replacing the base

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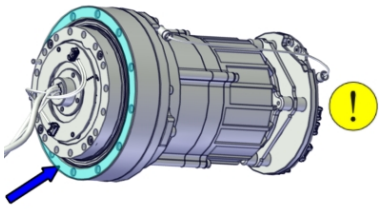
Refitting the swing(-5/0.95)

	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 (or equivalent)  xx2000001990
2	Separate the new swing parts by removing the pre-assembling screws.	
3	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
4	Secure the swing with the attachment screws. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001987
5	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm

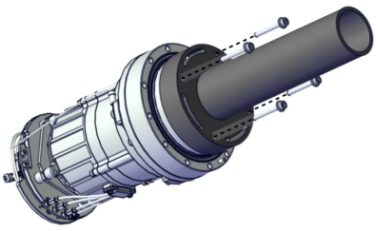
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Preparations before fitting the joint unit (-5/0.95)

	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 53*.	
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 (or equivalent)  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 53*.	

Refitting the axis-2 joint unit (-5/0.95)

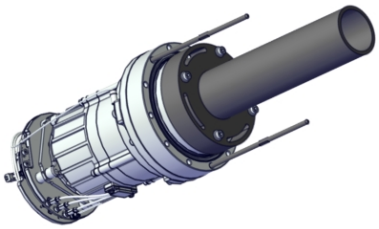
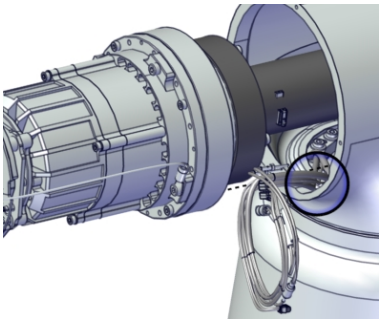
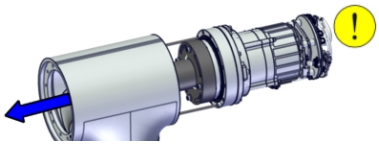
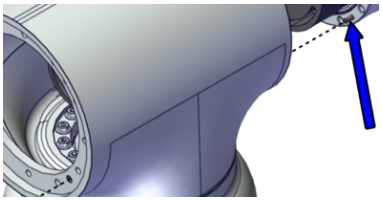
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Fit the lifting aid to the joint unit. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957

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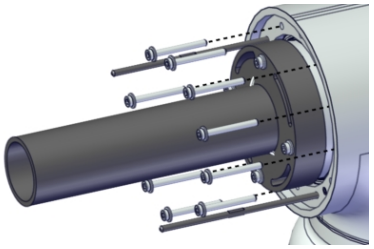
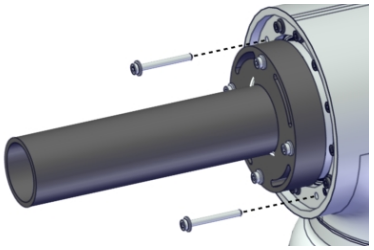
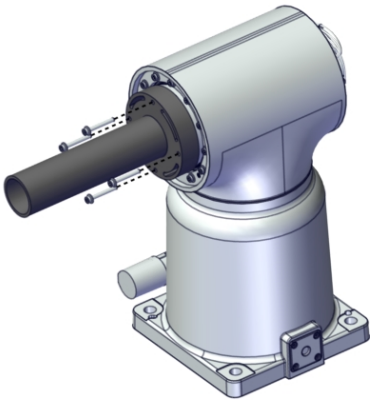
5.5.1 Replacing the base

Continued

	Action	Note
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 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  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
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

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	Action	Note
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 Used for joint unit of CRB 15000-5/0.95. 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.
10	Remove the lifting aid by removing the screws.	 xx2000001956
11	Clean pushed-out flange sealant, if any.	

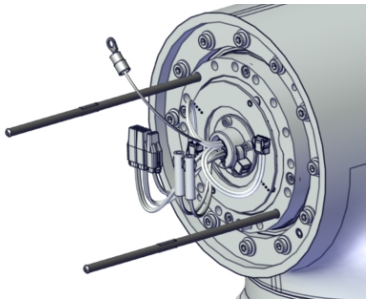
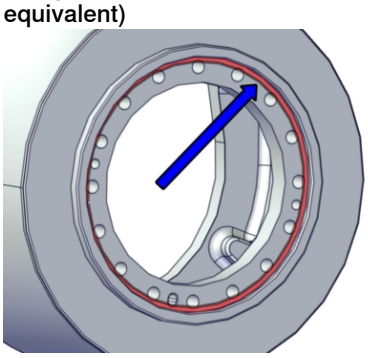
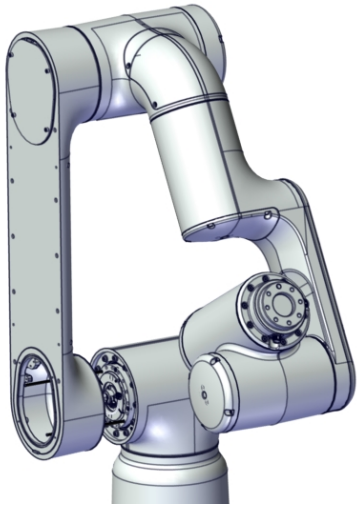
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5.5.1 Replacing the base

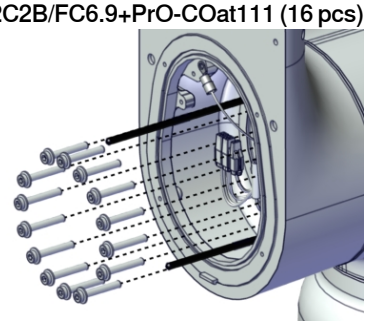
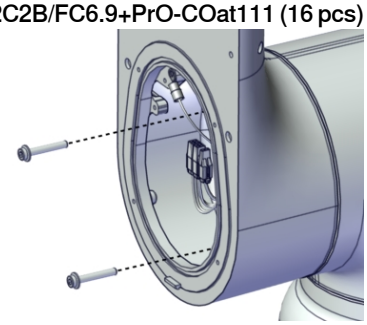
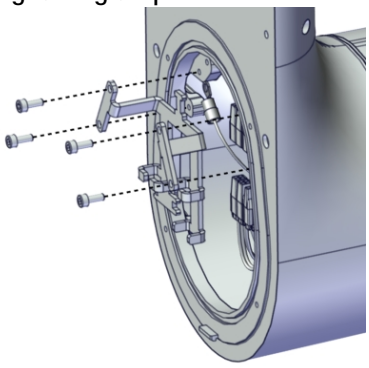
Continued

Refitting the lower and upper arm assembled (-5/0.95)

	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001  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 (or equivalent)  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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	Action	Note
5	Secure the lower arm to the swing with all attachment screws but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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

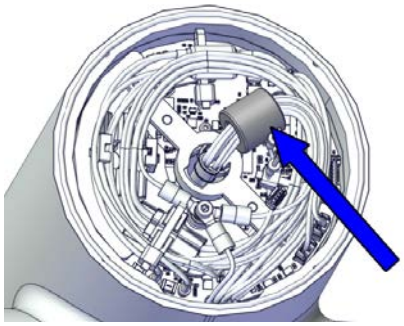
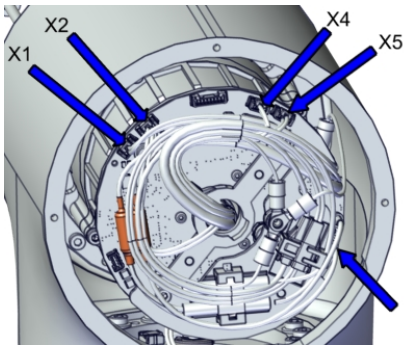
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5.5.1 Replacing the base

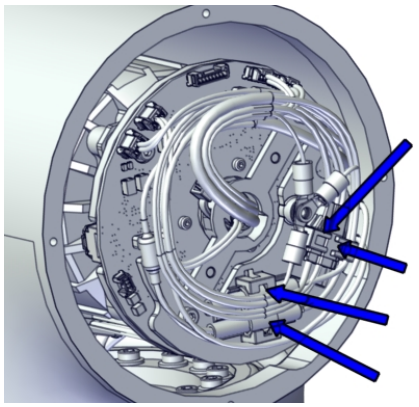
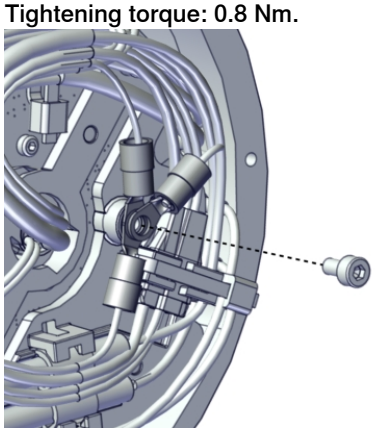
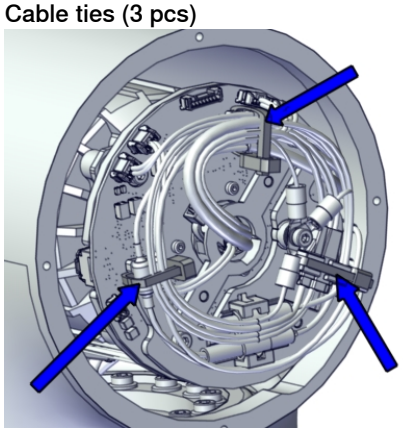
Continued

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 *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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

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	Action	Note
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944
6	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
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

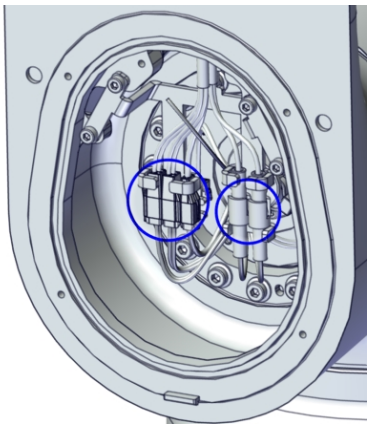
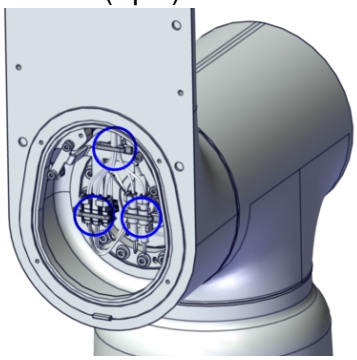
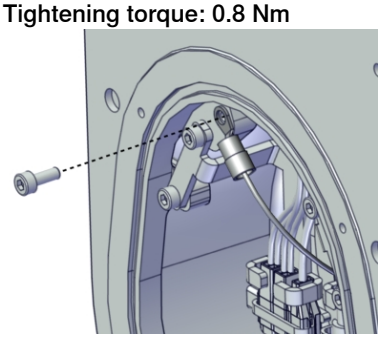
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5.5.1 Replacing the base

Continued

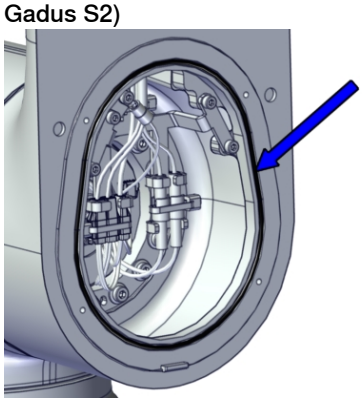
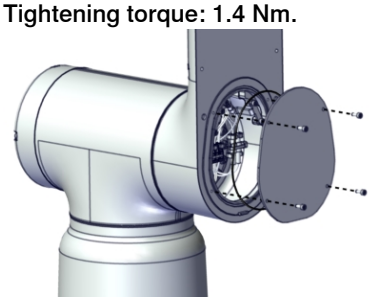
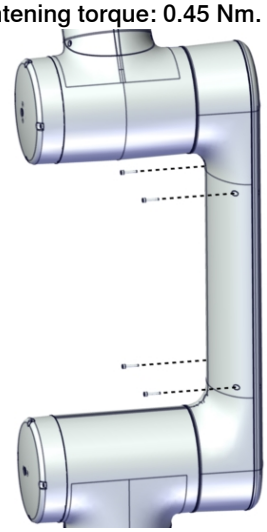
Connecting the cabling between the lower arm and swing

	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

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Refitting the lower arm covers (-5/0.95)

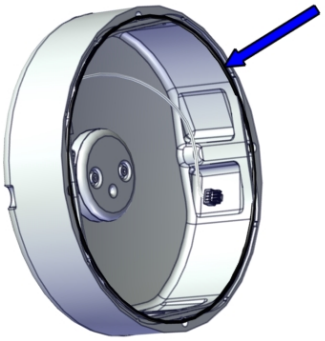
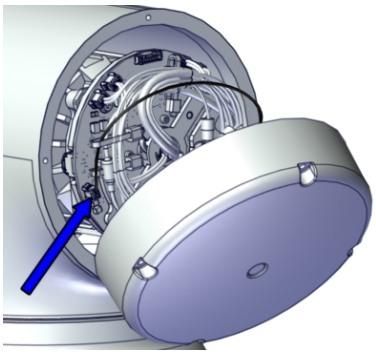
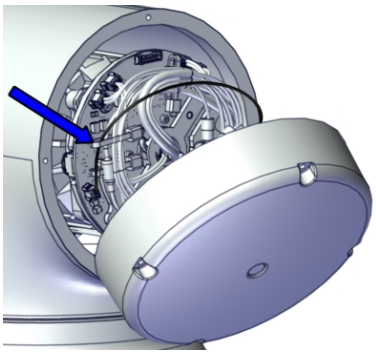
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001954
2	Refit the inner cover with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm.  xx2000001930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

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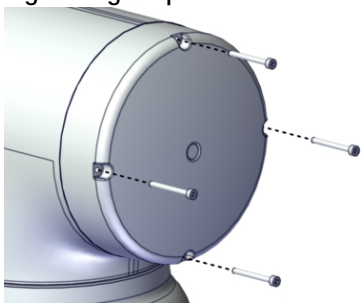
5.5.1 Replacing the base
Continued

Refitting the swing cover(-5/0.95)

	Action	Note
1	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-047 (for CRB 15000-5/0.95)  xx2000001962
2	**For robots with RobotWare earlier than 7.10** 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	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000001931

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	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  xx2000001935

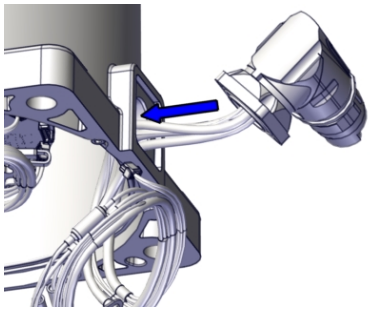
Concluding procedure

	Action	Note
1	Calibrate the joint unit torque sensor for the axis-1 and axis-2 joint units.	See *Calibration on page 1047*
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

Refitting the base (-10/1.52 and -12/1.27)

Use these procedures to refit the base.

Refitting the base cabling

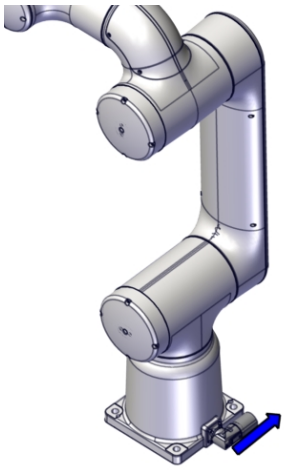
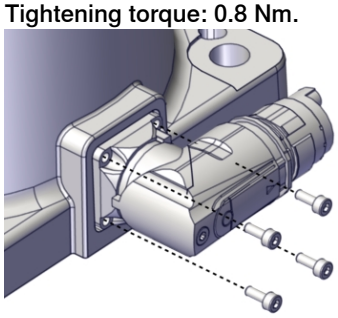
	Action	Note
1	Insert the cabling into the base.	 xx2100000408

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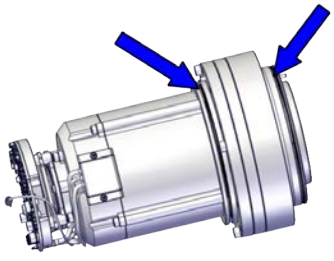
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5.5.1 Replacing the base

Continued

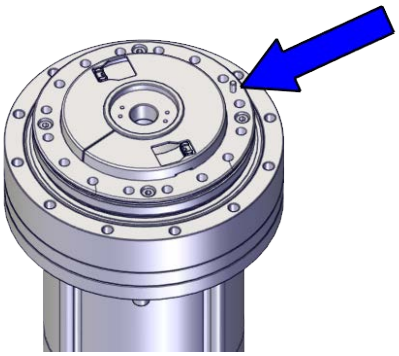
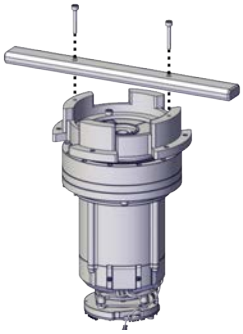
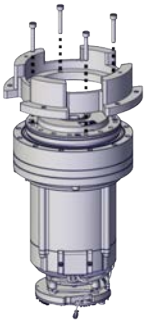
	Action	Note
2	Orient the base connector so that it points to the right, seen from back of the robot.	 xx2100000409
3	Secure the base connector with the attachment screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm.  xx2100000406

Refitting the axis-1 joint unit (-10/1.52 and -12/1.27)

	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 53*.	
2	Check the o-rings. Replace if damaged.	O-ring: 3HAC061327-044  xx2300000823

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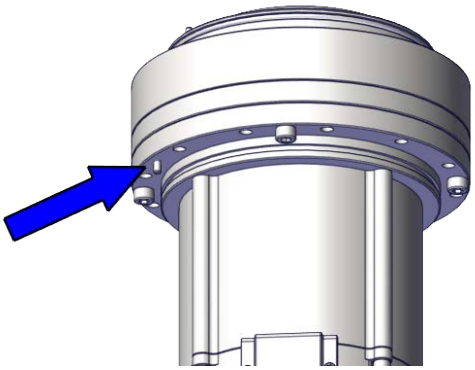
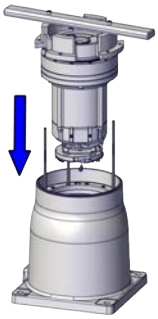
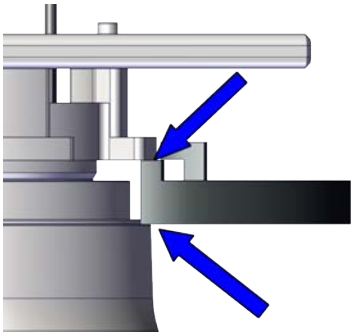
	Action	Note
3	Fit three guide pins to the base.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins together.  xx2300000775
4	Fit the lifting aid to the joint unit, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  xx2300000777	Joint unit: 3HAC087472-001 Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000778  xx2300000776

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5.5.1 Replacing the base

Continued

	Action	Note
5	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.  xx2300000780	 xx2300000779
6	Check the joint unit position by placing the lower boss of one semicircular block between the lifting aid and base. The joint unit is properly placed when no gaps between the block and both lifting aid and base	 xx2300000781
7	Remove the guide pins.	 xx2300000782

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	Action	Note
8	Secure with four attachment screws and pre-tighten the screws crosswise.	 xx2300000783
9	Remove the lifting aid by removing the screws.	 xx2300000784
10	Secure the joint unit with the remaining attachment screws.	Hex socket head cap screw: 3HAB3409-20  xx2300000785
11	Torque tighten all screws crosswise.	M5x55 12.9 Lafre 2C2B/FC6.9, 12 pcs Tightening torque: 8.2 Nm.

Connecting the axis-1 joint unit cabling

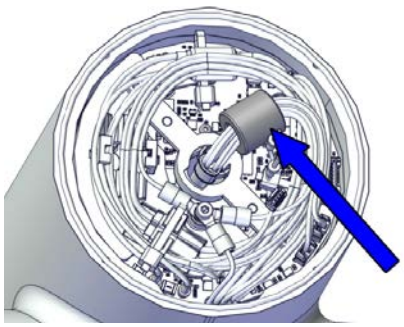
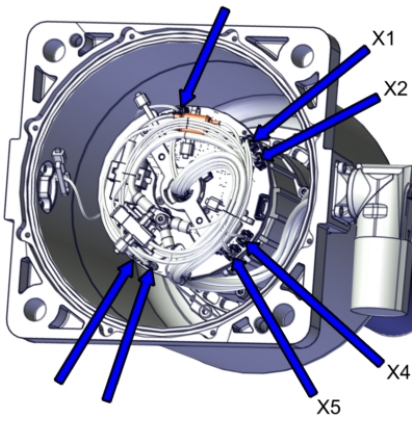
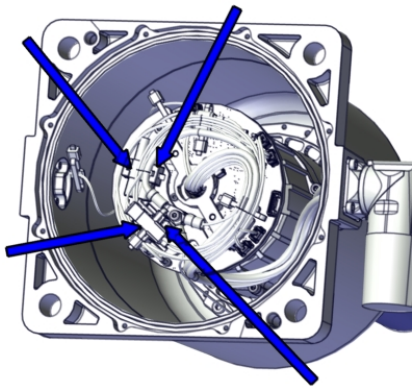
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	

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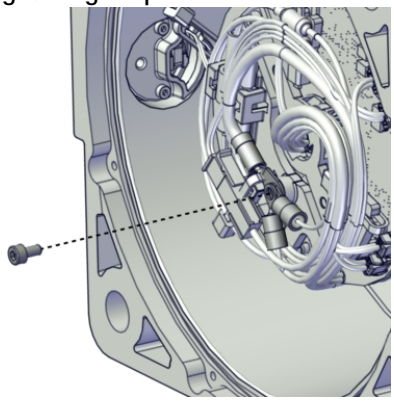
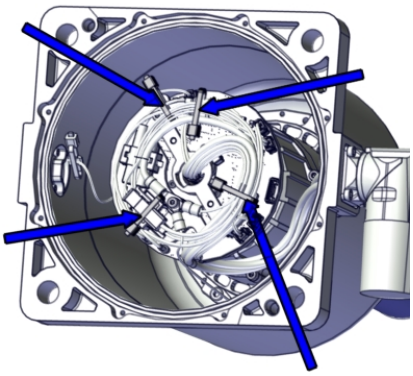
5.5.1 Replacing the base

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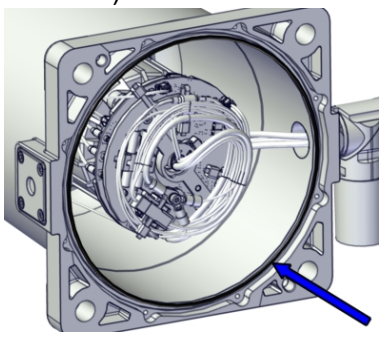
	Action	Note
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D1.X4 and D1.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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
5	Connect the connectors to each other and snap them to the cable holders. • J1.DC+ to J1.DC+ • J1.DC- to J1.DC- • J1.CS to J1.CS • J1.CP to J1.CP	 xx2000002010

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	Action	Note
6	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
7	Secure the cabling with cable ties.	Cable ties (4 pcs)  xx2000002012

Refitting the base cover (-10/1.52 and -12/1.27)

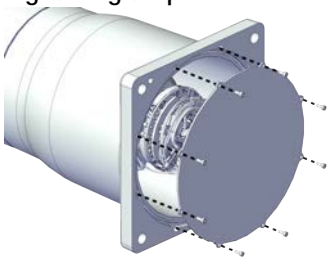
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	3HAC061327-072 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016

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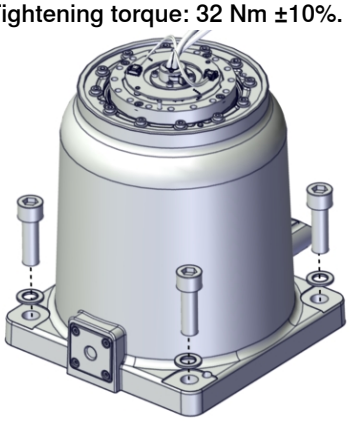
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5.5.1 Replacing the base

Continued

	Action	Note
2	Refit the bottom cover with the attachment screws. **Note** For CRB 15000-5/0.95, 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: 1.4 Nm.  xx2300000760

Securing the base

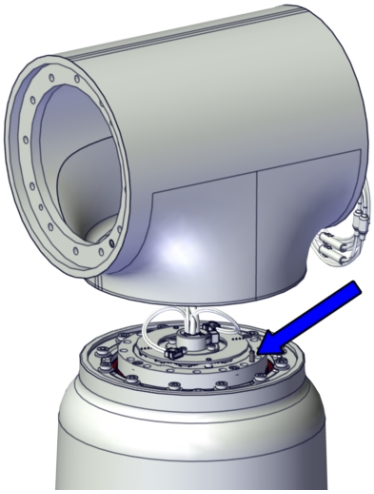
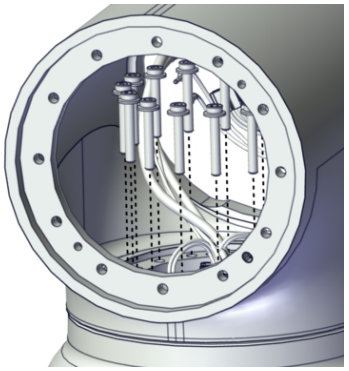
	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 32 Nm ±10%.  xx2000002006

Refitting the swing(-10/1.52 and -12/1.27)

	Action	Note
1	Fit two guide pins on the base unit for position guidance. Always use guide pins in pairs.	**Valid for CRB 15000-10/1.52** Guide pin, M5x75, 3HAC087786-002 **Valid for CRB 15000-12/1.27** Guide pin, M5x125: 3HAC087786-001

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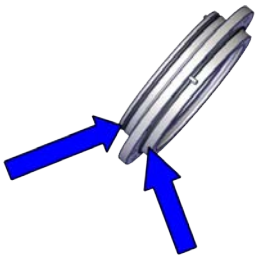
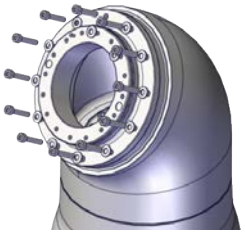
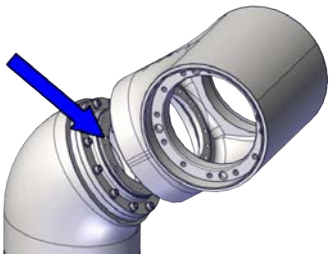
	Action	Note
2	Refit the swing to the base unit, aligning the pin with the pin hole. **CAUTION** The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	Example of CRB 15000-12/1.27, similar to CRB 15000-10/1.52.  xx2000001989
3	Secure the swing with the attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm **Valid for CRB 15000-12/1.27**  xx2000001987 **Valid for CRB 15000-10/1.52**  xx2300000819

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5.5.1 Replacing the base

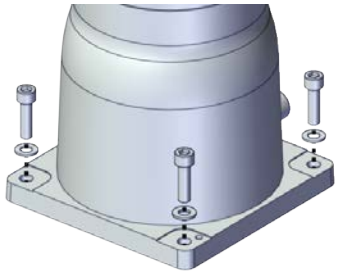
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	Action	Note
4	**Valid for CRB 15000-10/1.52** Check the o-rings on both side of the swing flange. Replace if damaged.	O-ring: 3HAC061327-073 O-ring: 3HAC061327-044  xx2300000821
5	**Valid for CRB 15000-10/1.52** Refit the swing flange with the attachment screws. Always check the serial number printed on the swing parts and use the parts in the same number for refitting. **CAUTION** Do not use the pre-assembling screws of swing parts for securing.	Hex socket head cap screw: M5x25 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm  xx2300000818
6	**Valid for CRB 15000-10/1.52** Fit two guide pins on the swing flange for position guidance. Always use guide pins in pairs.	Guide pin, M5x75, 3HAC087786-002
7	**Valid for CRB 15000-10/1.52** Refit the swing transition to the swing flange, aligning the pin with the pin hole. Always check the serial number printed on the swing parts and use the parts in the same number for refitting.	 xx2300000820
8	**Valid for CRB 15000-10/1.52** Secure the swing transition with the attachment screws. **CAUTION** Do not use the pre-assembling screws of swing parts for securing.	Hex socket head cap screw: M5x25 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm  xx2300000817

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Removing the base from foundation (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** The weight of the complete swing and base together is up to 25 kg	
2	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
3	Loosen the robot base from the foundation by removing the foundation attachment screws.	 xx2300001060
4	Lay the robot down with the torque sensor side upwards on a working bench. Do not damage the base socket. Caution with the cabling. **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.	

Refitting the axis-2 joint unit (-10/1.52 and -12/1.27)

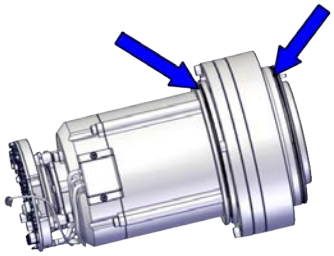
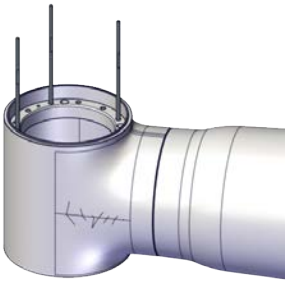
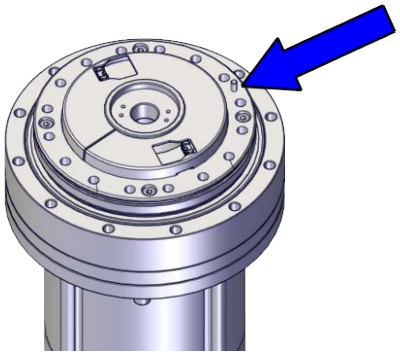
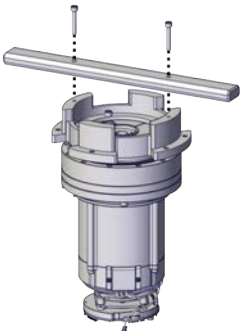
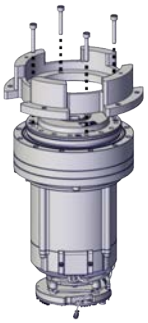
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	

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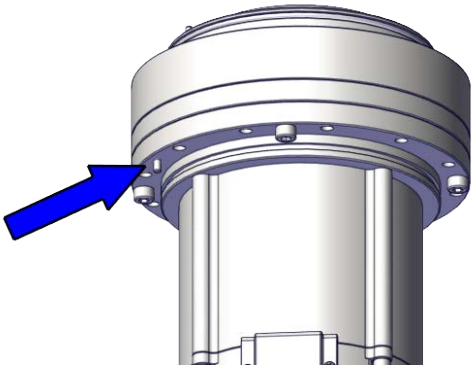
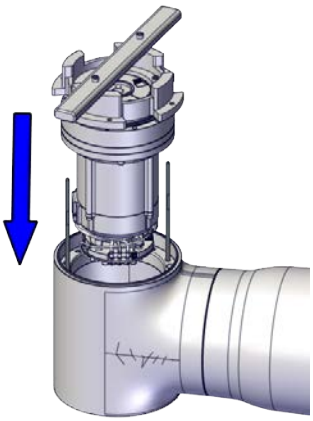
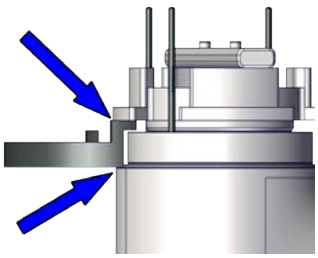
5.5.1 Replacing the base

Continued

	Action	Note
2	Check the o-rings. Replace if damaged.	O-ring: 3HAC061327-044  xx2300000823
3	Fit three guide pins to the swing.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins together.  xx2300000791
4	Fit the lifting aid to the joint unit, 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.  xx2300000777	Joint unit: 3HAC087472-001 Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000778  xx2300000776

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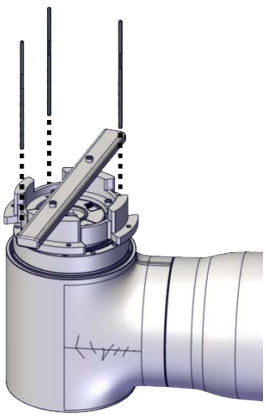
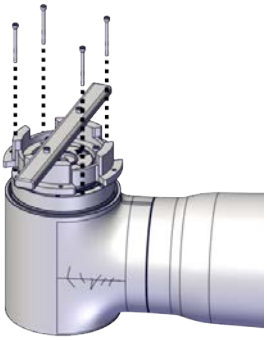
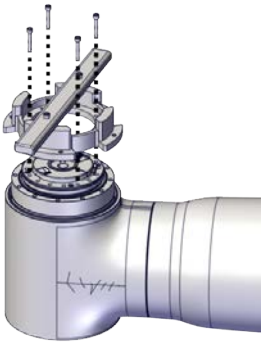
	Action	Note
5	Place the axis-1 cabling properly to avoid squeezing by the joint unit when putting the joint unit into the swing. **CAUTION** The cabling is sensitive to mechanical damage. Handle it with care to avoid damage to the cabling or the connector, avoid any kind of tilt or skew.	
6	Fit the joint 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.  xx2300000780	 xx2300000792
7	Check the joint unit position by placing the higher boss of one semicircular block between the lifting aid and swing. The joint unit is properly placed when no gaps between the block and both lifting aid and swing.	 xx2300000794

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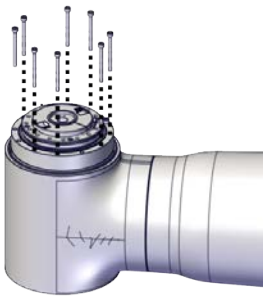
5.5.1 Replacing the base

Continued

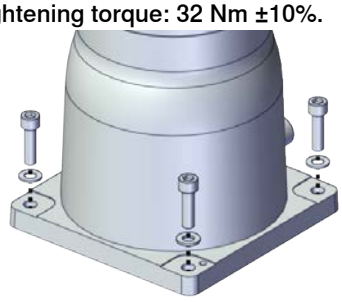
	Action	Note
8	Remove the guide pins.	 xx2300000795
9	Secure with four attachment screws and pre-tighten the screws crosswise.	 xx2300000796
10	Remove the lifting aid by removing the screws.	 xx2300000797

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	Action	Note
11	Secure the joint unit with the remaining attachment screws.	Hex socket head cap screw: 3HAB3409-20  xx2300000798
12	Torque tighten all screws crosswise.	M5x55 12.9 Lafre 2C2B/FC6.9, 12 pcs Tightening torque: 8.2 Nm.

Securing the base (-10/1.52 and -12/1.27)

	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: 32 Nm ±10%.  xx2300001060

Refitting the lower and upper arm assembled (-10/1.52 and -12/1.27)

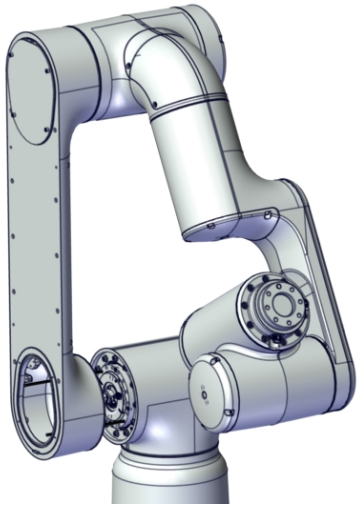
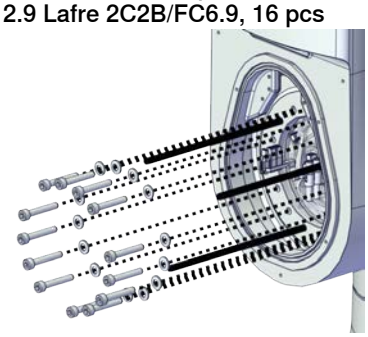
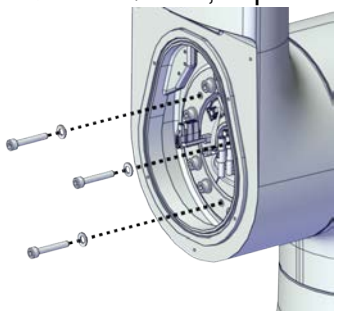
	Action	Note
1	Fit three guide pins to the axis-2 joint unit.	Guide pin, M5x125: 3HAC087786-001  xx2300001021

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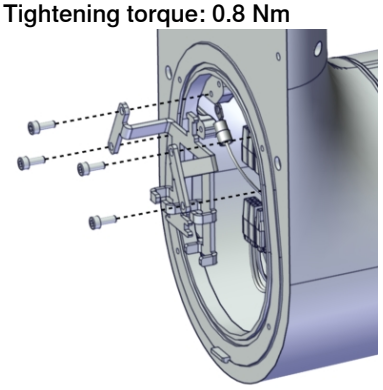
5.5.1 Replacing the base

Continued

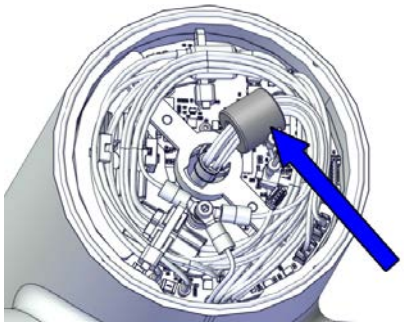
	Action	Note
2	**CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	
3	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000001941
4	Secure the lower arm to the swing with all screws and washers but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001022
5	Remove the guide pins and fasten the remaining two screws and washers. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001023
6	Torque tighten all screws crosswise.	Tightening torque: 8.2 Nm

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	Action	Note
7	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 axis-2 joint unit cabling

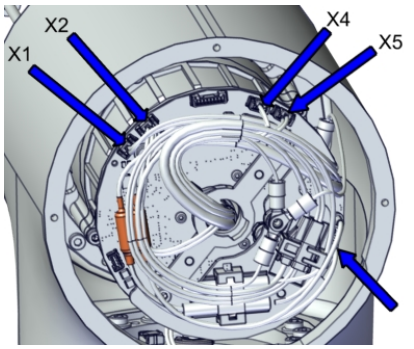
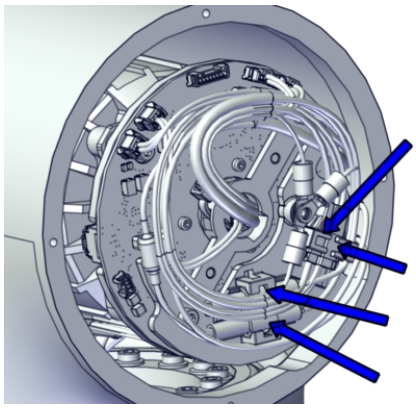
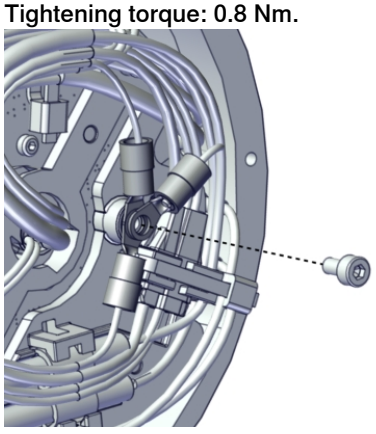
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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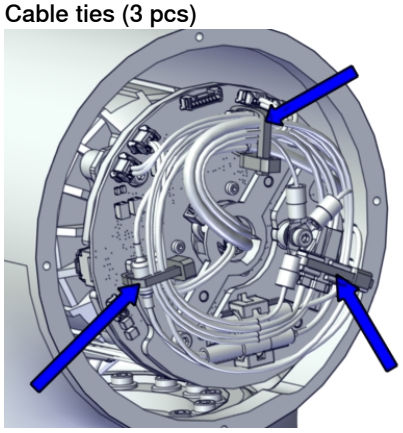
5.5.1 Replacing the base

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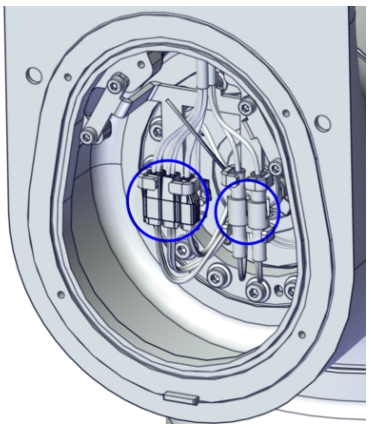
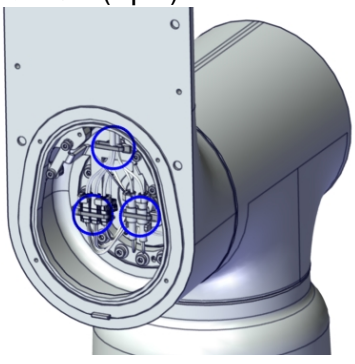
	Action	Note
4	Reconnect the connectors to the drive board. • D2.X1 to X1 • D2.DC+ to DC+ • D2.DC- to Ground • D2.X4 to X4 • D2.X2 to X2 • D2.X5 to X5	 xx2000002013
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944
6	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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	Action	Note
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

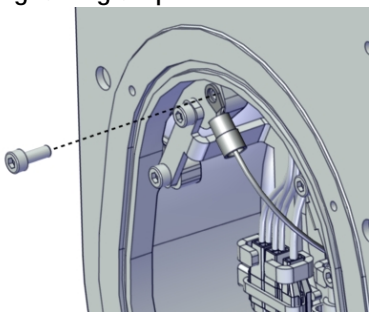
Connecting the cabling between the lower arm and swing

	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

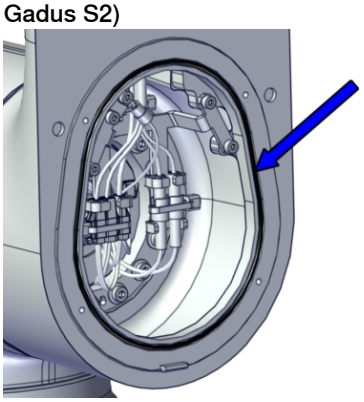
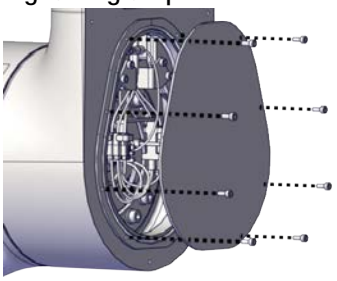
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5.5.1 Replacing the base
Continued

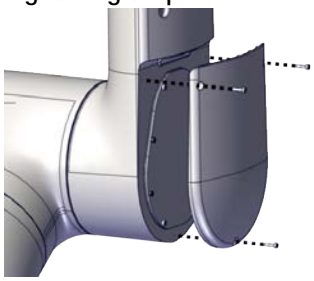
	Action	Note
3	Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

Refitting the lower arm covers (-10/1.52 and -12/1.27)

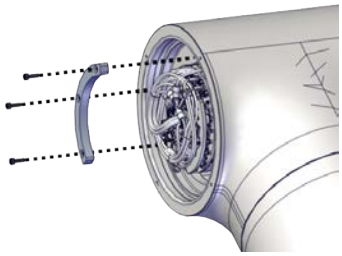
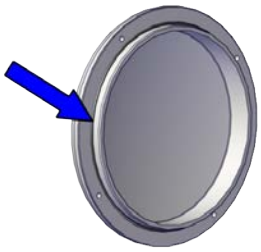
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-075 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000001954
2	Refit the inner cover with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm.  xx2300000813

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	Action	Note
3	Refit the lower cover of lower arm with three screws.	Lower arm cover, lower: Lower arm, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Tightening torque: 1.4 Nm.  xx2300000812

Refitting the swing cover and insert(-10/1.52 and -12/1.27)

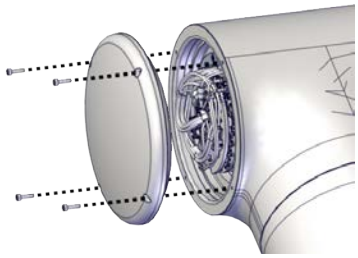
	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000815
2	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-074 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2300000816

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5.5.1 Replacing the base

Continued

	Action	Note
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000814

Concluding procedure

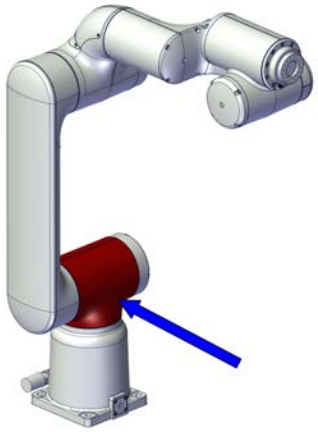
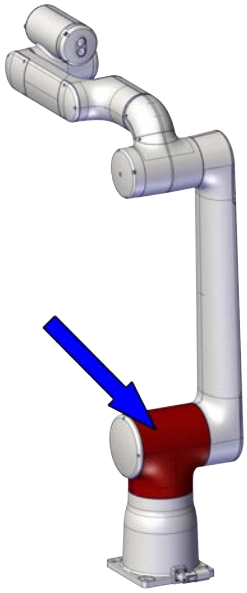
	Action	Note
1	Calibrate the joint unit torque sensor for the axis-1 and axis-2 joint units.	See *Calibration on page 1047*
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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5.5.2 Replacing the swing

Location of the swing

The swing is located as shown in the figure.

CRB 15000-5/0.95	CRB 15000-10/1.52	CRB 15000-12/1.27
 xx2000001986	 xx2300000766	 xx2300000769

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. (For CRB 15000-10/1.52 and CRB 15000-12/1.27) Loosen the base from the foundation and lay it down with the torque sensor side upwards.
5. Remove the axis-2 joint unit.
6. Replace the swing.

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*.

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5.5.2 Replacing the swing
Continued

Spare part	Article number	Note
Swing	3HAC073933-001	Used for CRB 15000-5/0.95. Also order new attachment screws for the axis-2 joint unit: 3HAB3413-435 (12 pcs).
Swing (CRB 15000-10/1.52)	3HAC087548-001	Used for CRB 15000-10/1.52. Also include O-ring (3HAC061327-073) and O-ring (3HAC061327-044).
Swing (CRB 15000-12/1.27)	3HAC087547-001	Used for CRB 15000-12/1.27.
Flange socket head screw with glue	3HAB3413-435	M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. 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 of CRB 15000-5/0.95. Attachment screws M4x35 (4 pcs) are enclosed.
Lifting aid	3HAC087787-001	For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27. A plate, a beam, a pair of semicircular blocks and attachment screws M5x30 (2 pcs) are enclosed.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M5x125	3HAC087786-001	Always use guide pins in pairs. For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M5x75	3HAC087786-002	Always use guide pins in pairs.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol

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Consumable	Article number	Note
Flange sealant	-	Loctite 574 (or equivalent)
Grease	3HAC042536-001	Shell Gadus S2
Cable ties	-	
O-ring	3HAC061327-044	Axis-1 and -2 joint unit, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-074	Swing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-073	Swing flange, big side, used for CRB 15000-10/1.52. Replace if damaged.
O-ring	3HAC061327-044	Swing flange, small side, used for CRB 15000-10/1.52. Replace if damaged.
O-ring	3HAC061327-044	Lower arm, inner cover of CRB 15000-5/0.95. 1 pcs / cover. Replace if damaged.
O-ring	3HAC061327-075	Lower arm, lower inner cover of CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.

Removing the swing (-5/0.95)

Use these procedures to remove the swing.

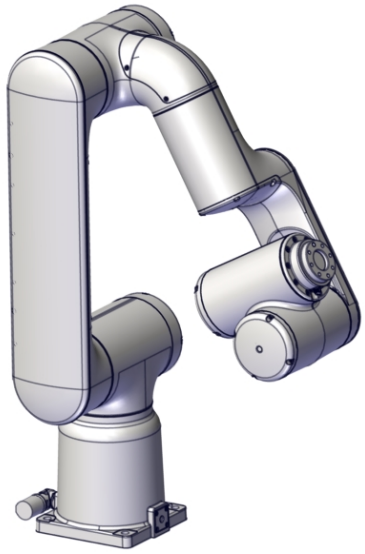
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5.5.2 Replacing the swing

Continued

Preparations before removing the swing

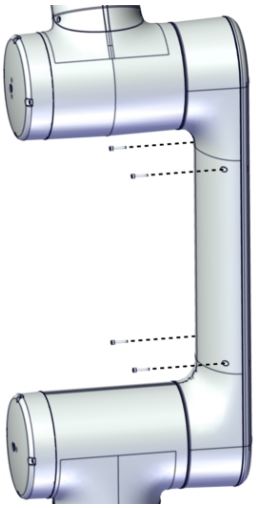
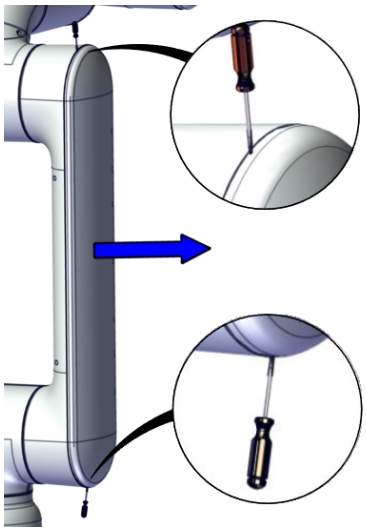
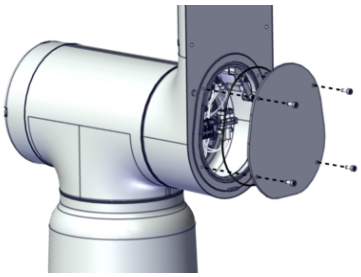
	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 0° (home position) • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. **CAUTION** Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.	 xx2100000044
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the lower arm covers (-5/0.95)

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

Continues on next page

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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

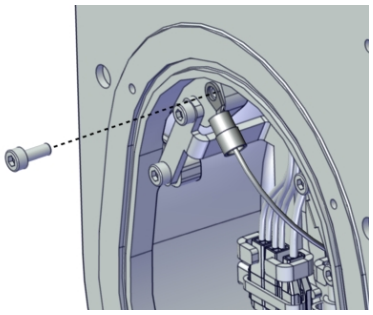
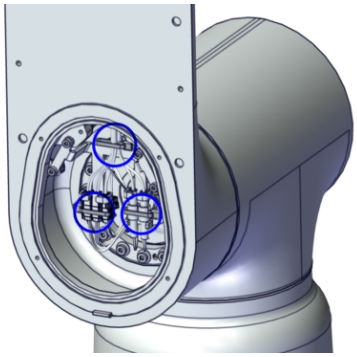
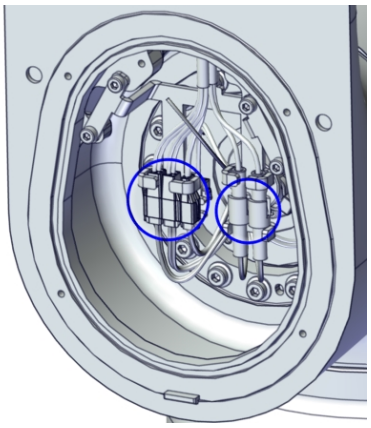
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5.5.2 Replacing the swing

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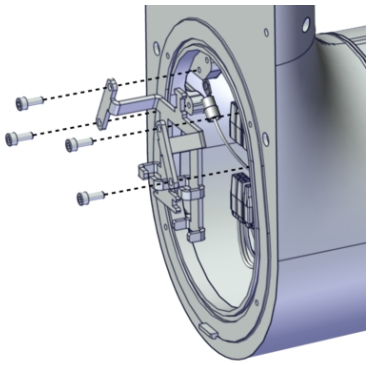
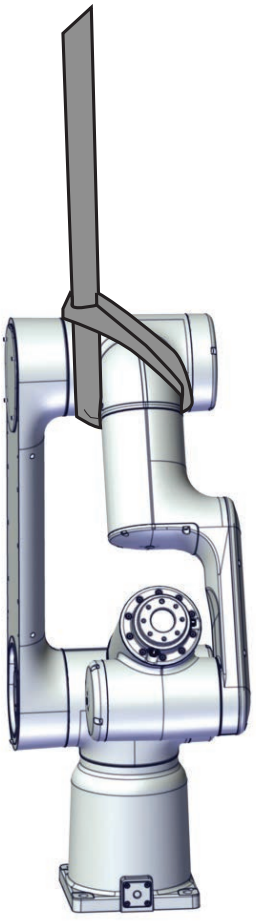
Disconnecting the cabling between the lower arm and the swing

	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

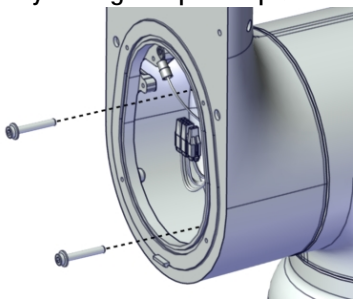
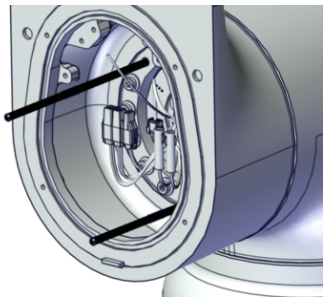
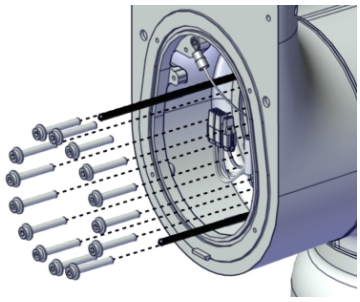
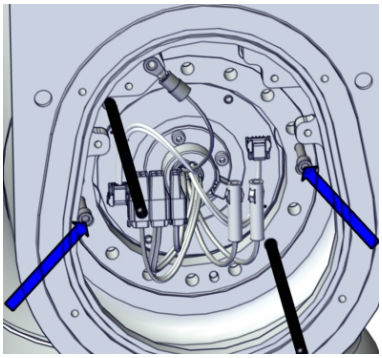
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939
2	Secure the weight of the upper and lower arm. **CAUTION** The weight of the complete upper and lower arm together is 18 kg	Suggestion with lifting sling and an overhead crane. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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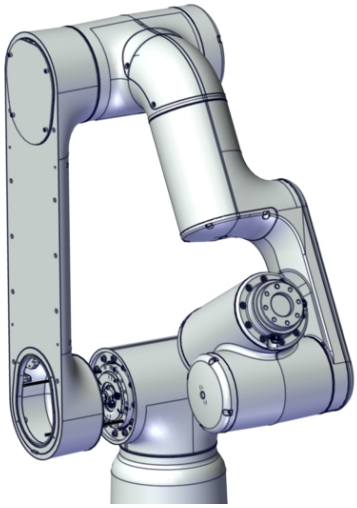
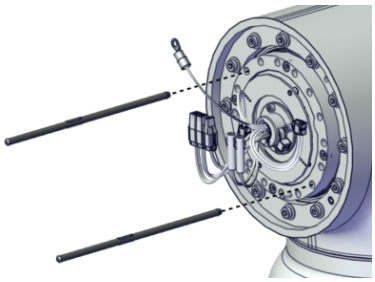
5.5.2 Replacing the swing

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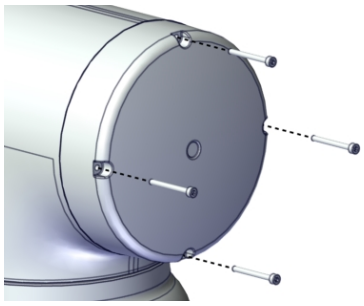
	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

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

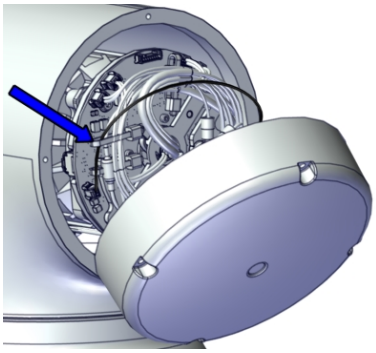
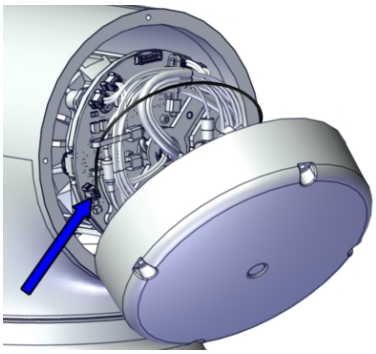
Removing the swing cover (-5/0.95)

	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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5.5.2 Replacing the swing
Continued

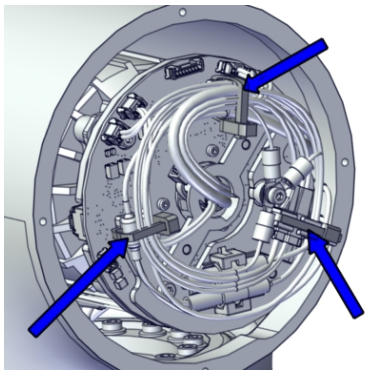
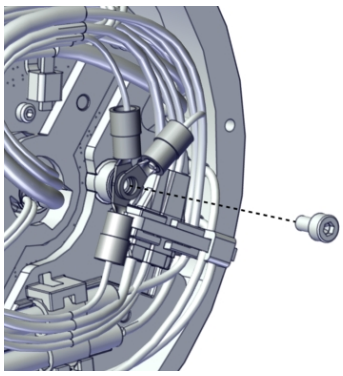
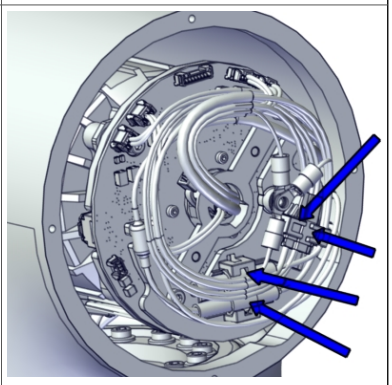
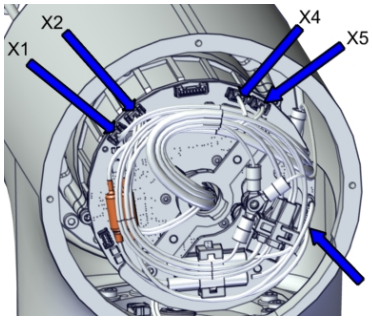
	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000001931
5	**For robots with RobotWare earlier than 7.10** 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 53*.	

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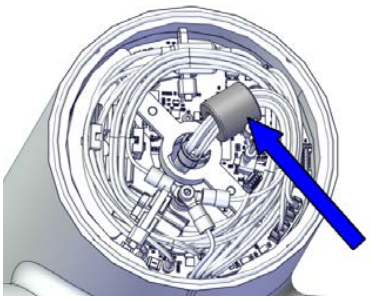
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	Action	Note
2	Cut the cable ties.	 xx2000001946
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: • J2.DC+ • J2.DC- • J2.CS • J2.CP	 xx2000001944
5	Disconnect the connectors from the drive board. • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002013

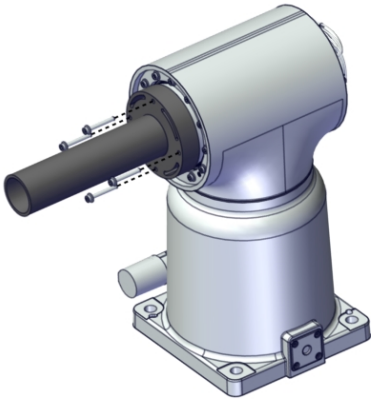
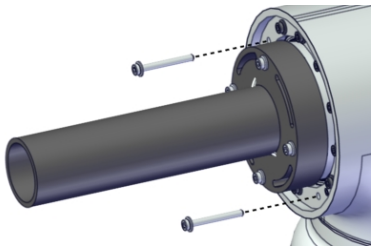
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5.5.2 Replacing the swing
Continued

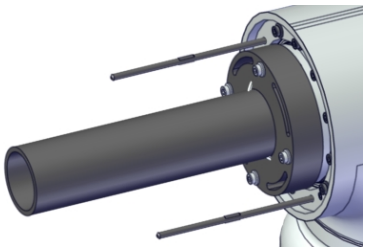
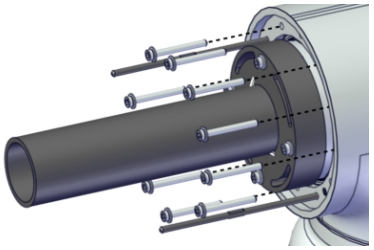
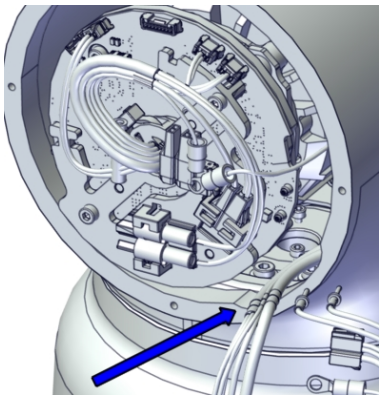
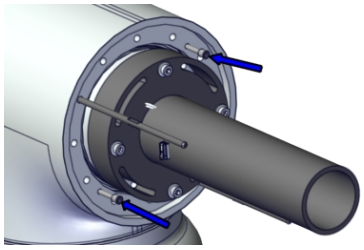
	Action	Note
6	Remove the ferrite core by pulling the cables D2.X4 and D2.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-2 joint unit (-5/0.95)

	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)  xx2000001956
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000295

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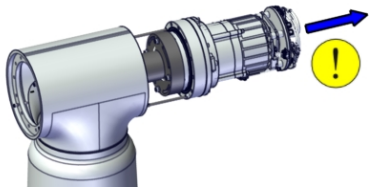
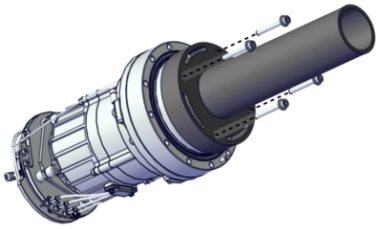
	Action	Note
3	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002433
4	Remove the remaining attachment screws. Use two screws 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.	 xx2000001943
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

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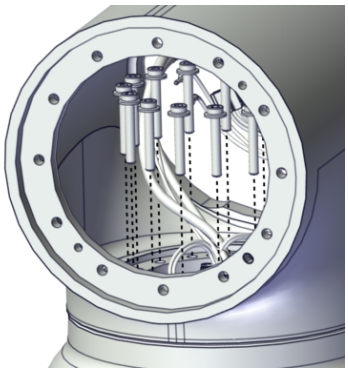
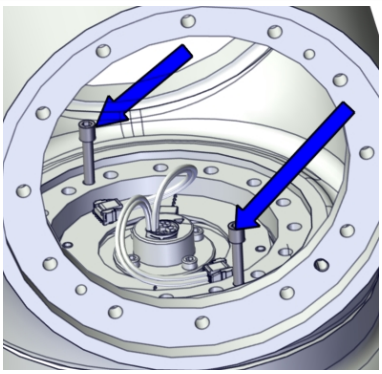
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5.5.2 Replacing the swing

Continued

	Action	Note
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 swing (-5/0.95)

	Action	Note
1	Remove the swing attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001987
2	Use two fully threaded attachment screws as removal tools to press the swing out of position. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000002152
3	Lift away the swing. **CAUTION** The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	

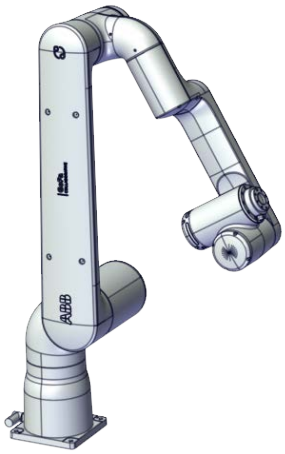
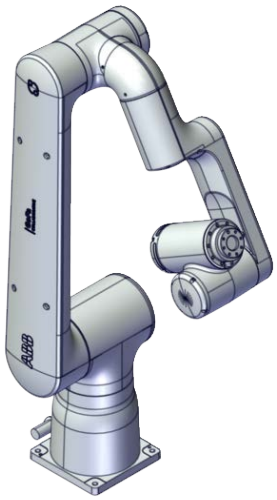
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Removing the swing (-10/1.52 and -12/1.27)

Use these procedures to remove the swing.

Preparations before removing the swing

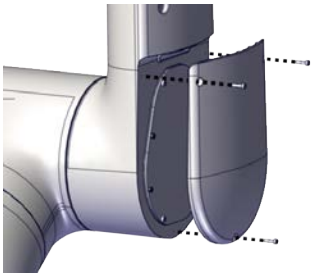
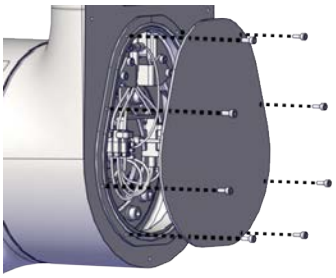
	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 0° (home position) • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. **CAUTION** Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.	**Valid for CRB 15000-10/1.52**  xx2300001062 **Valid for CRB 15000-12/1.27**  xx2300001063
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

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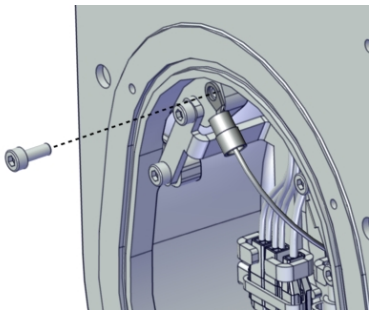
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5.5.2 Replacing the swing
Continued

Removing the lower arm covers (-10/1.52 and -12/1.27)

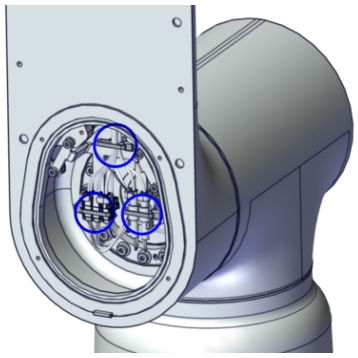
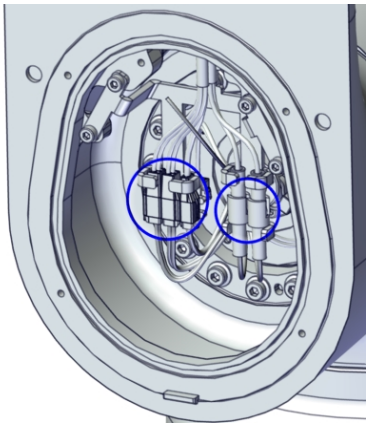
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the lower cover of lower arm by removing the screws.	 xx2300000812
3	Remove the lower inner cover by removing the screws.	 xx2300000813

Disconnecting the cabling between the lower arm and the swing

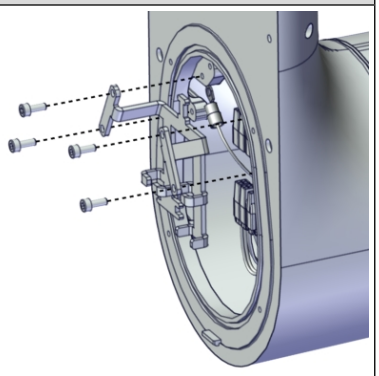
	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936

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	Action	Note
2	Cut the cable ties.	 xx2000001937
3	Snap loose and disconnect all connectors.	 xx2000001938

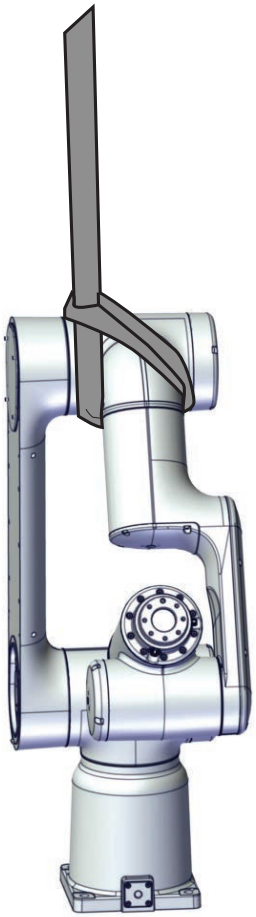
Removing the lower and upper arm assembled

	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939

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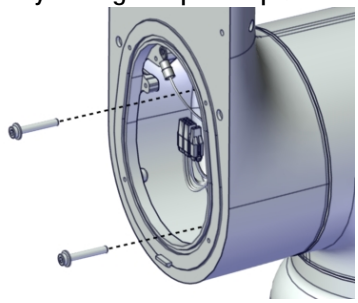
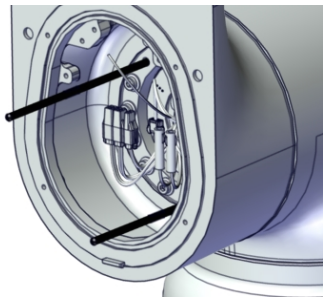
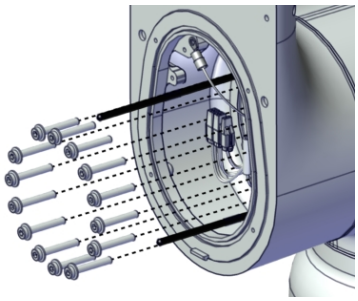
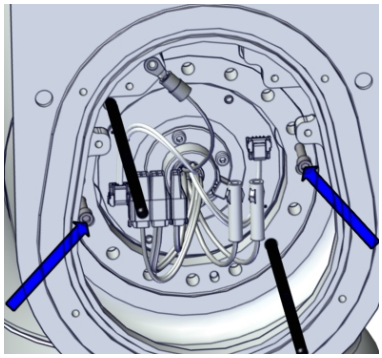
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5.5.2 Replacing the swing
Continued

	Action	Note
2	Secure the weight of the upper and lower arm. **CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	Suggestion with lifting sling and an overhead crane. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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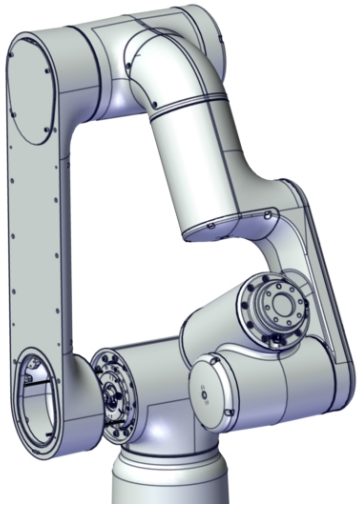
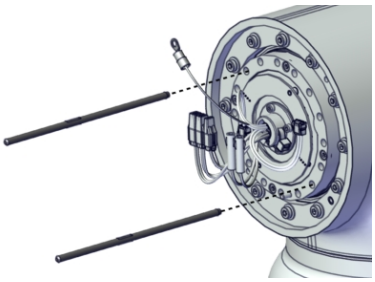
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	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

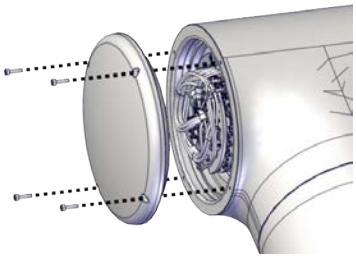
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5.5.2 Replacing the swing
Continued

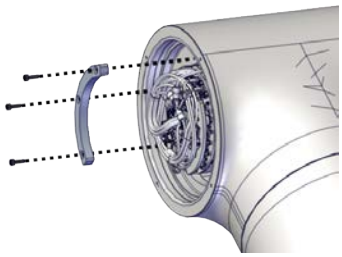
	Action	Note
6	Remove the complete arm system from the swing.	 xx2000001941
7	Remove the guide pins.	 xx2000002432

Removing the swing cover and insert (-10/1.52 and -12/1.27)

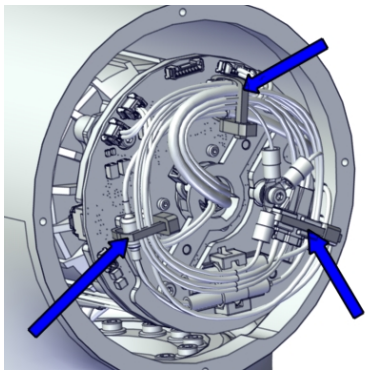
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000814

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	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	Remove the insert.	 xx2300000815

Disconnecting the axis-2 joint unit cabling

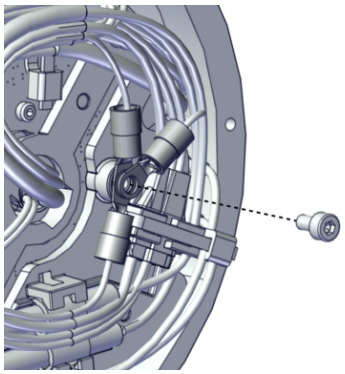
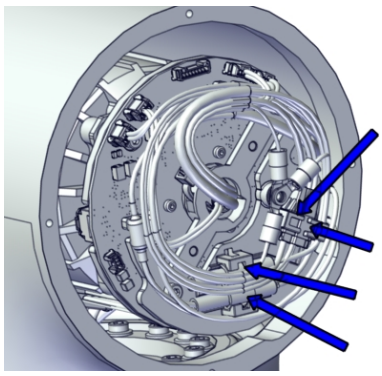
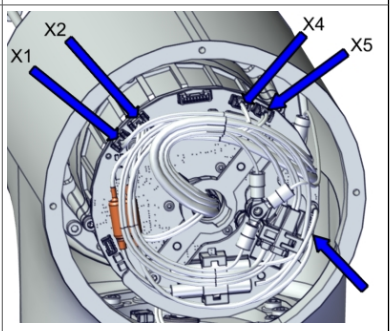
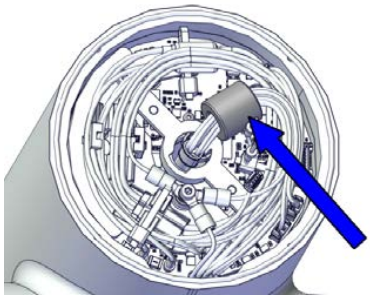
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Cut the cable ties.	 xx2000001946

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5.5.2 Replacing the swing

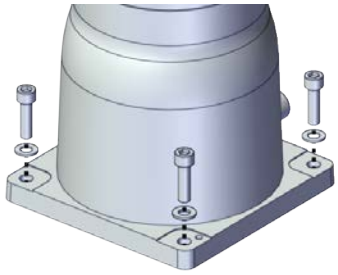
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	Action	Note
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: • J2.DC+ • J2.DC- • J2.CS • J2.CP	 xx2000001944
5	Disconnect the connectors from the drive board. • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002013
6	Remove the ferrite core by pulling the cables D2.X4 and D2.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

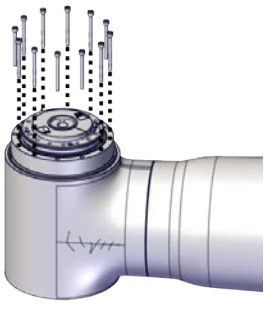
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Removing the base from foundation (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** The weight of the complete swing and base together is up to 25 kg	
2	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
3	Loosen the robot base from the foundation by removing the foundation attachment screws.	 xx2300001060
4	Lay the robot down with the torque sensor side upwards on a working bench. Do not damage the base socket. Caution with the cabling. **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.	

Removing the axis-2 joint unit

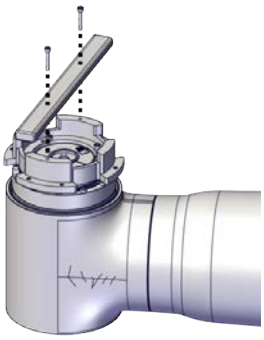
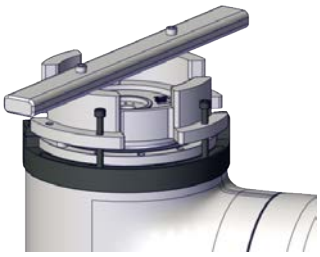
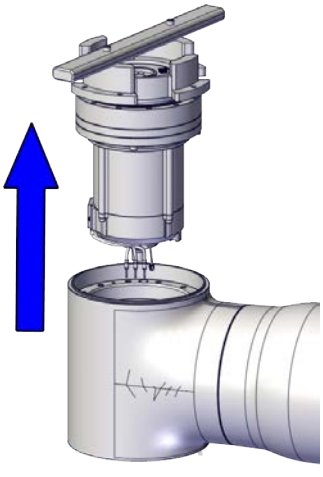
	Action	Note
1	Removing the attachment screws.	 xx2300000786

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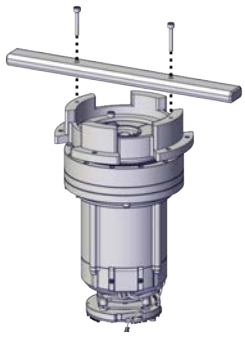
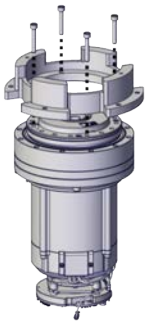
5.5.2 Replacing the swing

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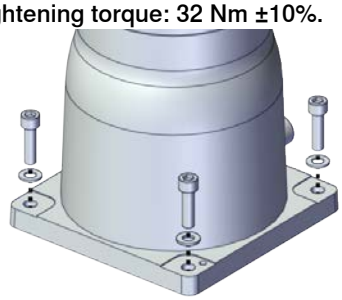
	Action	Note
2	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000787  xx2300000788
3	Place the two semicircular blocks surrounding the joint unit, and use two fully threaded attachment screws as removal tools to press the joint unit out of position.	 xx2300000789
4	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.	 xx2300000790

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	Action	Note
5	Remove the lifting aid.	 xx2300000778  xx2300000776

Securing the base (-10/1.52 and -12/1.27)

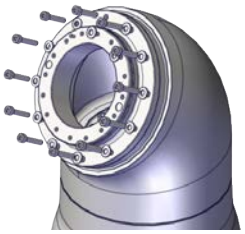
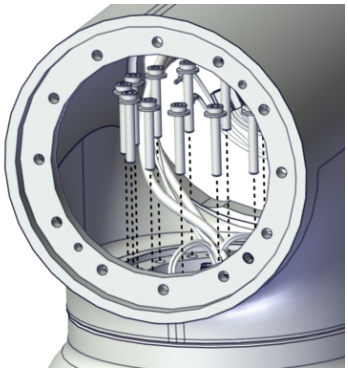
	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 32 Nm ±10%.  xx2300001060

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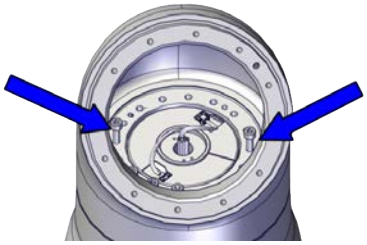
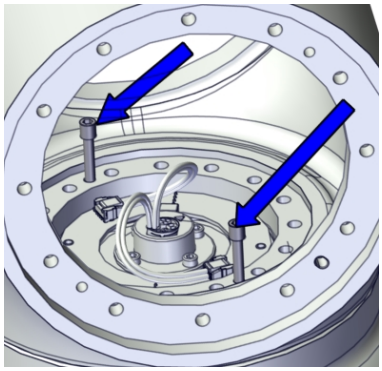
5.5.2 Replacing the swing
Continued

Removing the swing (-10/1.52 and -12/1.27)

	Action	Note
1	**Valid for CRB 15000-10/1.52** Remove the swing transition.	 xx2300000817
2	**Valid for CRB 15000-10/1.52** Remove the swing flange.	 xx2300000818
3	Remove the swing attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	**Valid for CRB 15000-10/1.52**  xx2300000819 **Valid for CRB 15000-12/1.27**  xx2000001987

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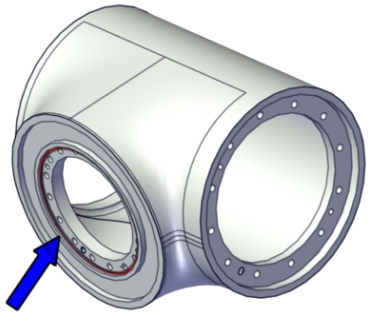
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	Action	Note
4	Use two fully threaded attachment screws as removal tools to press the swing out of position. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	**Valid for CRB 15000-10/1.52**  xx2300000822 **Valid for CRB 15000-12/1.27**  xx2000002152
5	Lift away the swing. **CAUTION** The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	

Refitting the swing (-5/0.95)

Use these procedures to refit the swing.

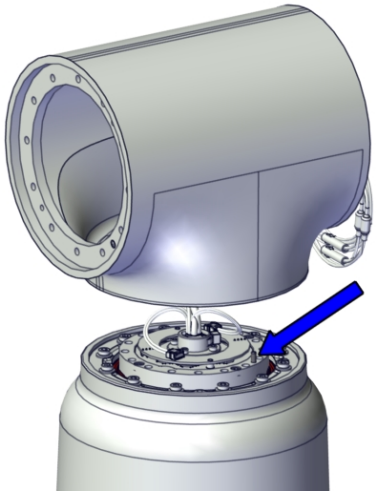
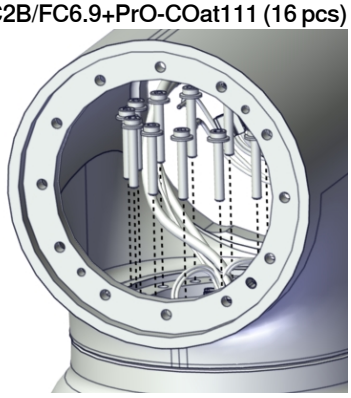
Refitting the swing(-5/0.95)

	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 (or equivalent)  xx2000001990

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5.5.2 Replacing the swing
Continued

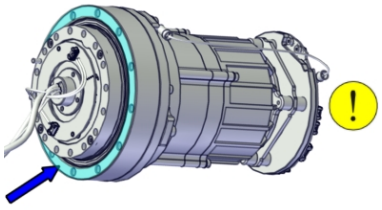
	Action	Note
2	Separate the new swing parts by removing the pre-assembling screws.	
3	Refit the swing to the base unit, aligning the pin with the pin hole. **CAUTION** The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	 xx2000001989
4	Secure the swing with the attachment screws. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001987
5	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm

Preparations before fitting the joint unit (-5/0.95)

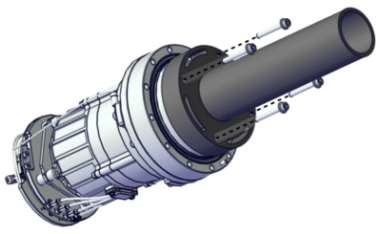
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	

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	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 (or equivalent)  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 53*.	

Refitting the axis-2 joint unit (-5/0.95)

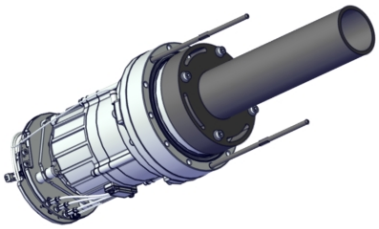
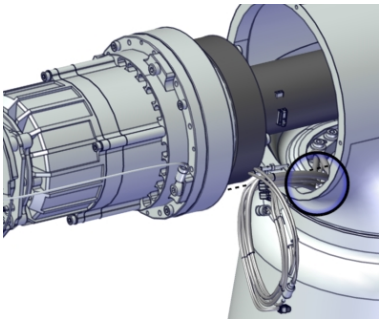
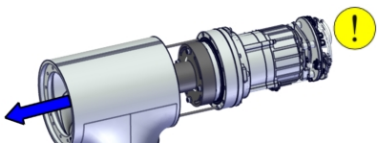
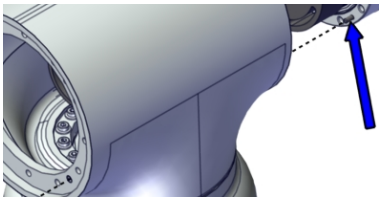
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Fit the lifting aid to the joint unit. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079141-001 Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001957

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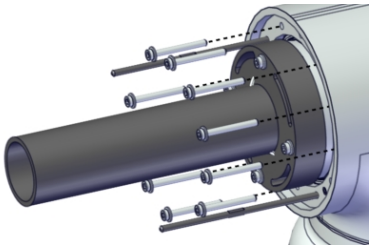
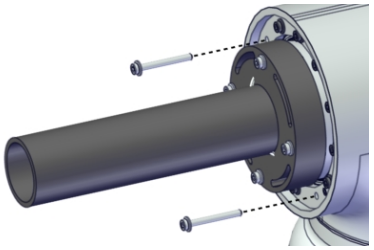
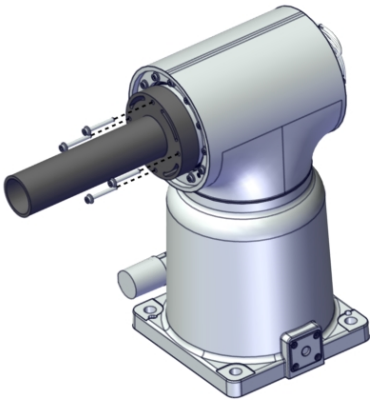
5.5.2 Replacing the swing

Continued

	Action	Note
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 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  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
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

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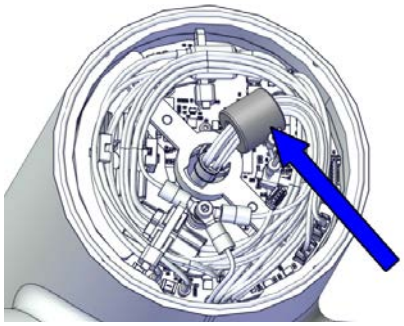
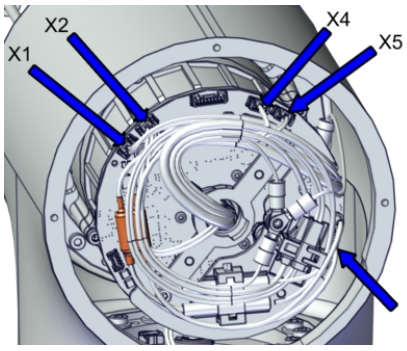
	Action	Note
6	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit 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.
10	Remove the lifting aid by removing the screws.	 xx2000001956
11	Clean pushed-out flange sealant, if any.	

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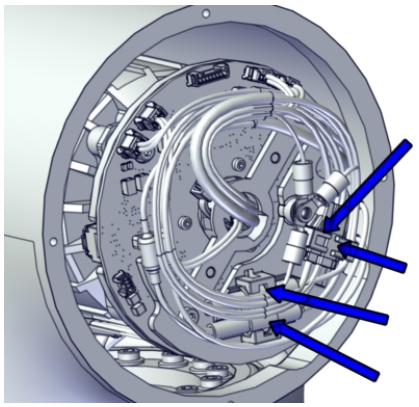
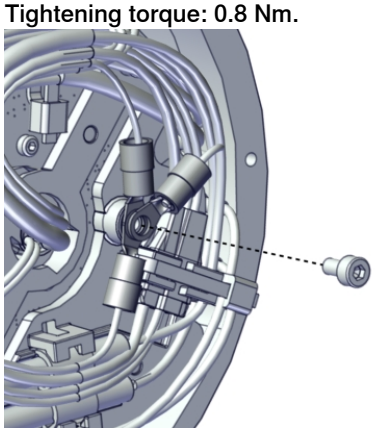
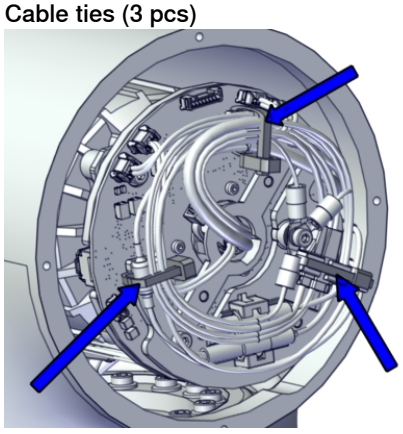
5.5.2 Replacing the swing
Continued

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 *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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

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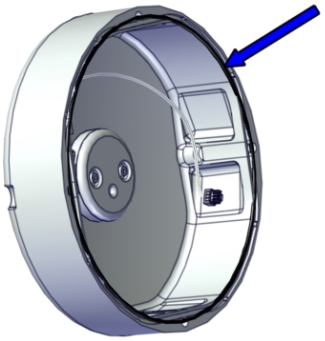
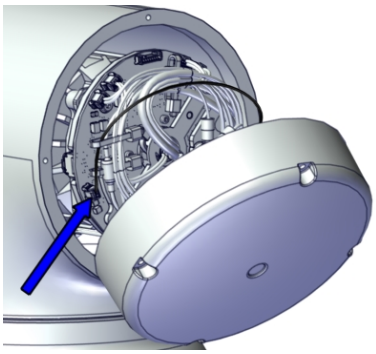
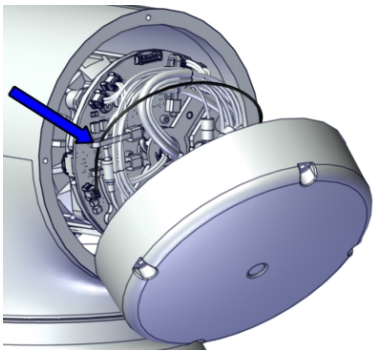
	Action	Note
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944
6	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000001945
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

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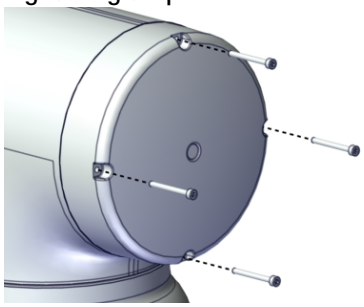
5.5.2 Replacing the swing
Continued

Refitting the swing cover(-5/0.95)

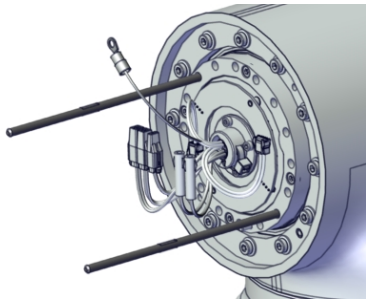
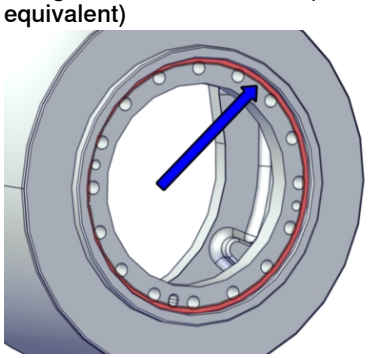
	Action	Note
1	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-047 (for CRB 15000-5/0.95)  xx2000001962
2	**For robots with RobotWare earlier than 7.10** Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board. Orient the cover for proper arrangement of the brake release cable.	 xx2000001932
3	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000001931

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	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  xx2000001935

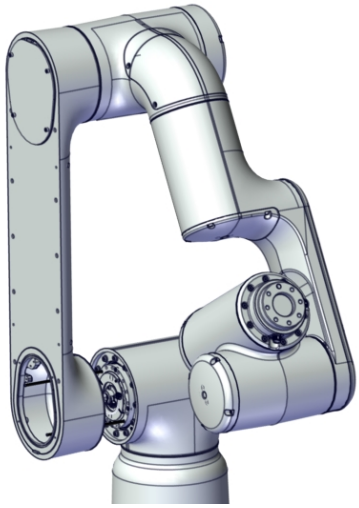
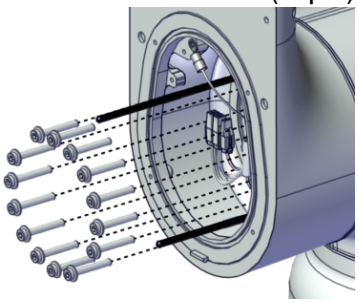
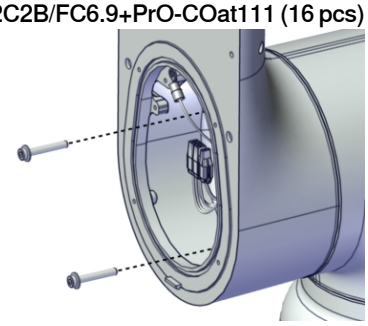
Refitting the lower and upper arm assembled (-5/0.95)

	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001  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 (or equivalent)  xx2000001963
3	**CAUTION** The weight of the complete upper and lower arm together is 18 kg	

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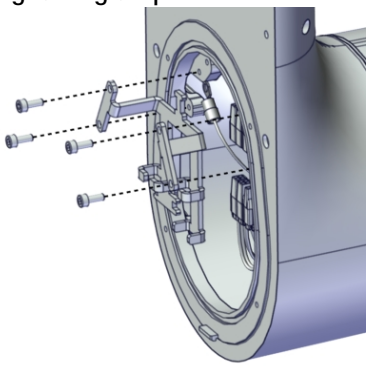
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5.5.2 Replacing the swing
Continued

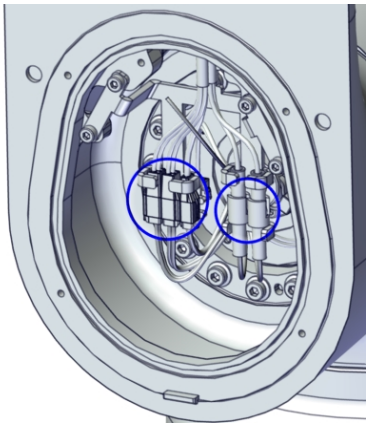
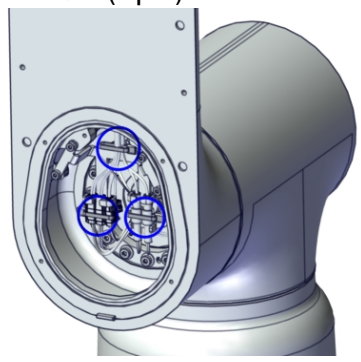
	Action	Note
4	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	 xx2000001941
5	Secure the lower arm to the swing with all attachment screws but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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

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	Action	Note
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

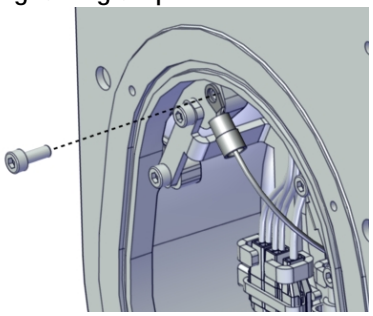
Connecting the cabling between the lower arm and swing

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

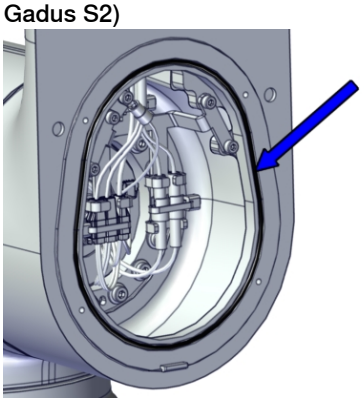
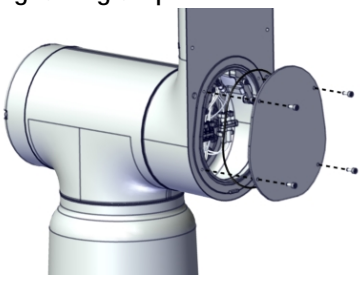
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5.5.2 Replacing the swing
Continued

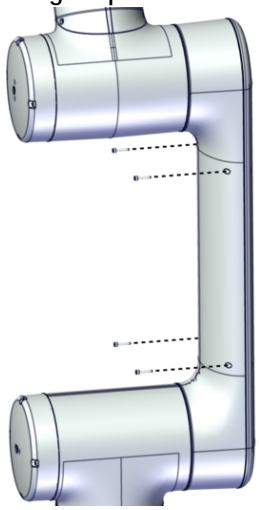
	Action	Note
3	Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

Refitting the lower arm covers (-5/0.95)

	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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	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.  xx2000001929
4	Secure the cover with four screws.	

Concluding procedure

	Action	Note
1	Calibrate the joint unit torque sensor for the axis-2 joint unit.	See *Calibration on page 1047*
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

Refitting the swing (-10/1.52 and -12/1.27)

Use these procedures to refit the swing.

Refitting the swing(-10/1.52 and -12/1.27)

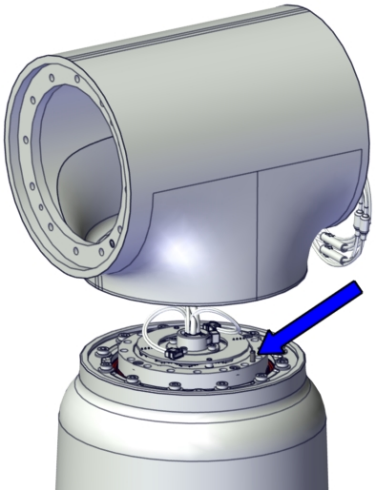
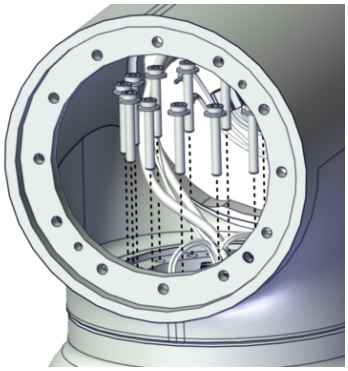
	Action	Note
1	Fit two guide pins on the base unit for position guidance. Always use guide pins in pairs.	**Valid for CRB 15000-10/1.52** Guide pin, M5x75, 3HAC087786-002 **Valid for CRB 15000-12/1.27** Guide pin, M5x125: 3HAC087786-001

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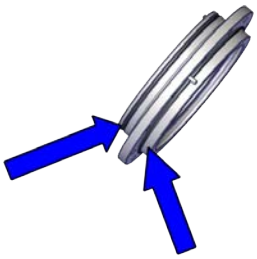
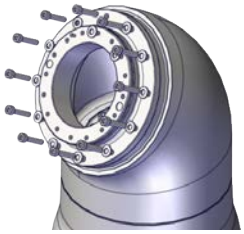
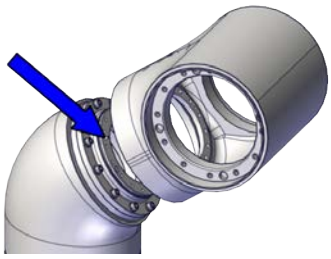
5.5.2 Replacing the swing

Continued

	Action	Note
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.	Example of CRB 15000-12/1.27, similar to CRB 15000-10/1.52.  xx2000001989
3	Secure the swing with the attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm **Valid for CRB 15000-12/1.27**  xx2000001987 **Valid for CRB 15000-10/1.52**  xx2300000819

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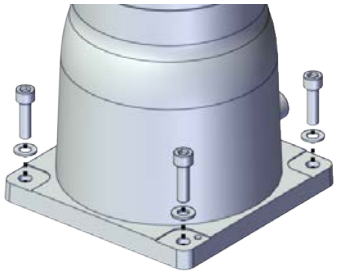
	Action	Note
4	**Valid for CRB 15000-10/1.52** Check the o-rings on both side of the swing flange. Replace if damaged.	O-ring: 3HAC061327-073 O-ring: 3HAC061327-044  xx2300000821
5	**Valid for CRB 15000-10/1.52** Refit the swing flange with the attachment screws. Always check the serial number printed on the swing parts and use the parts in the same number for refitting. **CAUTION** Do not use the pre-assembling screws of swing parts for securing.	Hex socket head cap screw: M5x25 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm  xx2300000818
6	**Valid for CRB 15000-10/1.52** Fit two guide pins on the swing flange for position guidance. Always use guide pins in pairs.	Guide pin, M5x75, 3HAC087786-002
7	**Valid for CRB 15000-10/1.52** Refit the swing transition to the swing flange, aligning the pin with the pin hole. Always check the serial number printed on the swing parts and use the parts in the same number for refitting.	 xx2300000820
8	**Valid for CRB 15000-10/1.52** Secure the swing transition with the attachment screws. **CAUTION** Do not use the pre-assembling screws of swing parts for securing.	Hex socket head cap screw: M5x25 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm  xx2300000817

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5.5.2 Replacing the swing
Continued

Removing the base from foundation (-10/1.52 and -12/1.27)

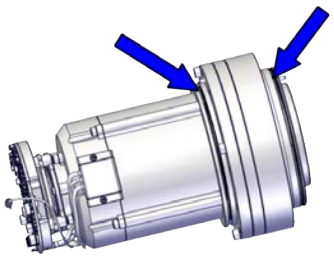
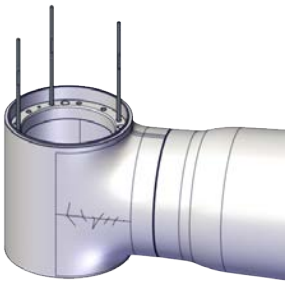
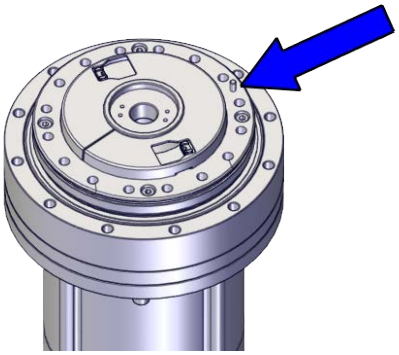
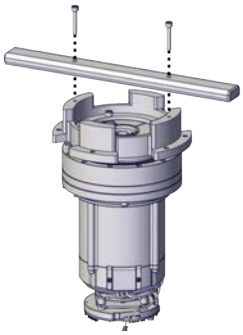
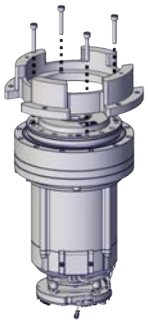
	Action	Note
1	**CAUTION** The weight of the swing and base together is up to 16.7 kg	
2	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
3	Loosen the robot base from the foundation by removing the foundation attachment screws.	 xx2300001060
4	Lay the robot down with the side that axis-2 torque sensor will be upwards on a working bench. Do not damage the base socket. Caution with the cabling. **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.	

Refitting the axis-2 joint unit (-10/1.52 and -12/1.27)

	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 53*.	

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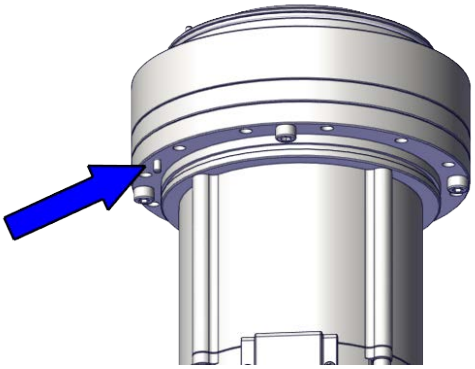
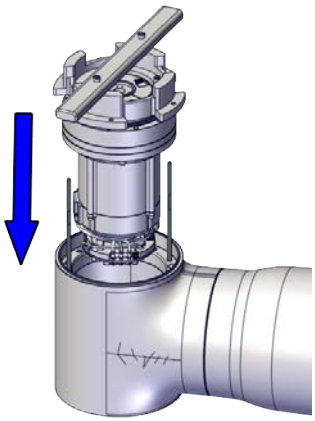
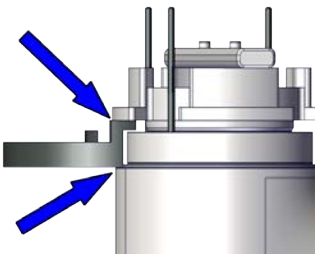
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	Action	Note
2	Check the o-rings. Replace if damaged.	O-ring: 3HAC061327-044  xx2300000823
3	Fit three guide pins to the swing.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins together.  xx2300000791
4	Fit the lifting aid to the joint unit, 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.  xx2300000777	Joint unit: 3HAC087472-001 Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000778  xx2300000776

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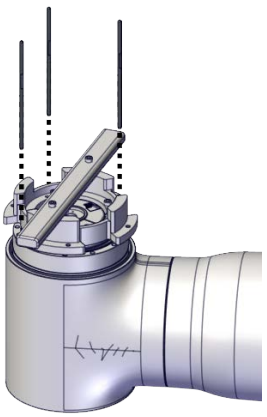
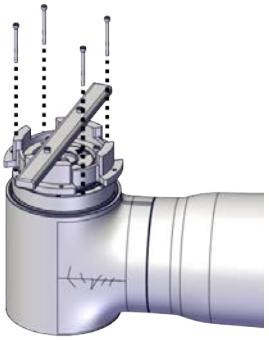
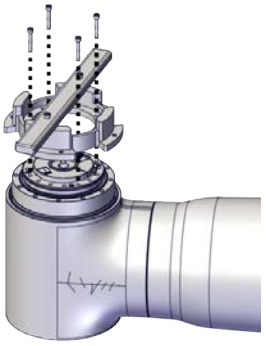
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5.5.2 Replacing the swing
Continued

	Action	Note
5	Place the axis-1 cabling properly to avoid squeezing by the joint unit when putting the joint unit into 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.	
6	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.  xx2300000780	 xx2300000792
7	Check the joint unit position by placing the higher boss of one semicircular block between the lifting aid and swing. The joint unit is properly placed when no gaps between the block and both lifting aid and swing.	 xx2300000794

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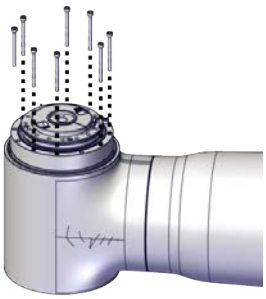
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	Action	Note
8	Remove the guide pins.	 xx2300000795
9	Secure with four attachment screws and pre-tighten the screws crosswise.	 xx2300000796
10	Remove the lifting aid by removing the screws.	 xx2300000797

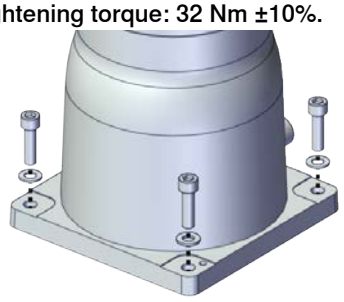
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5.5.2 Replacing the swing
Continued

	Action	Note
11	Secure the joint unit with the remaining attachment screws.	Hex socket head cap screw: 3HAB3409-20  xx2300000798
12	Torque tighten all screws crosswise.	M5x55 12.9 Lafre 2C2B/FC6.9, 12 pcs Tightening torque: 8.2 Nm.

Securing the base (-10/1.52 and -12/1.27)

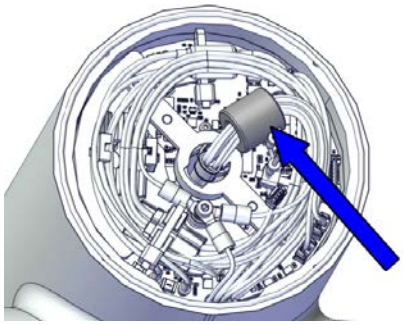
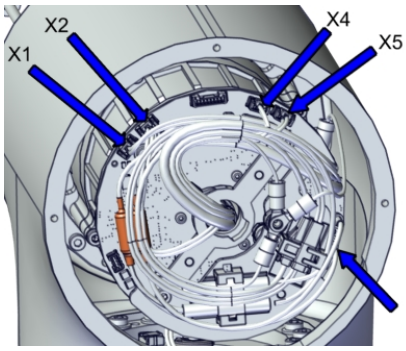
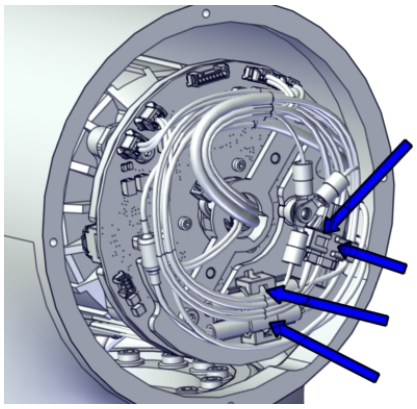
	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 32 Nm ±10%.  xx2300001060

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 53*.	

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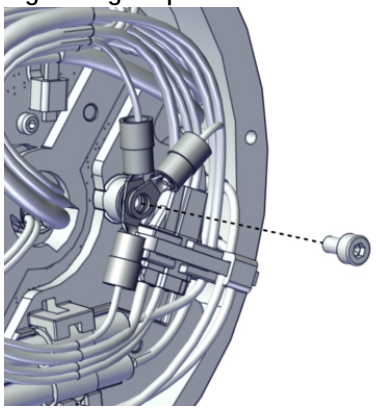
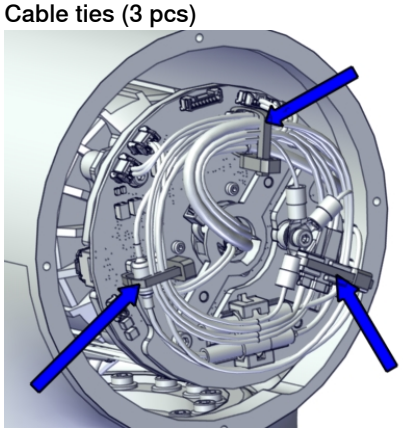
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	Action	Note
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944

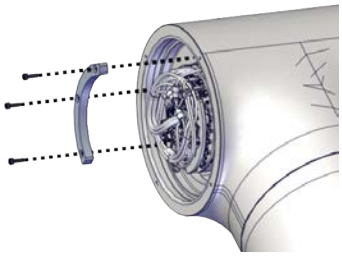
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5.5.2 Replacing the swing
Continued

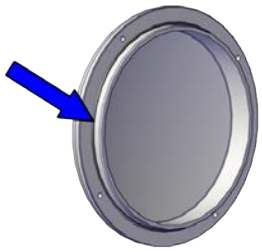
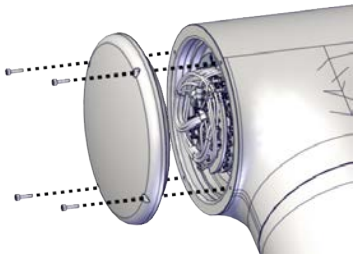
	Action	Note
6	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000001945
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

Refitting the swing cover and insert(-10/1.52 and -12/1.27)

	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000815

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	Action	Note
2	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-074 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2300000816
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000814

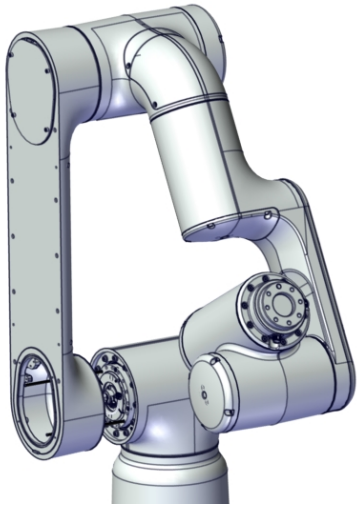
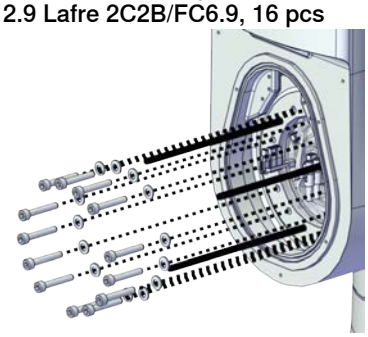
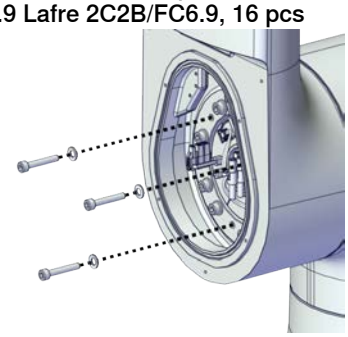
Refitting the lower and upper arm assembled (-10/1.52 and -12/1.27)

	Action	Note
1	Fit three guide pins to the axis-2 joint unit.	Guide pin, M5x125: 3HAC087786-001  xx2300001021
2	**CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	

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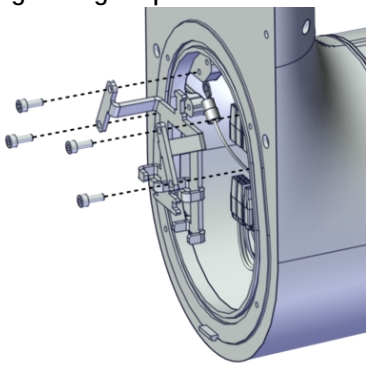
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5.5.2 Replacing the swing
Continued

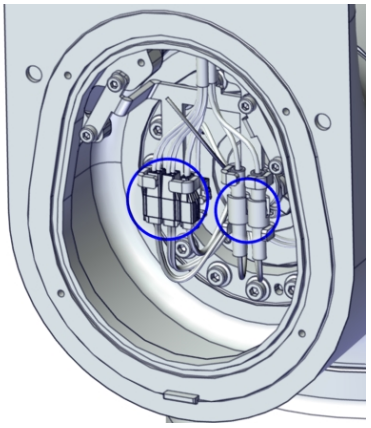
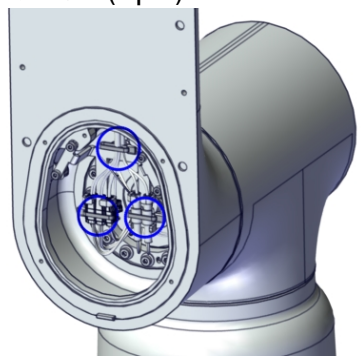
	Action	Note
3	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000001941
4	Secure the lower arm to the swing with all screws and washers but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001022
5	Remove the guide pins and fasten the remaining two screws and washers. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001023
6	Torque tighten all screws crosswise.	Tightening torque: 8.2 Nm

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	Action	Note
7	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

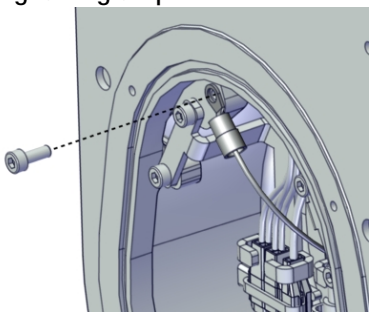
Connecting the cabling between the lower arm and swing

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

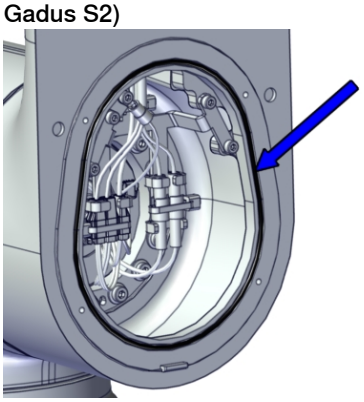
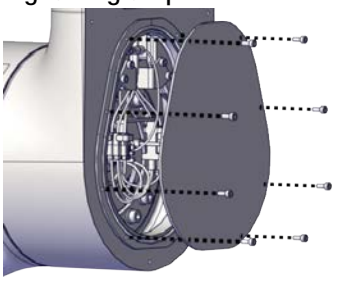
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5.5.2 Replacing the swing
Continued

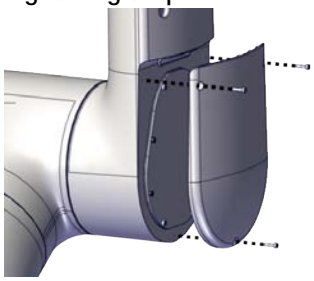
	Action	Note
3	Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

Refitting the lower arm covers (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-075 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.  xx2300000813

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	Action	Note
3	Refit the lower cover of lower arm with three screws.	Lower arm cover, lower: Lower arm, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Tightening torque: 1.4 Nm.  xx2300000812

Concluding procedure

	Action	Note
1	Calibrate the joint unit torque sensor for the axis-2 joint unit.	See *Calibration on page 1047*
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

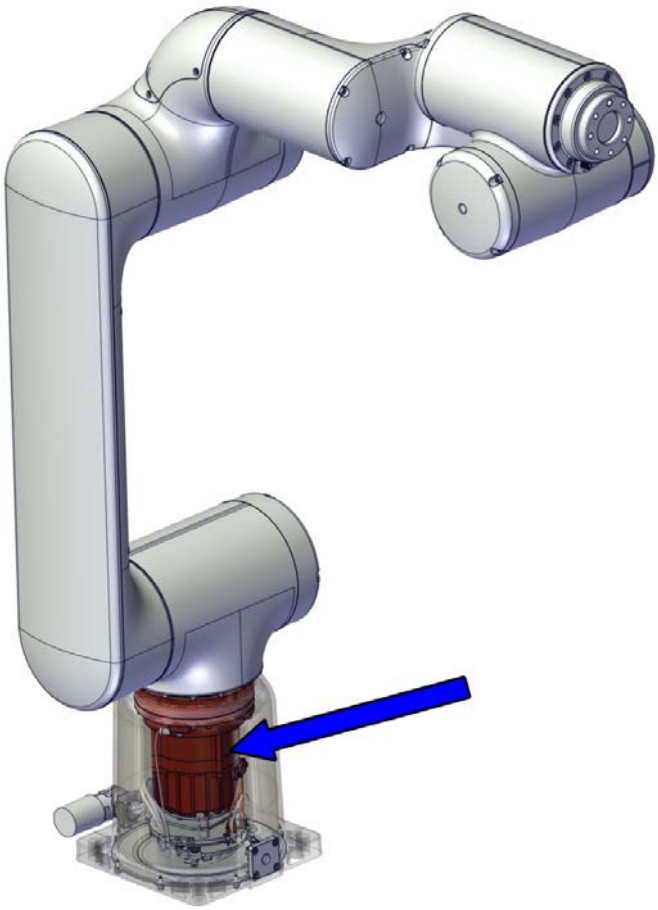
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5.6 Joint units

5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

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.

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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Joint unit	3HAC079141-001	Used for CRB 15000-5/0.95. New attachment screws and cable tie 3HAC075545-001 are included in the delivery.
Ferrite core	3HAC092224-001	

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95. 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 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint units of CRB 15000-5/0.95.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Cable ties	-	
O-ring	3HAB3772-64	Base cover, used for CRB 15000-5/0.95.
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-044	Lower arm, inner cover of CRB 15000-5/0.95. 1 pcs / cover. Replace if damaged.

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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)
Continued

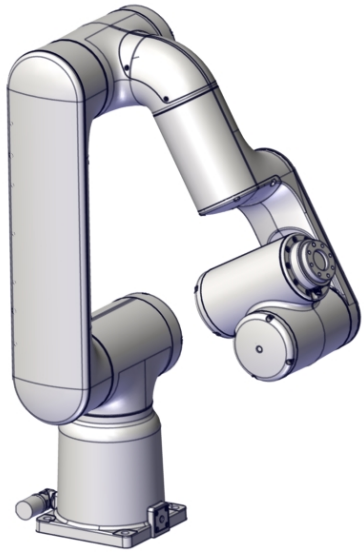
Removing the joint unit

Use these procedures to remove the joint unit.

Note

If the RobotWare version is older than 7.10, then create a backup of the system before replacing the joint unit. After the replacement, the software must be upgraded to version 7.10 or later.

Preparations before removing the joint unit

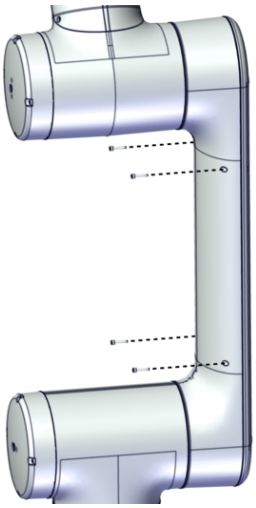
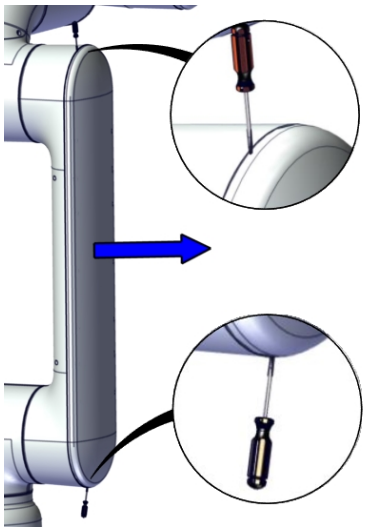
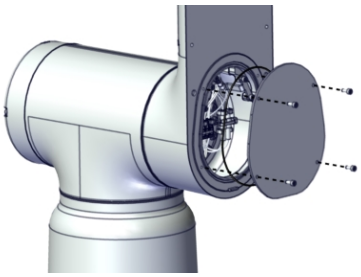
	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° (home position) • Axis 2: 0° • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. **CAUTION** Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.	 xx2100000044
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the lower arm covers (-5/0.95)

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

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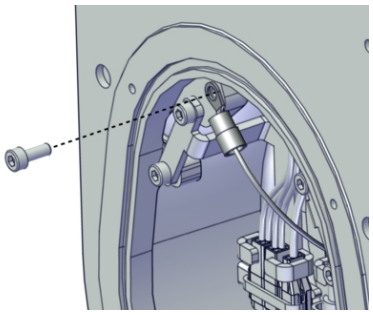
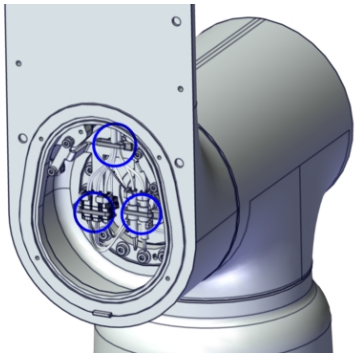
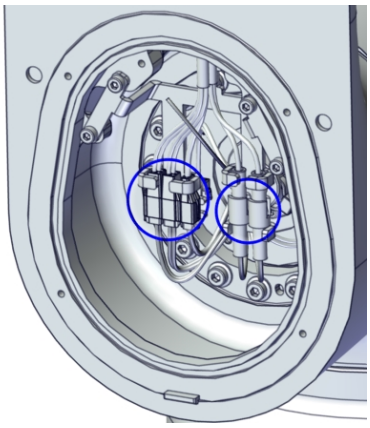
	Action	Note
2	Remove the four lower arm cover screws.	 xx2000001929
3	Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267
4	Remove the inner cover by removing the four screws.	 xx2000001930

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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)
Continued

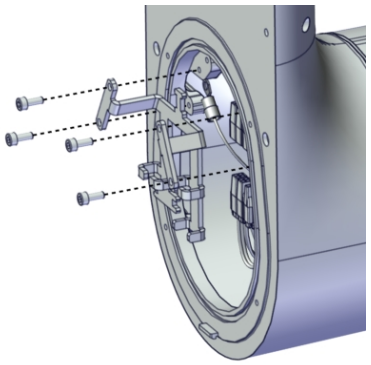
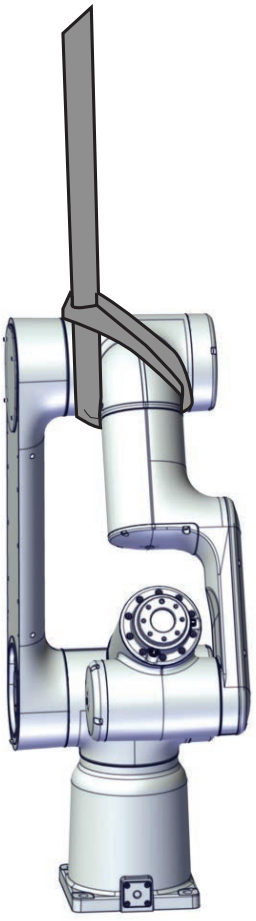
Disconnecting the cabling between the lower arm and the swing

	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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Removing the lower and upper arm assembled

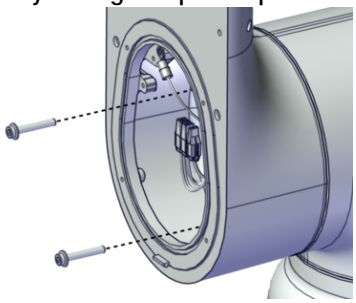
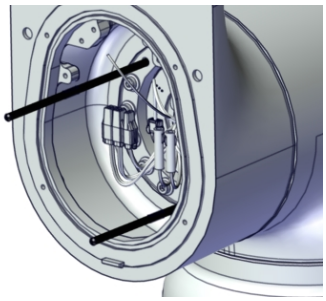
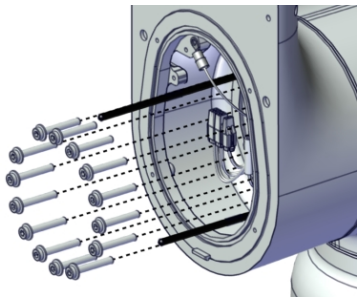
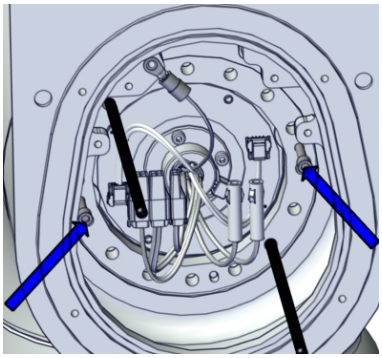
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939
2	Secure the weight of the upper and lower arm. **CAUTION** The weight of the complete upper and lower arm together is 18 kg	Suggestion with lifting sling and an overhead crane. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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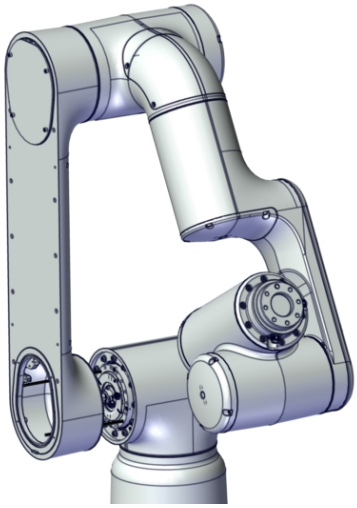
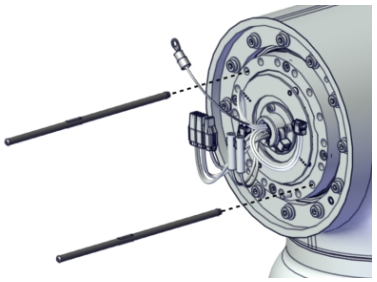
5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

Continued

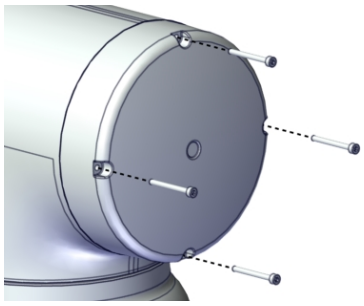
	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

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

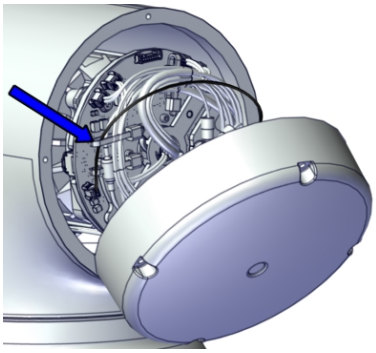
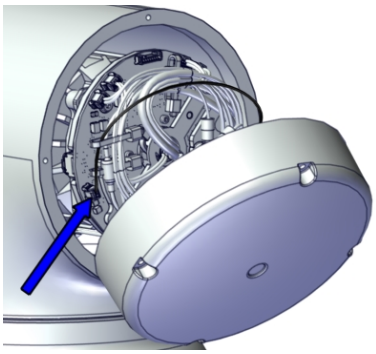
Removing the swing cover (-5/0.95)

	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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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)
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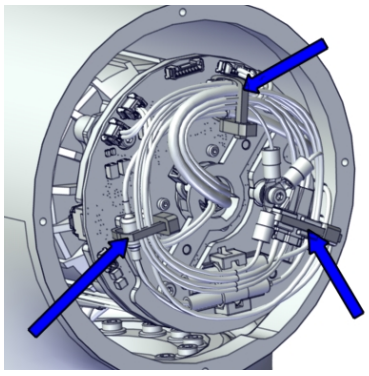
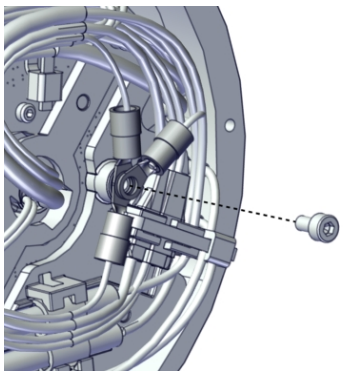
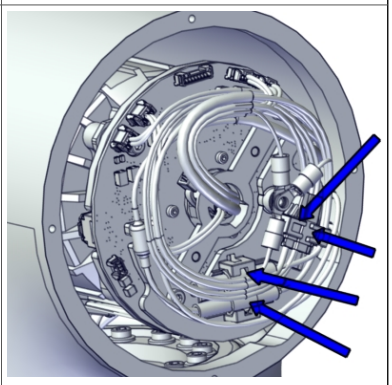
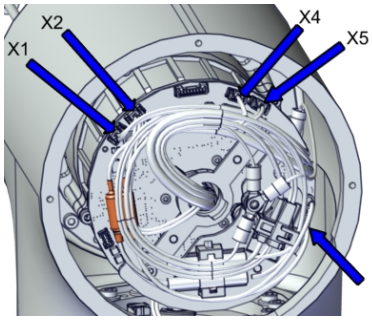
	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000001931
5	**For robots with RobotWare earlier than 7.10** 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 53*.	

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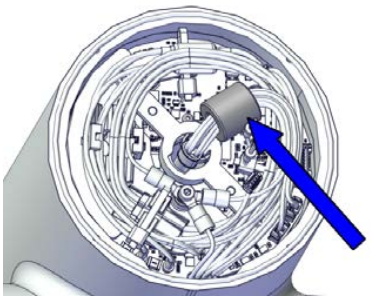
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	Action	Note
2	Cut the cable ties.	 xx2000001946
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: • J2.DC+ • J2.DC- • J2.CS • J2.CP	 xx2000001944
5	Disconnect the connectors from the drive board. • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002013

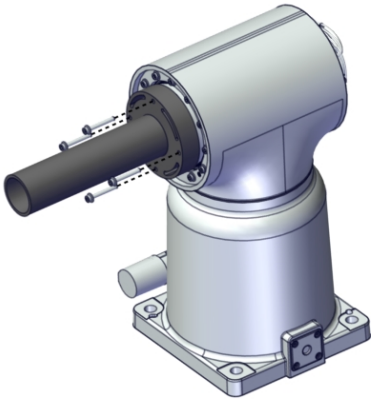
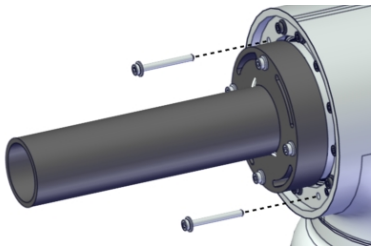
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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)
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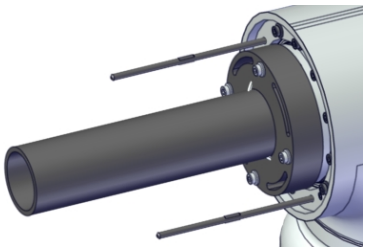
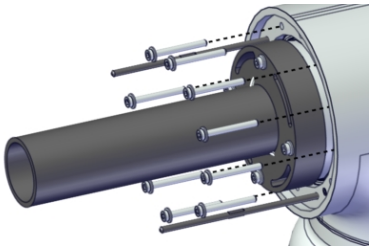
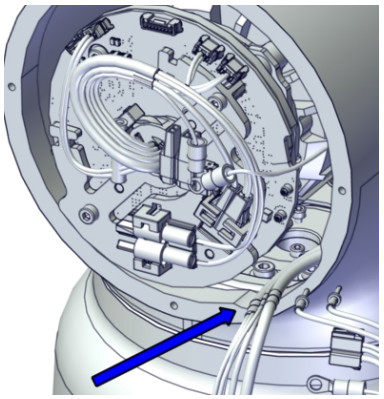
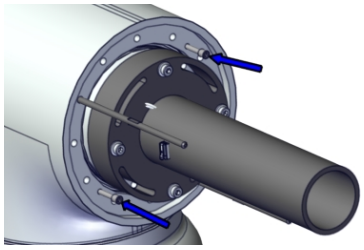
	Action	Note
6	Remove the ferrite core by pulling the cables D2.X4 and D2.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-2 joint unit (-5/0.95)

	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)  xx2000001956
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000295

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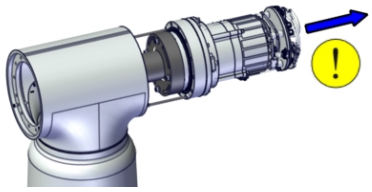
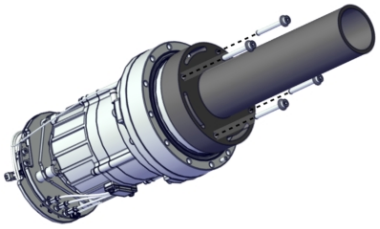
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	Action	Note
3	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002433
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.	 xx2000001943
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

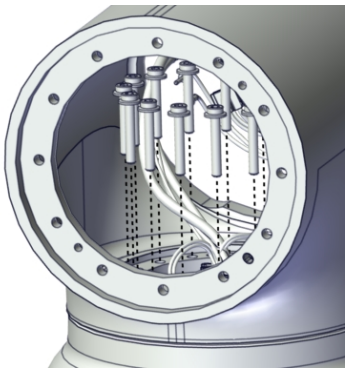
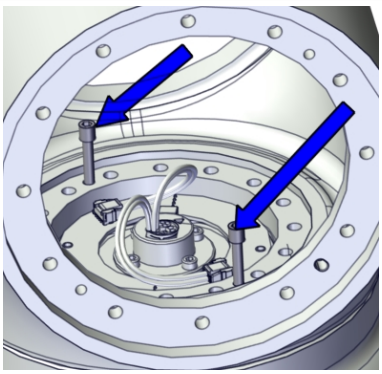
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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)
Continued

	Action	Note
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

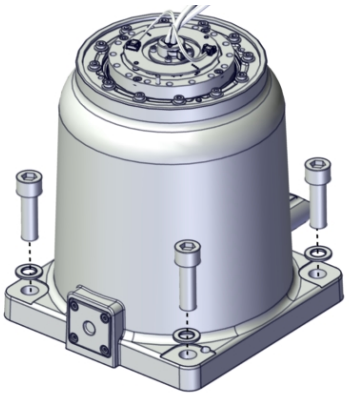
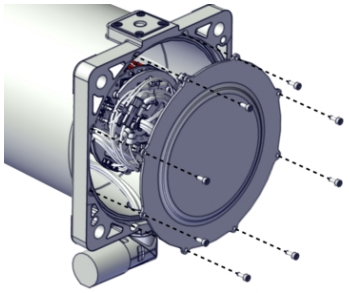
Removing the swing (-5/0.95)

	Action	Note
1	Remove the swing attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001987
2	Use two fully threaded attachment screws as removal tools to press the swing out of position. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000002152
3	Lift away the swing. **CAUTION** The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	

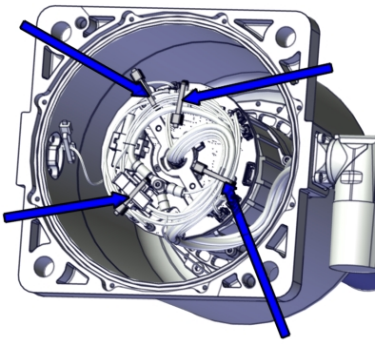
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Loosening the base and removing the base cover

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

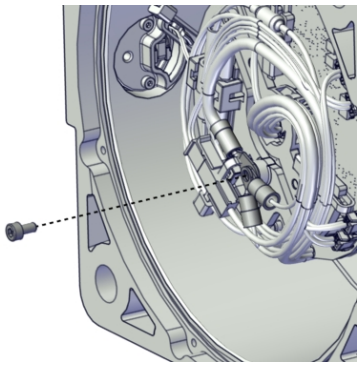
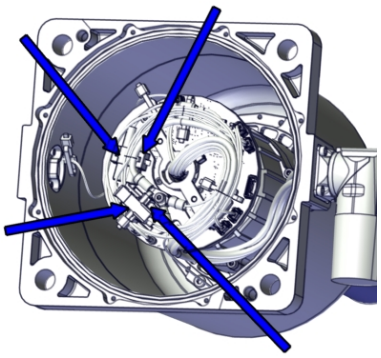
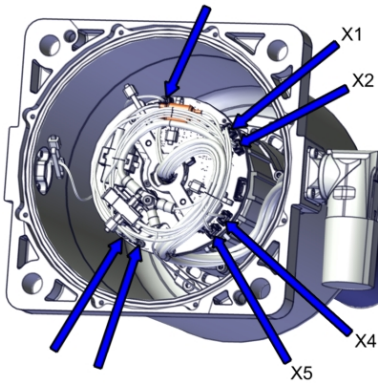
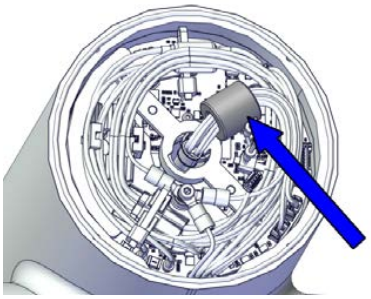
	Action	Note
1	Cut the cable ties.	 xx2000002012

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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

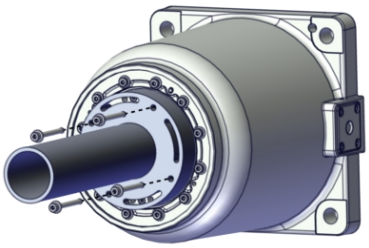
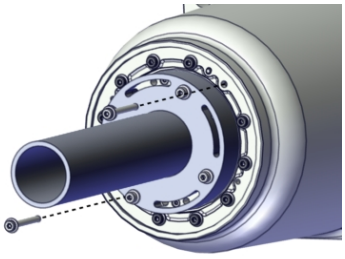
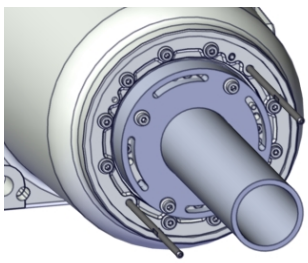
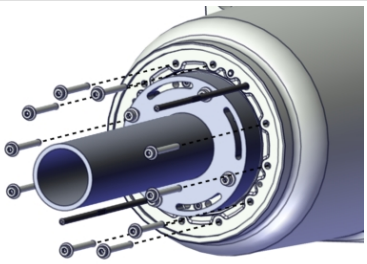
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	Action	Note
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002011
3	Snap loose and disconnect the connectors: • J1.DC+ • J1.DC- • J1.CS • J1.CP	 xx2000002010
4	Disconnect the connectors from the drive board. • D1.X1 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 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002009
5	Remove the ferrite core by pulling the cables D1.X4 and D1.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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Removing the axis-1 joint unit (-5/0.95)

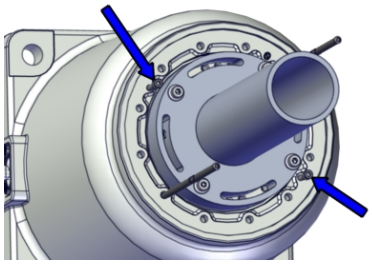
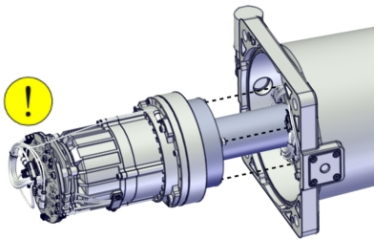
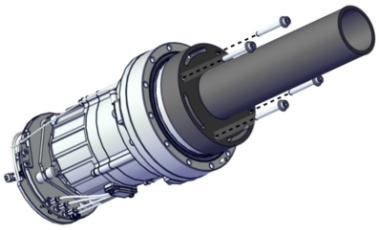
	Action	Note
1	Fit the lifting aid to the joint unit. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000001994
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000296
3	Fit two guide pins to the axis-1 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002435
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

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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

Continued

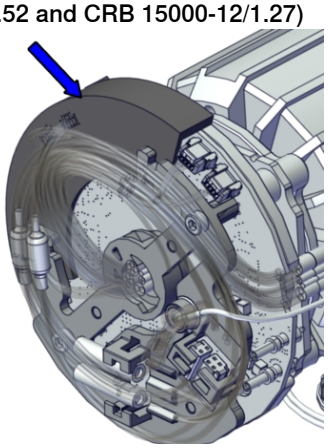
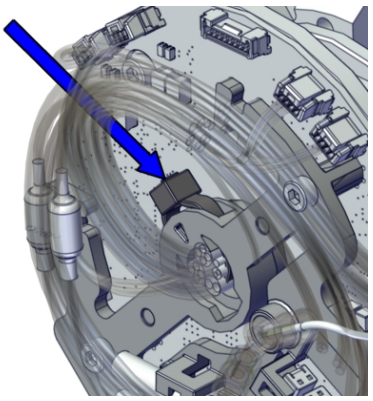
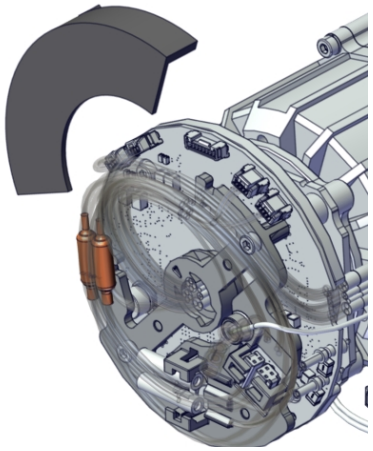
	Action	Note
5	Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2000002436
6	Remove the joint unit from the base. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002014
7	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 53*.	

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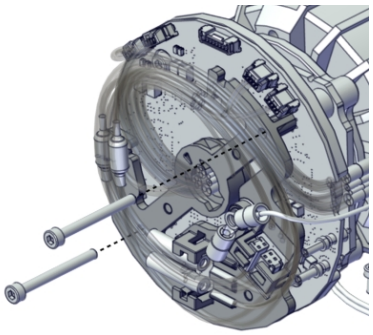
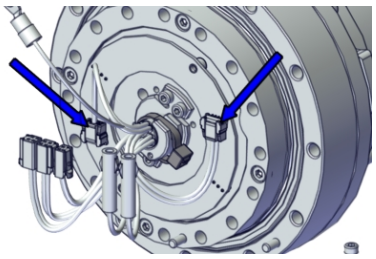
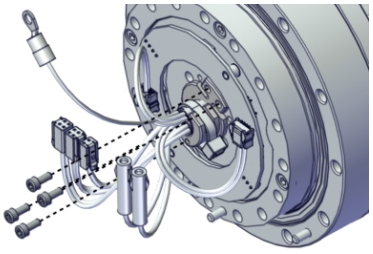
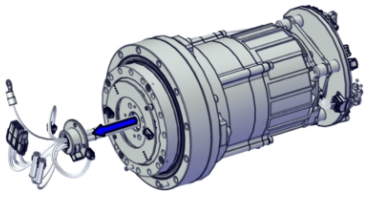
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	Action	Note
2	Fit the protection plate to the drive board unit. **Tip** Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
3	Cut the cable tie at the drive board.	 xx2000002058
4	Remove the protection plate.	 xx2100000301

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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)
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. • 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

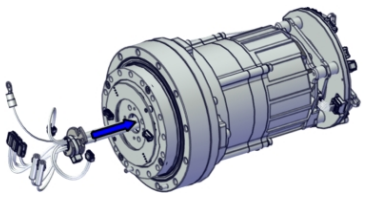
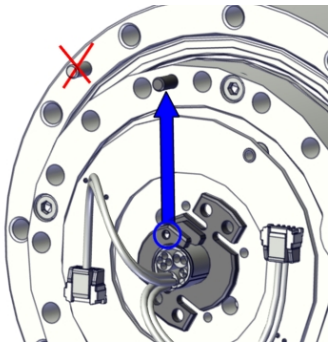
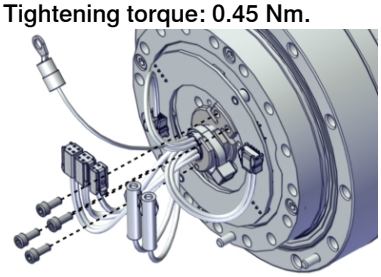
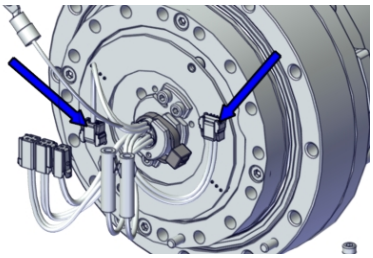
Use these procedures to refit the joint unit.

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 53*.	

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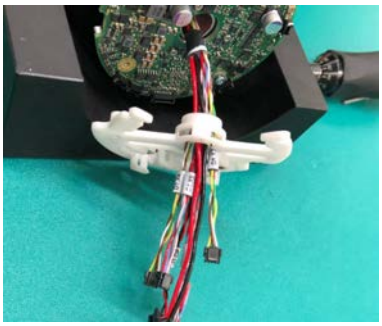
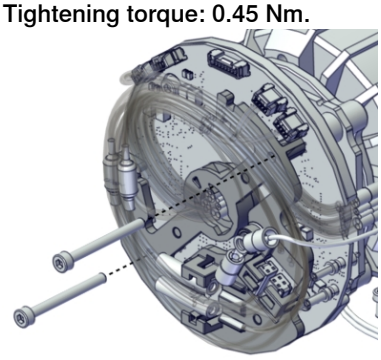
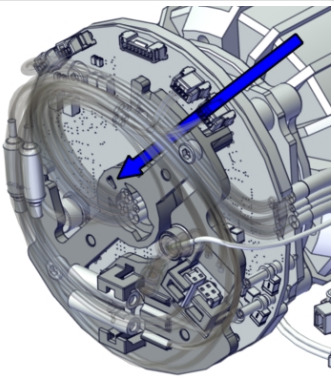
	Action	Note
2	Place the joint cable through the hollow shaft from the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002048
3	Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.	 xx2000002051
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. • TQ.A to CH1/A • TQ.B to CH2/B	 xx2000002053

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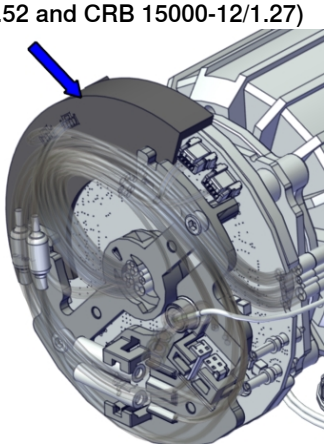
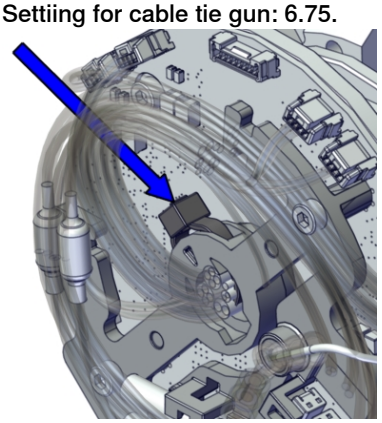
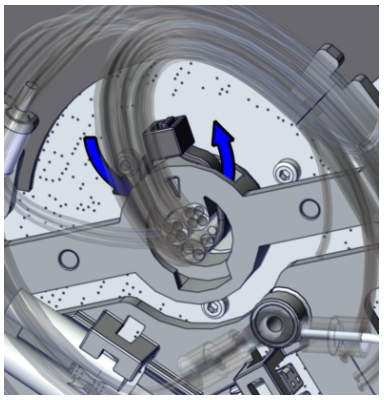
5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

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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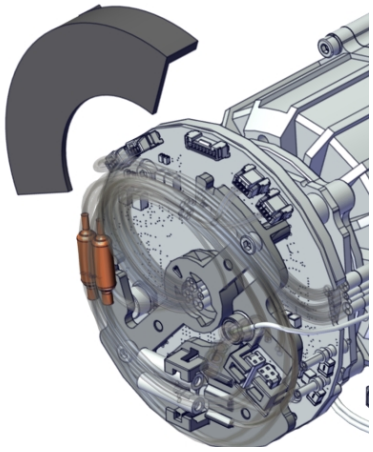
	Action	Note
8	Fit the protection plate to the drive board unit.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
9	Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.	Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059

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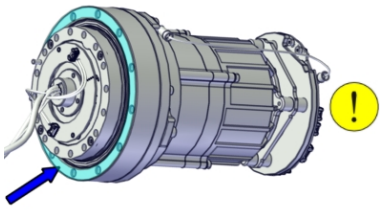
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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

Continued

	Action	Note
10	Remove the protection plate.	 xx2100000301

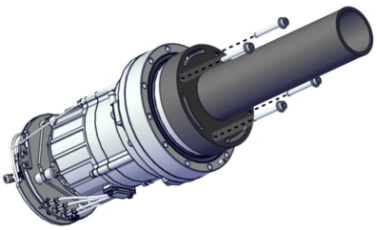
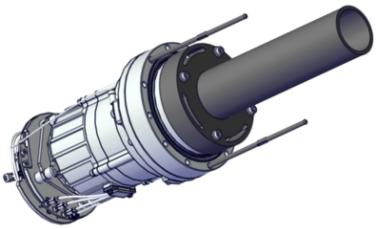
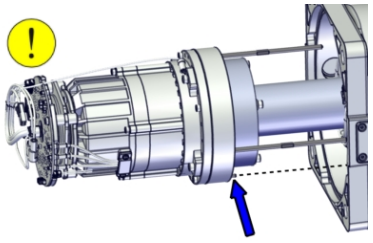
Preparations before fitting the joint unit (-5/0.95)

	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 53*.	
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 (or equivalent)  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 53*.	

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Refitting the axis-1 joint unit (-5/0.95)

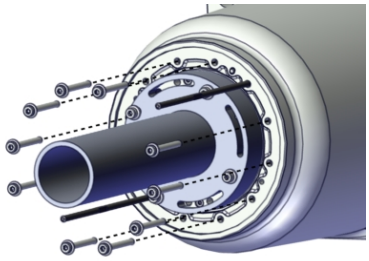
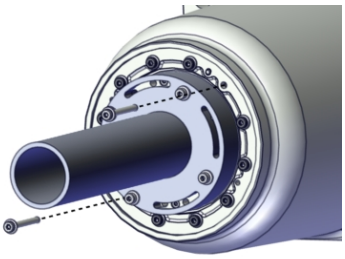
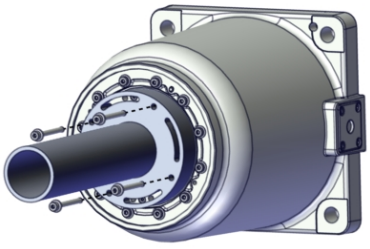
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Fit the lifting aid to the joint unit. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical 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 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  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

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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

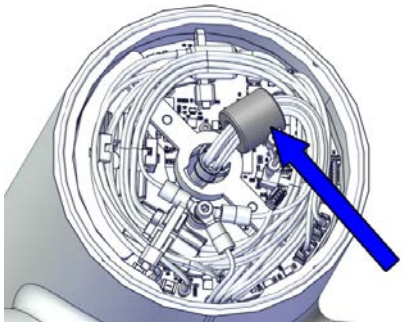
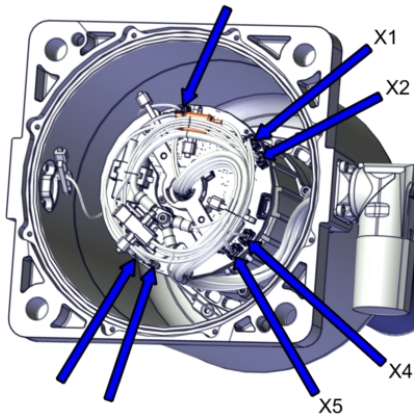
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	Action	Note
5	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2000002008
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.	

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Connecting the axis-1 joint unit cabling

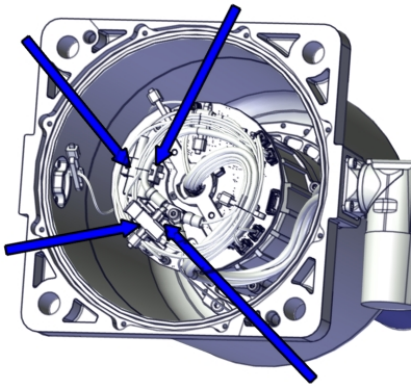
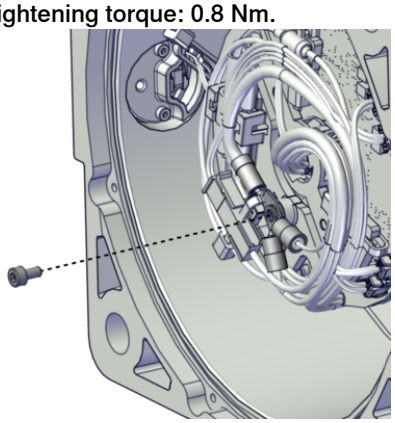
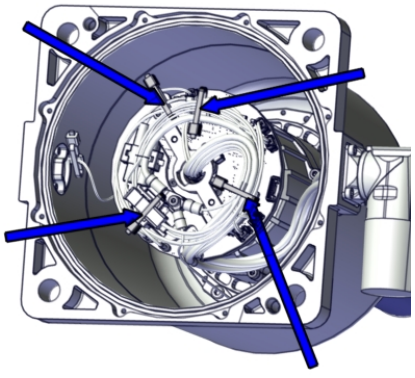
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D1.X4 and D1.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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

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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

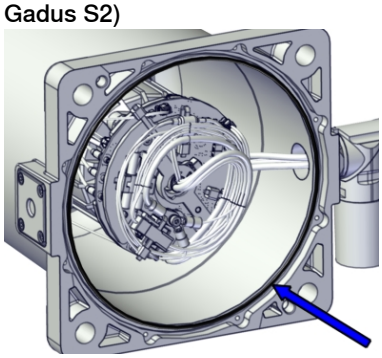
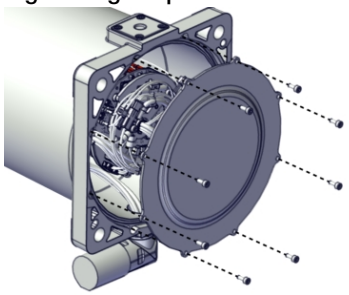
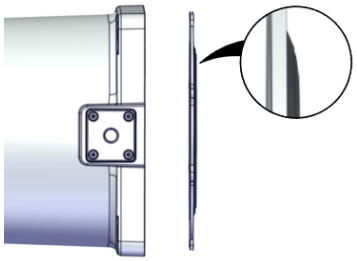
Continued

	Action	Note
5	Connect the connectors to each other and snap them to the cable holders. • J1.DC+ to J1.DC+ • J1.DC- to J1.DC- • J1.CS to J1.CS • J1.CP to J1.CP	 xx2000002010
6	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
7	Secure the cabling with cable ties.	Cable ties (4 pcs)  xx2000002012

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Refitting the base cover (-5/0.95)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAB3772-64 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016
2	Refit the bottom cover with the attachment screws. **Note** For CRB 15000-5/0.95, 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

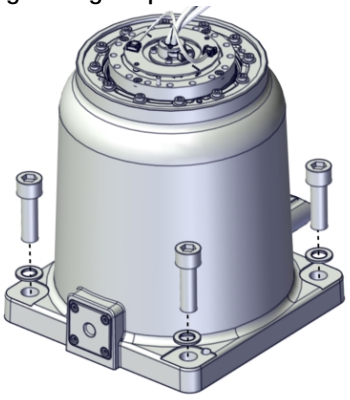
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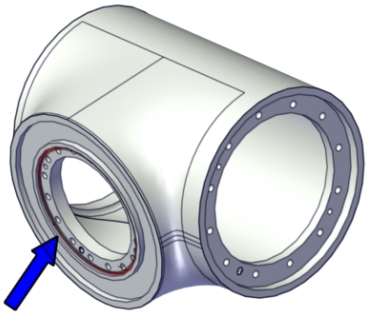
5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

Continued

Securing the base

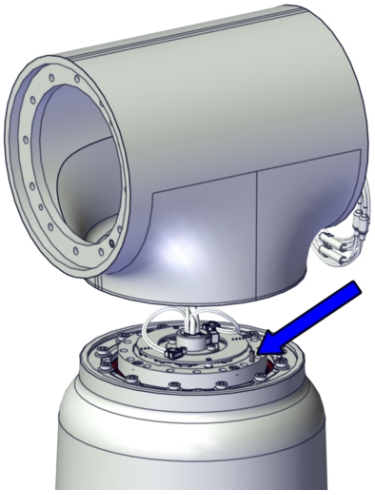
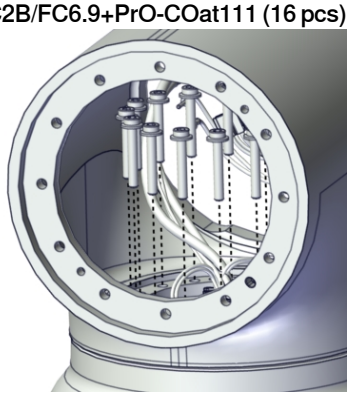
	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 32 Nm ±10%.  xx2000002006

Refitting the swing(-5/0.95)

	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 (or equivalent)  xx2000001990
2	Separate the new swing parts by removing the pre-assembling screws.	

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	Action	Note
3	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
4	Secure the swing with the attachment screws. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap flange screw: M4x25 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs)  xx2000001987
5	Torque tighten all screws crosswise.	Tightening torque: 4.6 Nm

Preparations before fitting the joint unit

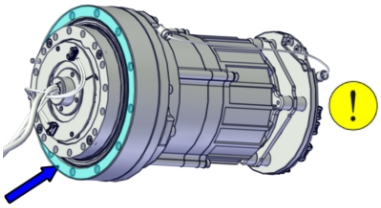
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	

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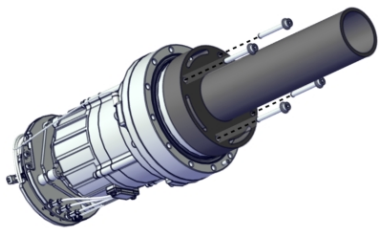
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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

Continued

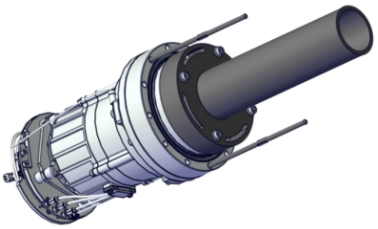
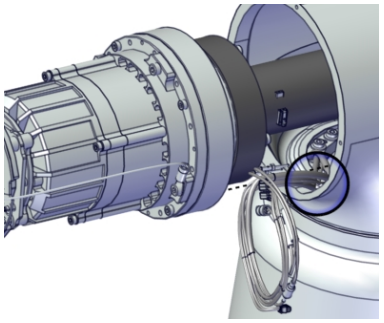
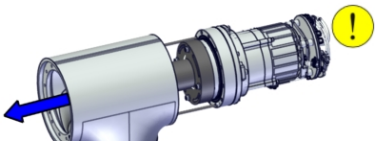
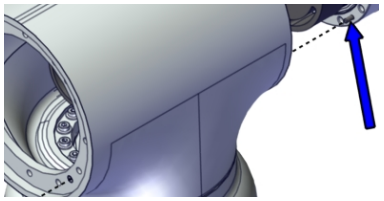
	Action	Note
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000001860
3	Apply a thin layer of flange sealant to 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 53*.	

Refitting the axis-2 joint unit (-5/0.95)

	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 53*.	
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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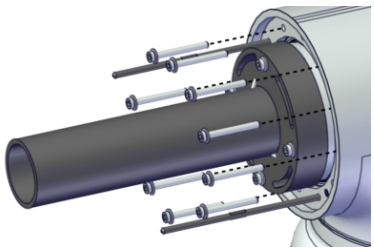
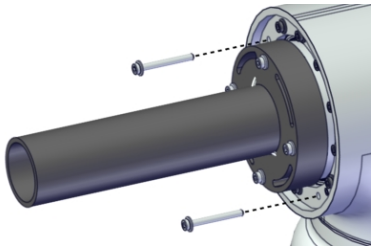
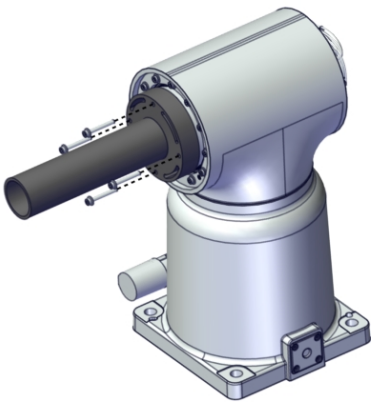
	Action	Note
3	Fit two guide pins to the joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002438
4	Place the axis-1 cabling at the notch in the swing. **CAUTION** 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
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

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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

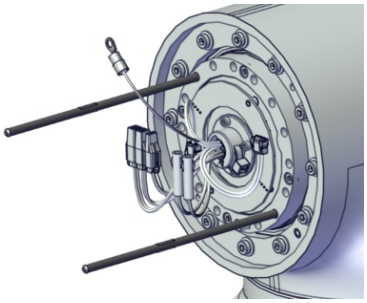
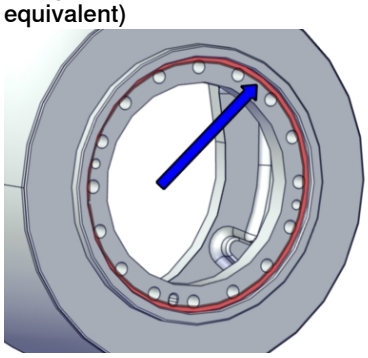
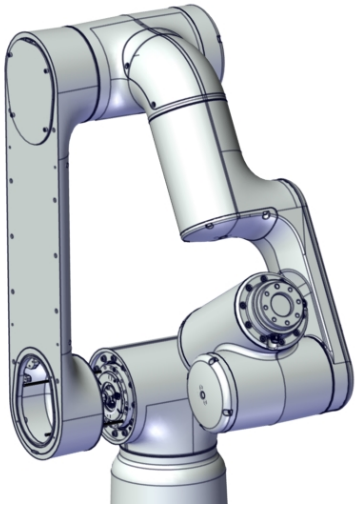
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	Action	Note
6	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. Always use new screws when 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.
10	Remove the lifting aid by removing the screws.	 xx2000001956
11	Clean pushed-out flange sealant, if any.	

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Refitting the lower and upper arm assembled (-5/0.95)

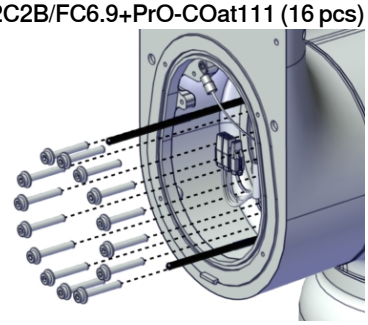
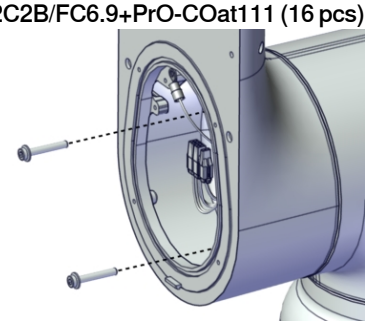
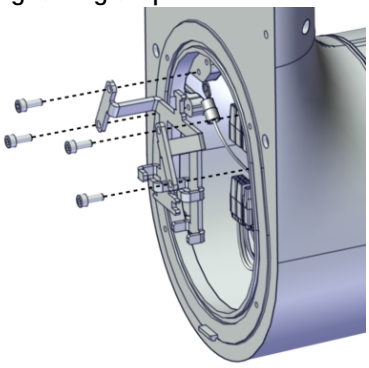
	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001  xx2000001949
2	Remove any old residuals of flange sealant from the lower arm mounting surface and clean with isopropanol. Apply new flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  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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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

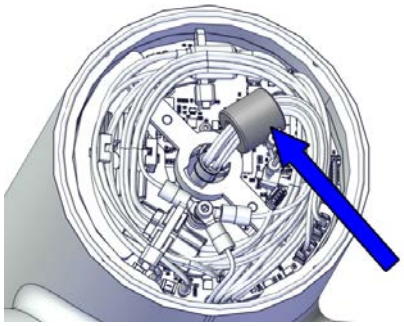
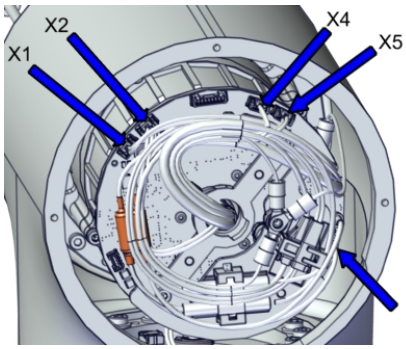
Continued

	Action	Note
5	Secure the lower arm to the swing with all attachment screws but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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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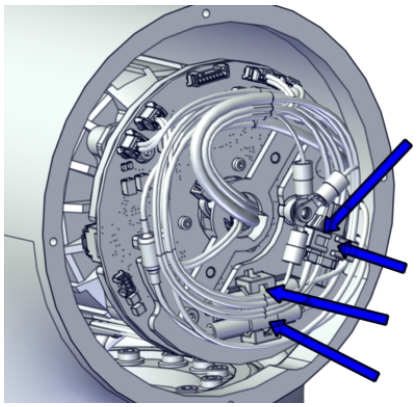
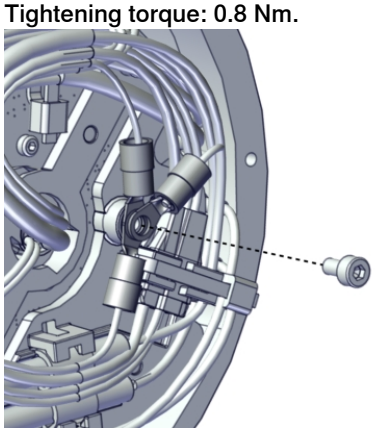
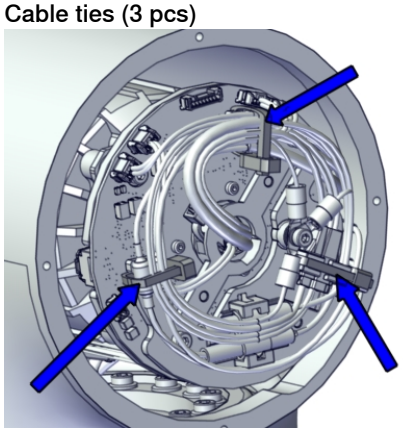
Connecting the axis-2 joint unit cabling

	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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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

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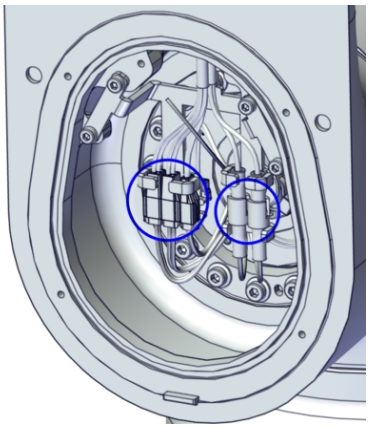
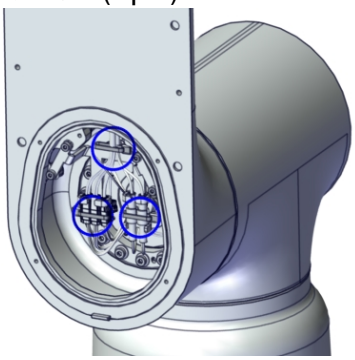
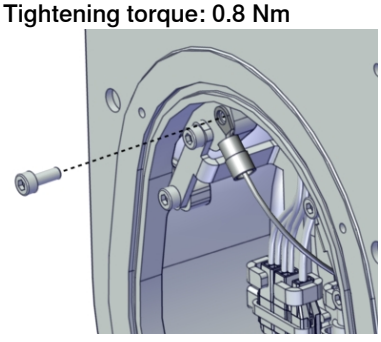
5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)
Continued

	Action	Note
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944
6	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
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

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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

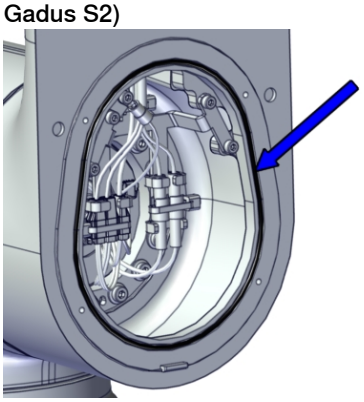
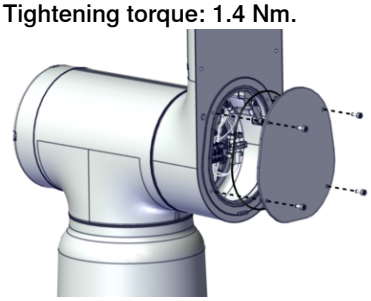
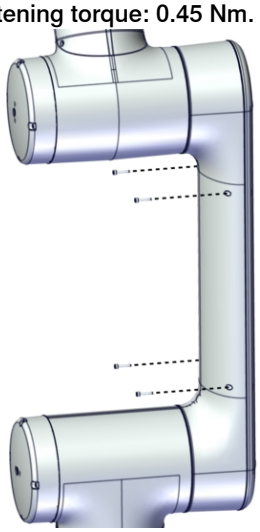
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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)

Continued

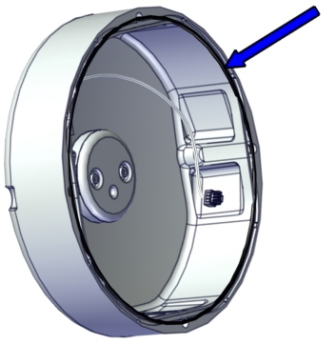
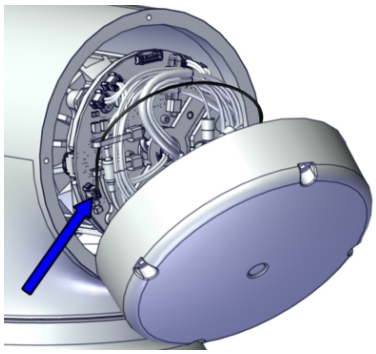
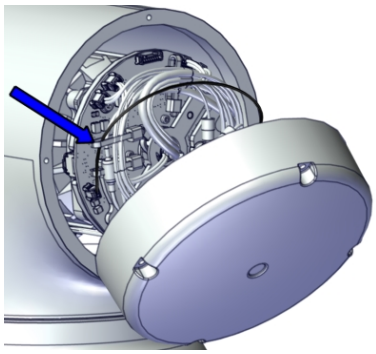
Refitting the lower arm covers (-5/0.95)

	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.  xx2000001929
4	Secure the cover with four screws.	

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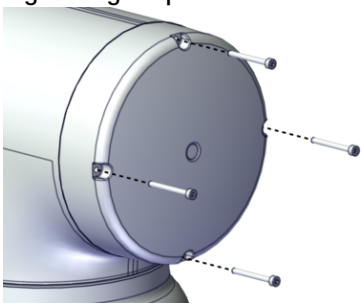
Refitting the swing cover(-5/0.95)

	Action	Note
1	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-047 (for CRB 15000-5/0.95)  xx2000001962
2	**For robots with RobotWare earlier than 7.10** 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	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000001931

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5.6.1 Replacing the axis-1 joint unit (CRB 15000-5/0.95)
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  xx2000001935

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

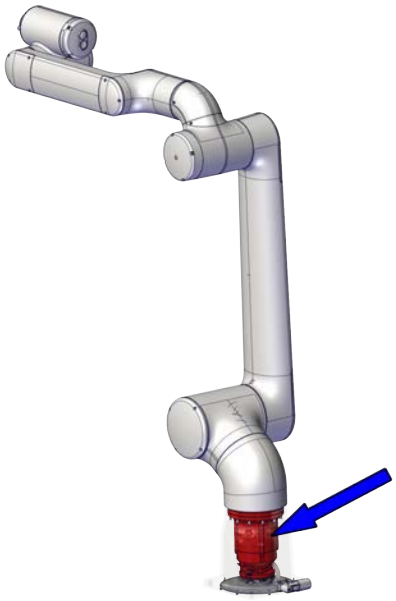
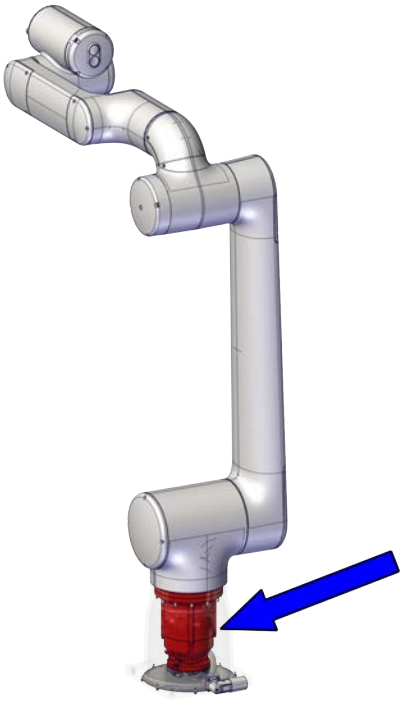
	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)

Location of the axis-1 joint unit

The joint unit is located as shown in the figure.

CRB 15000-10/1.52	CRB 15000-12/1.27
 xx2300000764	 xx2300000767

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.

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*.

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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

Spare part	Article number	Note
Joint unit	3HAC087472-001	Used for CRB 15000-10/1.52 and CRB 15000-12/1.27. New O-rings 3HAC061327-044 and cable tie 3HAC075545-001 are included in the delivery.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC087787-001	For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27. A plate, a beam, a pair of semicircular blocks and attachment screws M5x30 (2 pcs) are enclosed.
Guide pin, M5x125	3HAC087786-001	Always use guide pins in pairs. For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M5x75	3HAC087786-002	Always use guide pins in pairs.
Protection plate	3HAC087789-001	For protection of drive board during cabling installation on joint units of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cable ties	-	
O-ring	3HAC061327-072	Base cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27.
O-ring	3HAC061327-044	Axis-1 and -2 joint unit, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-074	Swing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-075	Lower arm, lower inner cover of CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.

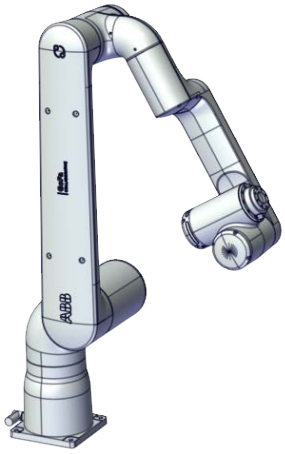
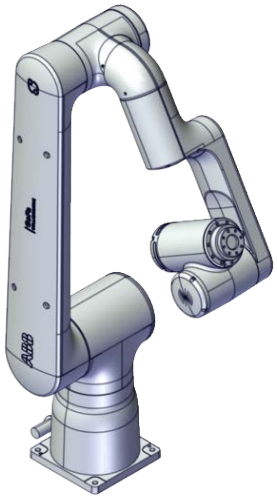
Removing the joint unit

Use these procedures to remove the joint unit.

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Preparations before removing the joint unit

	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° (home position) • Axis 2: 0° • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. **CAUTION** 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.	**Valid for CRB 15000-10/1.52**  xx2300001062 **Valid for CRB 15000-12/1.27**  xx2300001063
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

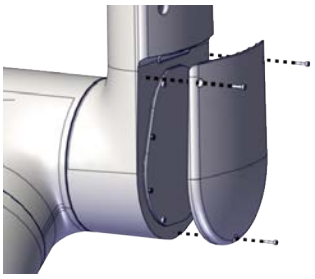
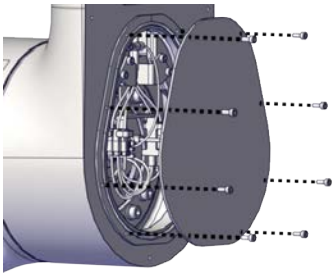
Removing the lower arm covers (-10/1.52 and -12/1.27)

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

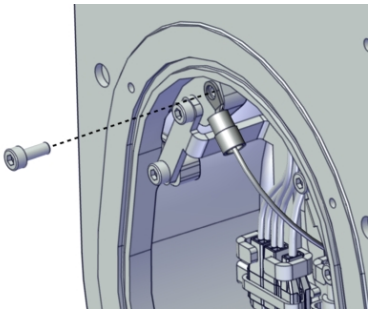
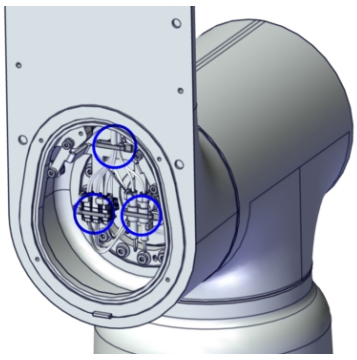
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

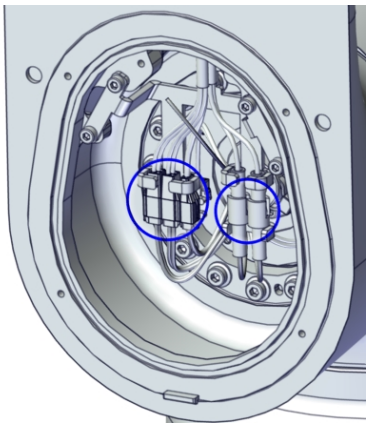
	Action	Note
2	Remove the lower cover of lower arm by removing the screws.	 xx2300000812
3	Remove the lower inner cover by removing the screws.	 xx2300000813

Disconnecting the cabling between the lower arm and the swing

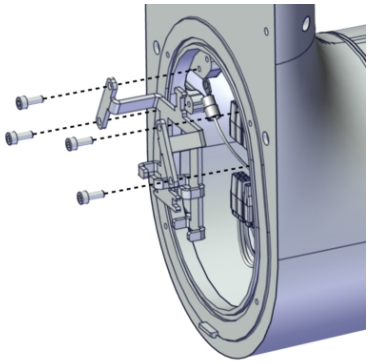
	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936
2	Cut the cable ties.	 xx2000001937

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	Action	Note
3	Snap loose and disconnect all connectors.	 xx2000001938

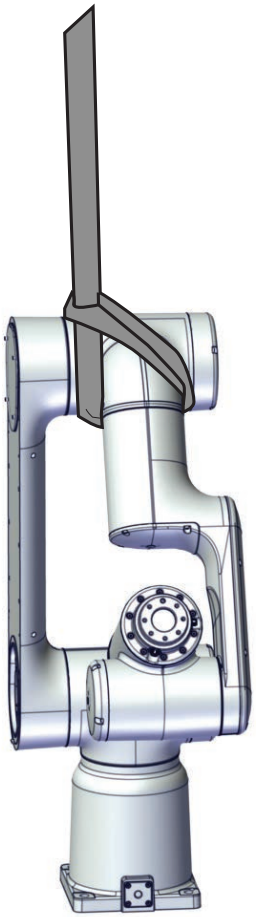
Removing the lower and upper arm assembled

	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939

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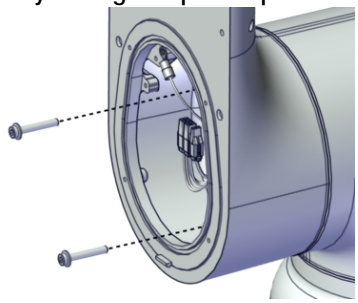
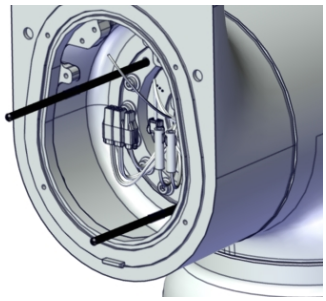
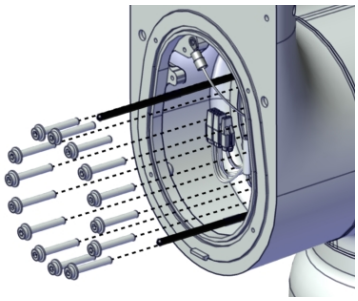
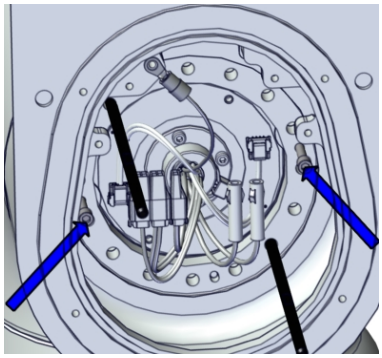
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

	Action	Note
2	Secure the weight of the upper and lower arm. **CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	Suggestion with lifting sling and an overhead crane. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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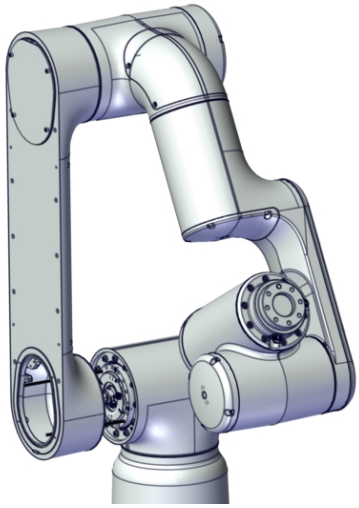
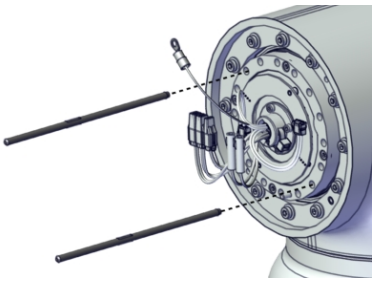
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	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

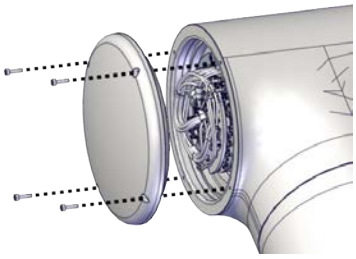
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

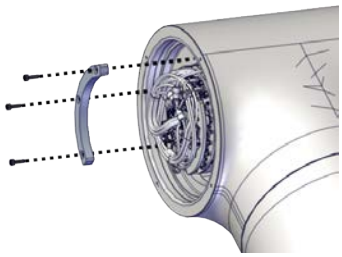
	Action	Note
6	Remove the complete arm system from the swing.	 xx2000001941
7	Remove the guide pins.	 xx2000002432

Removing the swing cover and insert (-10/1.52 and -12/1.27)

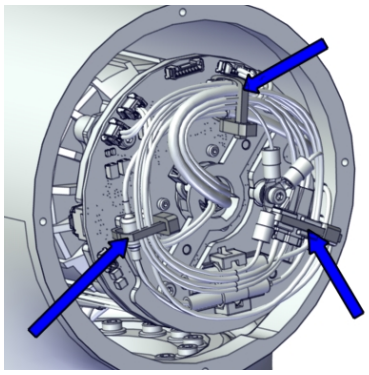
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000814

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	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	Remove the insert.	 xx2300000815

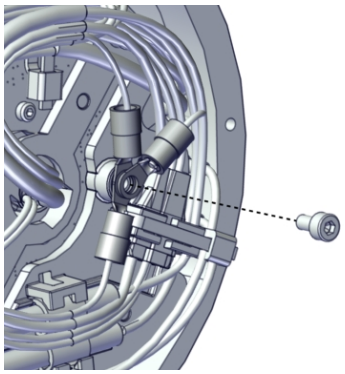
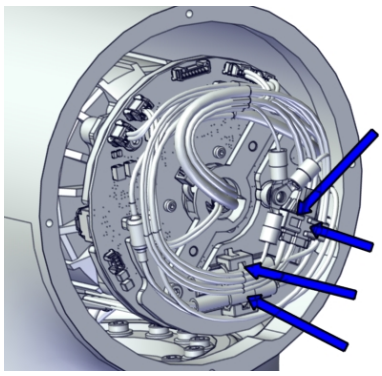
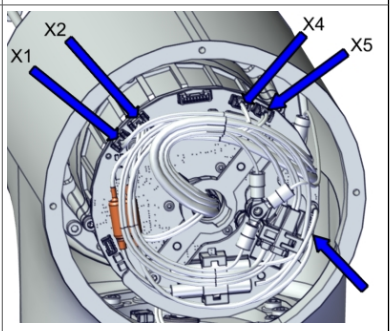
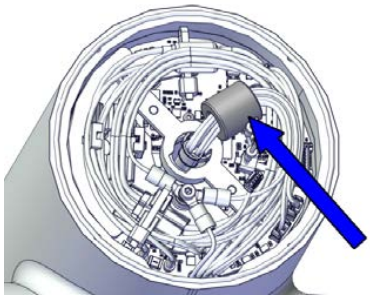
Disconnecting the axis-2 joint unit cabling

	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 53*.	
2	Cut the cable ties.	 xx2000001946

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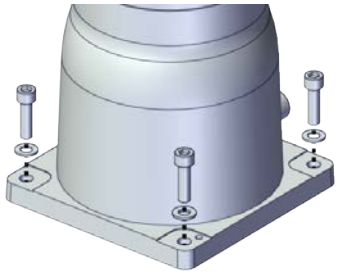
5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

	Action	Note
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: • J2.DC+ • J2.DC- • J2.CS • J2.CP	 xx2000001944
5	Disconnect the connectors from the drive board. • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002013
6	Remove the ferrite core by pulling the cables D2.X4 and D2.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

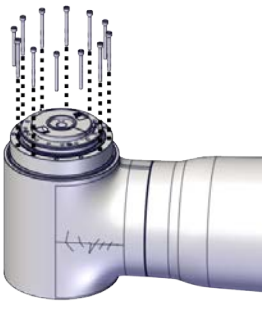
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Removing the base from foundation (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** The weight of the complete swing and base together is up to 25 kg	
2	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
3	Loosen the robot base from the foundation by removing the foundation attachment screws.	 xx2300001060
4	Lay the robot down with the torque sensor side upwards on a working bench. Do not damage the base socket. Caution with the cabling. **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.	

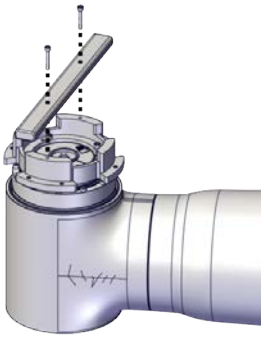
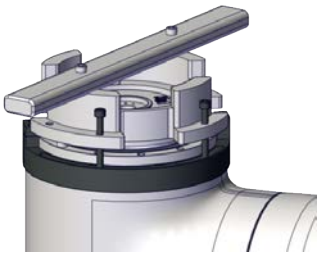
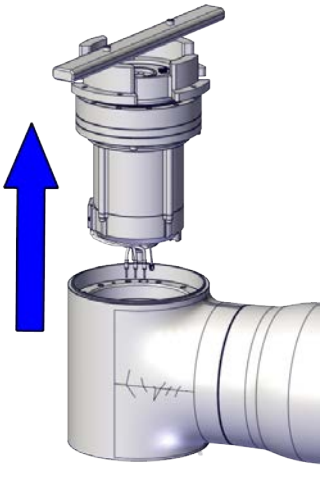
Removing the axis-2 joint unit

	Action	Note
1	Removing the attachment screws.	 xx2300000786

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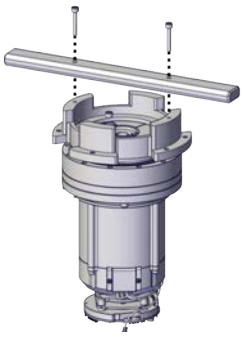
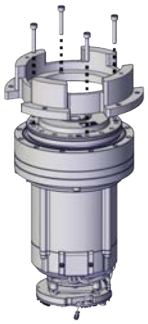
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

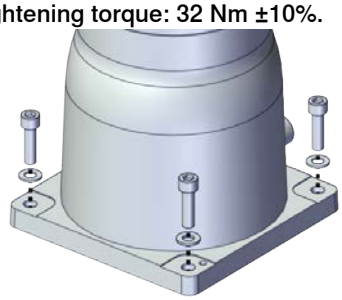
	Action	Note
2	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000787  xx2300000788
3	Place the two semicircular blocks surrounding the joint unit, and use two fully threaded attachment screws as removal tools to press the joint unit out of position.	 xx2300000789
4	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.	 xx2300000790

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	Action	Note
5	Remove the lifting aid.	 xx2300000778  xx2300000776

Securing the base (-10/1.52 and -12/1.27)

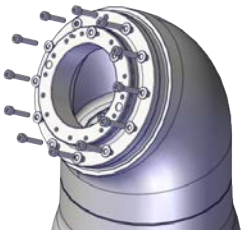
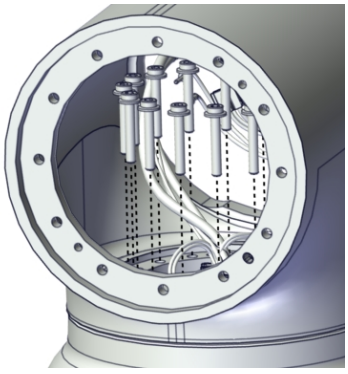
	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 32 Nm ±10%.  xx2300001060

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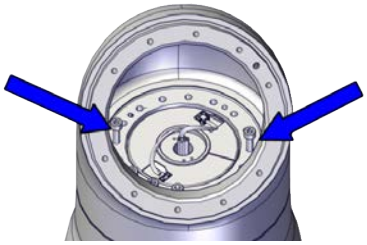
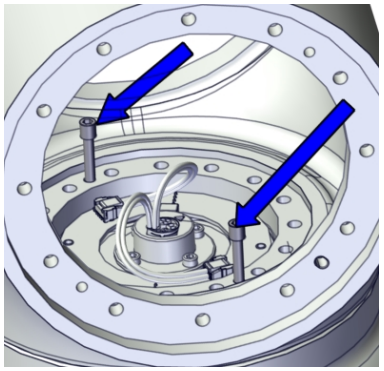
5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

Removing the swing (-10/1.52 and -12/1.27)

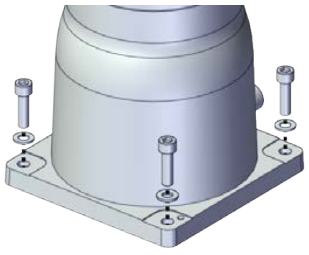
	Action	Note
1	**Valid for CRB 15000-10/1.52** Remove the swing transition.	 xx2300000817
2	**Valid for CRB 15000-10/1.52** Remove the swing flange.	 xx2300000818
3	Remove the swing attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	**Valid for CRB 15000-10/1.52**  xx2300000819 **Valid for CRB 15000-12/1.27**  xx2000001987

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	Action	Note
4	Use two fully threaded attachment screws as removal tools to press the swing out of position. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	**Valid for CRB 15000-10/1.52**  xx2300000822 **Valid for CRB 15000-12/1.27**  xx2000002152
5	Lift away the swing. **CAUTION** The torque sensor (on the exposed PCBA) is sensitive to mechanical damage. Handle the assembly with care.	

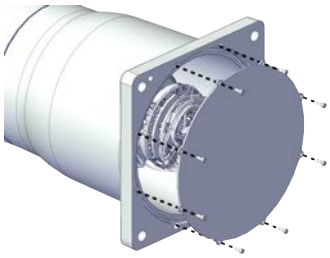
Loosening the base and removing the base cover

	Action	Note
1	Loosen the base from the foundation by removing the attachment screws and washers.	 xx2300001060

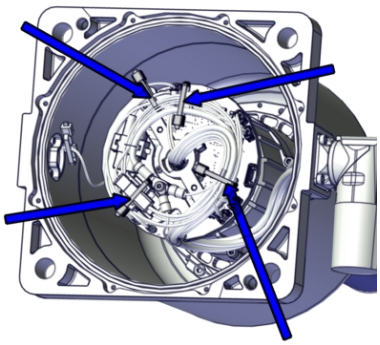
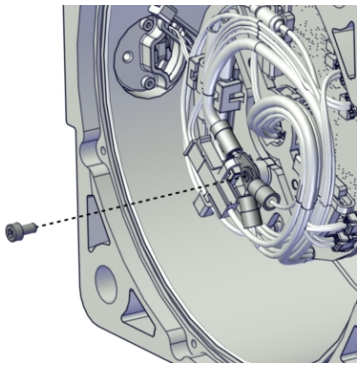
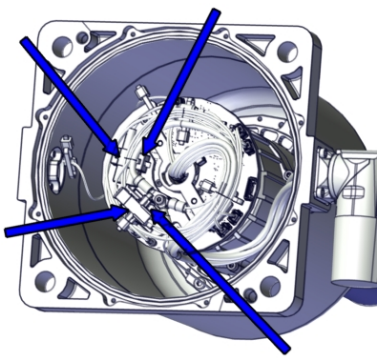
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

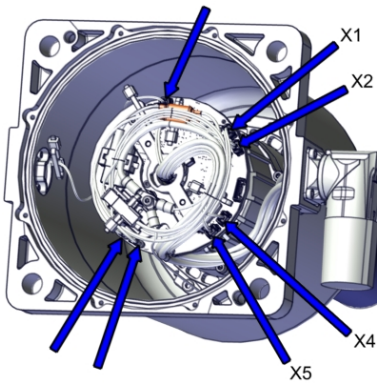
	Action	Note
2	Tilt the base on to its side and remove the bottom cover by removing the attachment screws.	 xx2300000760

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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	Action	Note
4	Disconnect the connectors from the drive board. • 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 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002009
5	Remove the ferrite core by pulling the cables D1.X4 and D1.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

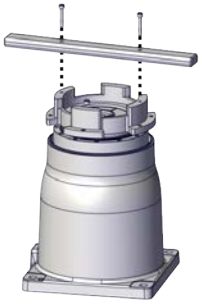
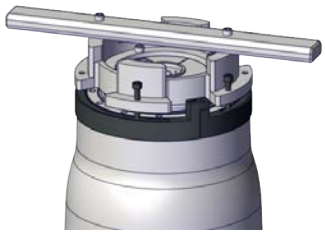
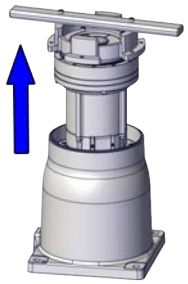
Removing the axis-1 joint unit (-10/1.52 and -12/1.27)

	Action	Note
1	Removing the attachment screws.	 xx2300000770

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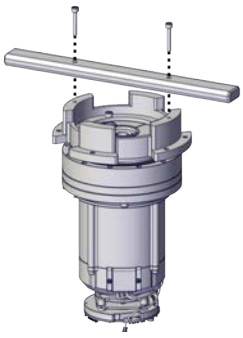
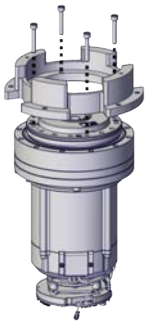
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

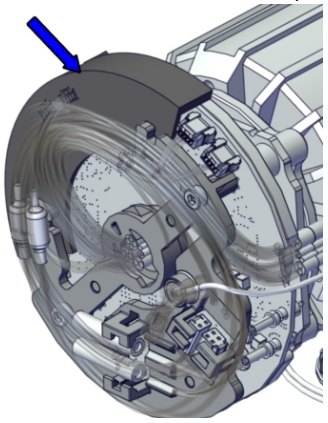
	Action	Note
2	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000771  xx2300000772
3	Place the two semicircular blocks surrounding the joint unit, and use two fully threaded attachment screws as removal tools to press the joint unit out of position.	 xx2300000773
4	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.	 xx2300000774

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	Action	Note
5	Remove the lifting aid.	 xx2300000778  xx2300000776

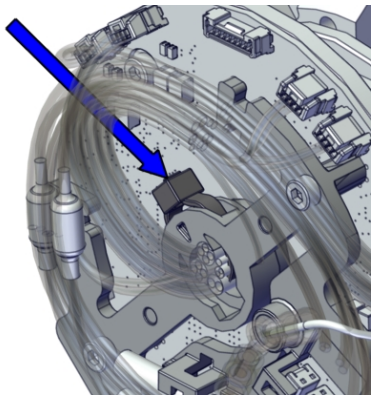
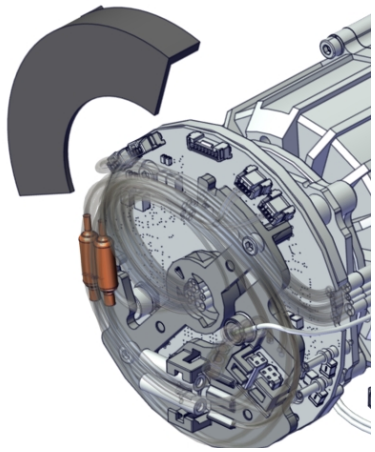
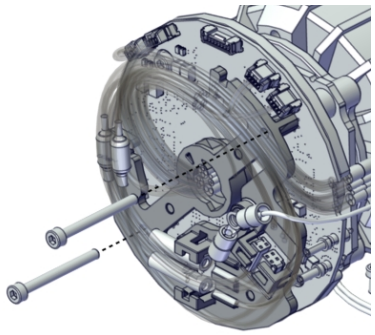
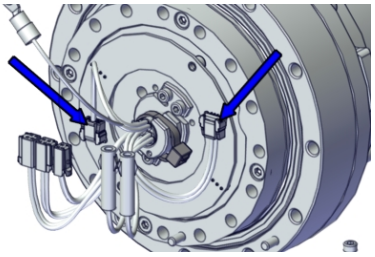
Removing the joint cable

	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 53*.	
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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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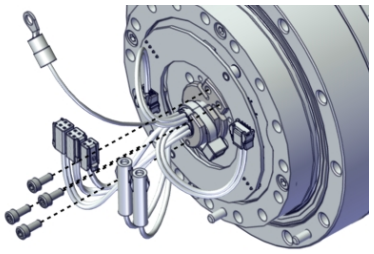
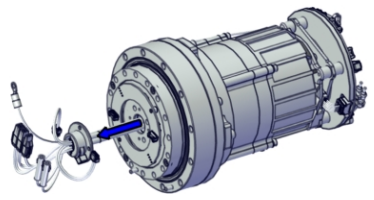
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

	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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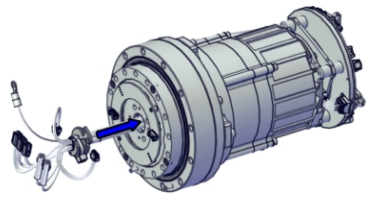
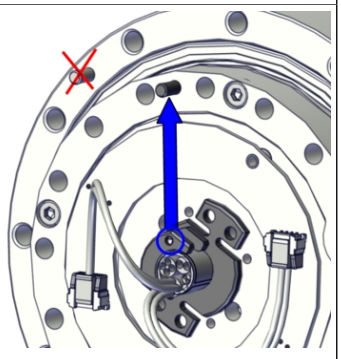
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	Action	Note
7	Remove the cable plate by removing the attachment screws.	 xx2000002049
8	Remove the joint cable from the hollow shaft from the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002060

Refitting the joint unit

Use these procedures to refit the joint unit.

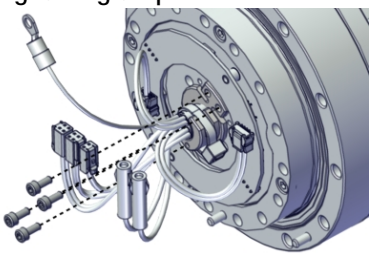
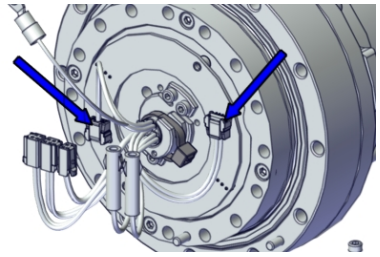
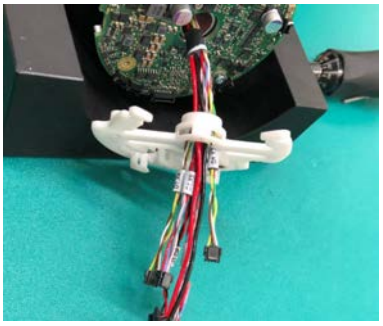
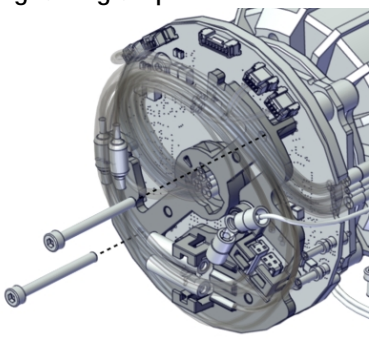
Refitting the joint cable

	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 53*.	
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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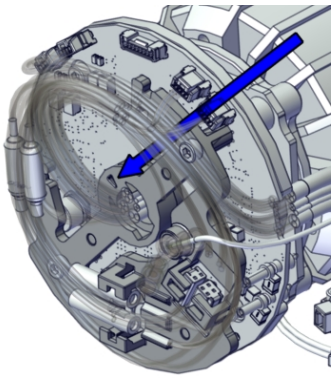
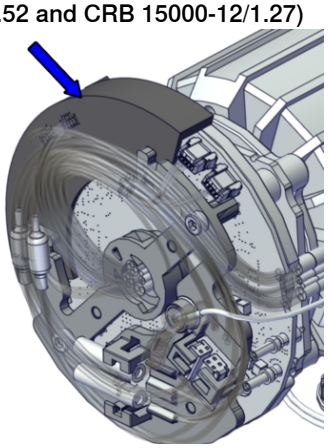
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

	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. • 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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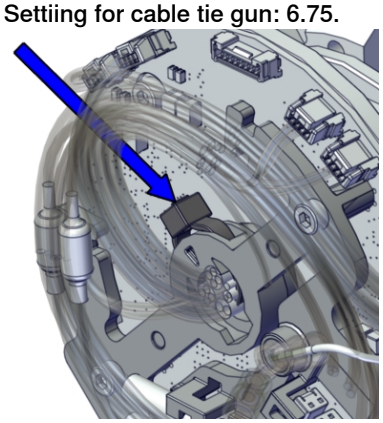
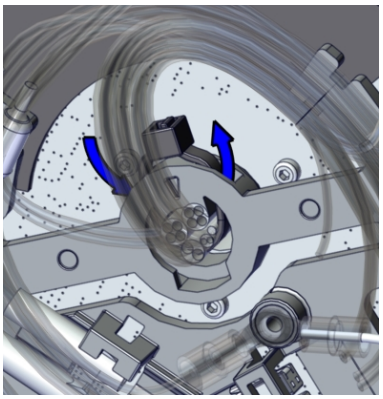
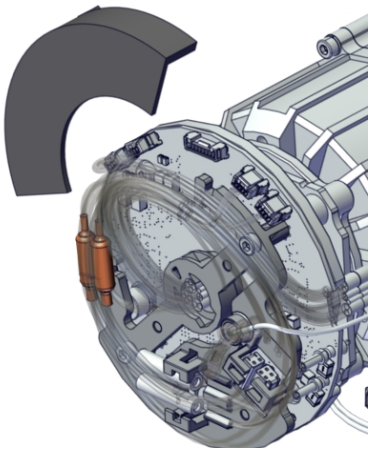
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	Action	Note
7	Keep the cabling loose, making sure not to twist or strain it. Use the cable tie to pre-fix the cable by hand.	 xx2100000507
8	Fit the protection plate to the drive board unit.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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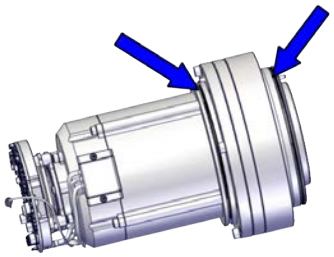
5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

	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 EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059
10	Remove the protection plate.	 xx2100000301

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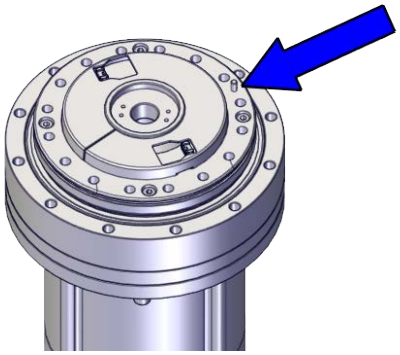
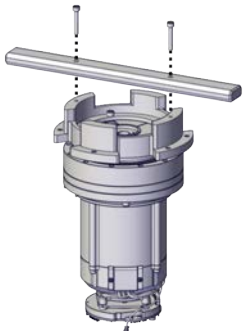
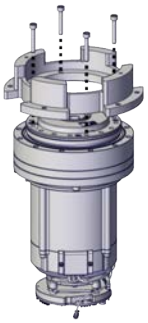
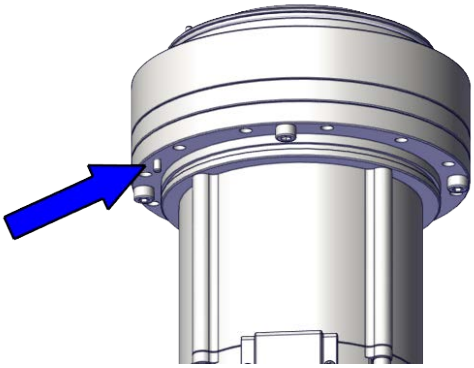
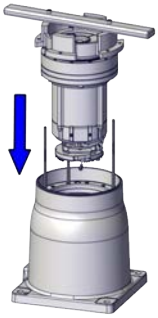
Refitting the axis-1 joint unit (-10/1.52 and -12/1.27)

	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 53*.	
2	Check the o-rings. Replace if damaged.	O-ring: 3HAC061327-044  xx2300000823
3	Fit three guide pins to the base.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins together.  xx2300000775

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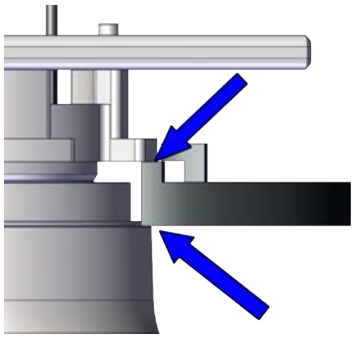
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

	Action	Note
4	Fit the lifting aid to the joint unit, 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.  xx2300000777	Joint unit: 3HAC087472-001 Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000778  xx2300000776
5	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.  xx2300000780	 xx2300000779

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	Action	Note
6	Check the joint unit position by placing the lower boss of one semicircular block between the lifting aid and base. The joint unit is properly placed when no gaps between the block and both lifting aid and base	 xx2300000781
7	Remove the guide pins.	 xx2300000782
8	Secure with four attachment screws and pre-tighten the screws crosswise.	 xx2300000783
9	Remove the lifting aid by removing the screws.	 xx2300000784

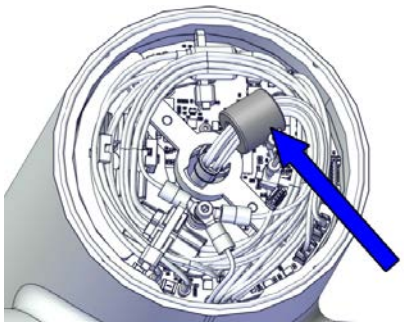
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

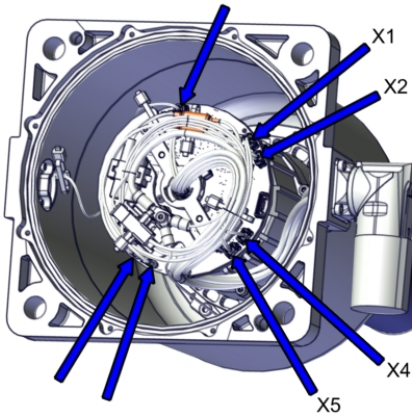
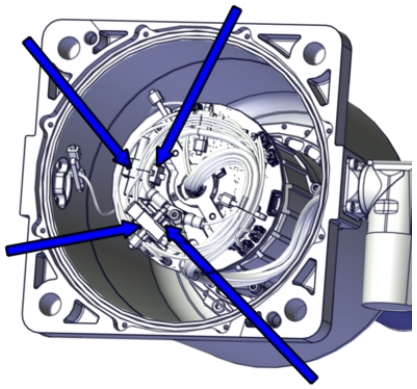
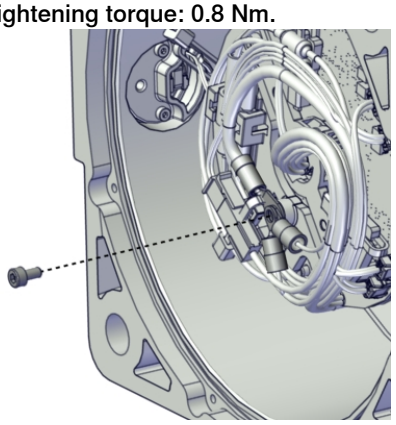
	Action	Note
10	Secure the joint unit with the remaining attachment screws.	Hex socket head cap screw: 3HAB3409-20  xx2300000785
11	Torque tighten all screws crosswise.	M5x55 12.9 Lafre 2C2B/FC6.9, 12 pcs Tightening torque: 8.2 Nm.

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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D1.X4 and D1.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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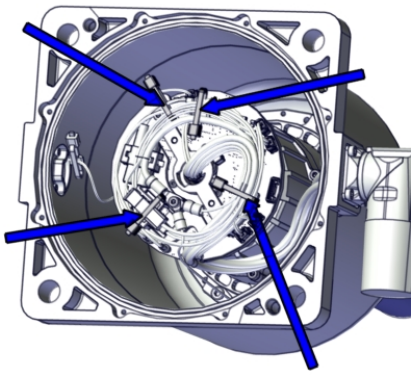
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	Action	Note
4	Reconnect the connectors to the drive board. • D1.X1 to X1 • D1.DC+ to DC+ • D1.DC- to Ground • D1.X4 to X4 • D1.X2 to X2 • D1.X5 to X5 • DR.X8 to X8	 xx2000002009
5	Connect the connectors to each other and snap them to the cable holders. • J1.DC+ to J1.DC+ • J1.DC- to J1.DC- • J1.CS to J1.CS • J1.CP to J1.CP	 xx2000002010
6	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

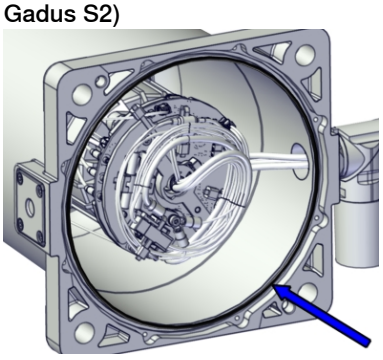
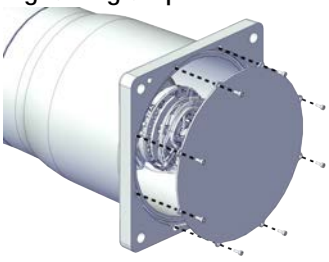
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

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

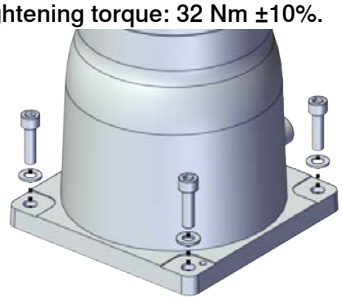
Refitting the base cover (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	3HAC061327-072 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002016
2	Refit the bottom cover with the attachment screws. **Note** For CRB 15000-5/0.95, 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: 1.4 Nm.  xx2300000760

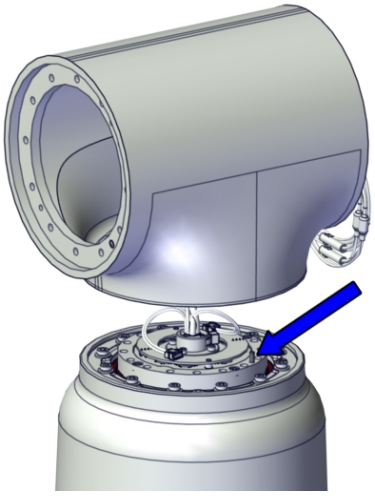
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Securing the base (-10/1.52 and -12/1.27)

	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: 32 Nm ±10%.  xx2300001060

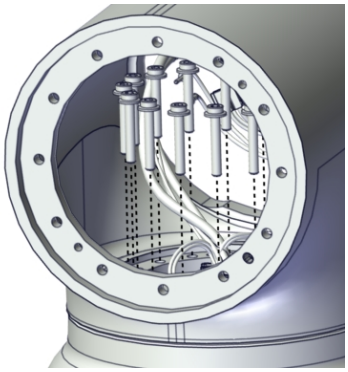
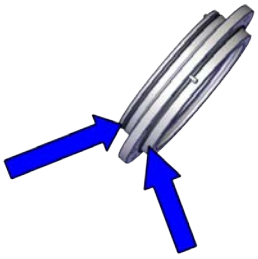
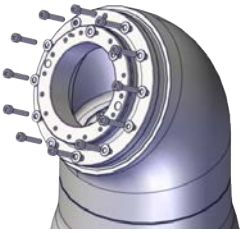
Refitting the swing(-10/1.52 and -12/1.27)

	Action	Note
1	Fit two guide pins on the base unit for position guidance. Always use guide pins in pairs.	**Valid for CRB 15000-10/1.52** Guide pin, M5x75, 3HAC087786-002 **Valid for CRB 15000-12/1.27** Guide pin, M5x125: 3HAC087786-001
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.	Example of CRB 15000-12/1.27, similar to CRB 15000-10/1.52.  xx2000001989

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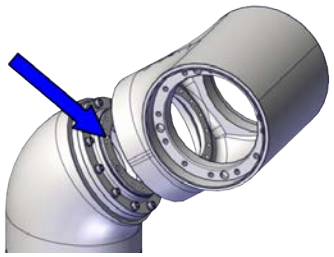
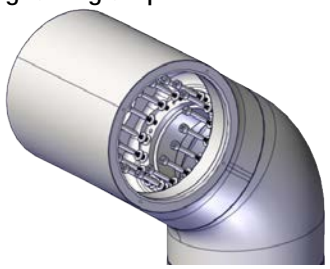
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

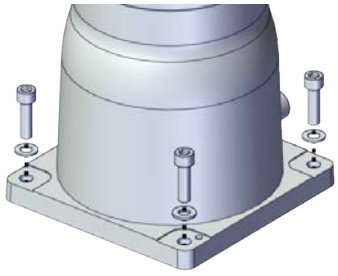
	Action	Note
3	Secure the swing with the attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm **Valid for CRB 15000-12/1.27**  xx2000001987 **Valid for CRB 15000-10/1.52**  xx2300000819
4	**Valid for CRB 15000-10/1.52** Check the o-rings on both side of the swing flange. Replace if damaged.	O-ring: 3HAC061327-073 O-ring: 3HAC061327-044  xx2300000821
5	**Valid for CRB 15000-10/1.52** Refit the swing flange with the attachment screws. Always check the serial number printed on the swing parts and use the parts in the same number for refitting. **CAUTION** Do not use the pre-assembling screws of swing parts for securing.	Hex socket head cap screw: M5x25 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm  xx2300000818

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	Action	Note
6	**Valid for CRB 15000-10/1.52** Fit two guide pins on the swing flange for position guidance. Always use guide pins in pairs.	Guide pin, M5x75, 3HAC087786-002
7	**Valid for CRB 15000-10/1.52** Refit the swing transition to the swing flange, aligning the pin with the pin hole. Always check the serial number printed on the swing parts and use the parts in the same number for refitting.	 xx2300000820
8	**Valid for CRB 15000-10/1.52** Secure the swing transition with the attachment screws. **CAUTION** Do not use the pre-assembling screws of swing parts for securing.	Hex socket head cap screw: M5x25 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 8.2 Nm  xx2300000817

Removing the base from foundation (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** The weight of the complete swing and base together is up to 25 kg	
2	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
3	Loosen the robot base from the foundation by removing the foundation attachment screws.	 xx2300001060

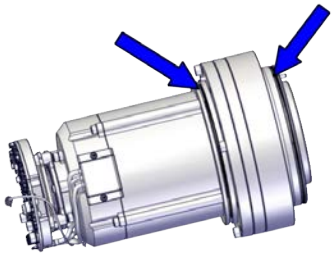
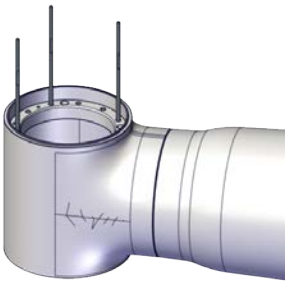
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

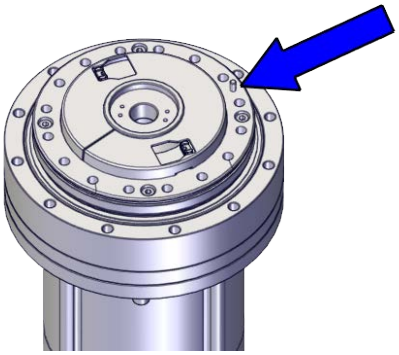
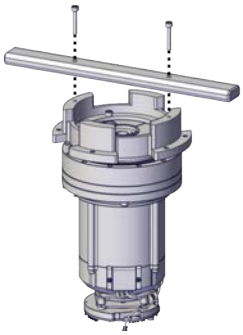
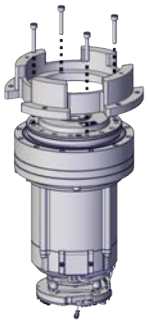
	Action	Note
4	Lay the robot down with the torque sensor side upwards on a working bench. Do not damage the base socket. Caution with the cabling. **CAUTION** The cabling is sensitive to mechanical damage. Handle it with care to avoid damage to the cabling or the connector, avoid any kind of tilt or skew.	

Refitting the axis-2 joint unit (-10/1.52 and -12/1.27)

	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 53*.	
2	Check the o-rings. Replace if damaged.	O-ring: 3HAC061327-044  xx2300000823
3	Fit three guide pins to the swing.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins together.  xx2300000791

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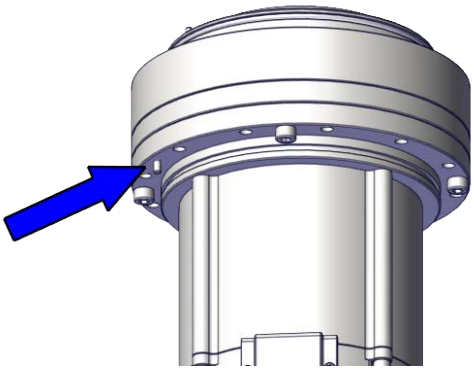
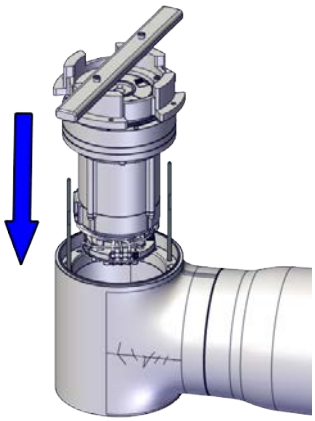
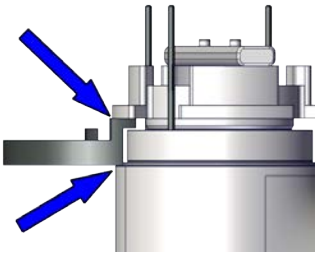
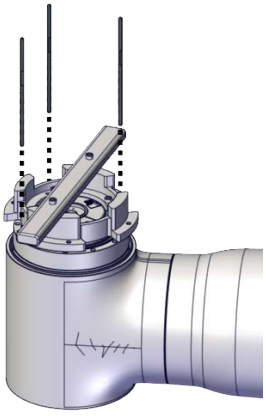
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	Action	Note
4	Fit the lifting aid to the joint unit, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  xx2300000777	Joint unit: 3HAC087472-001 Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000778  xx2300000776
5	Place the axis-1 cabling properly to avoid squeezing by the joint unit when putting the joint unit into 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.	

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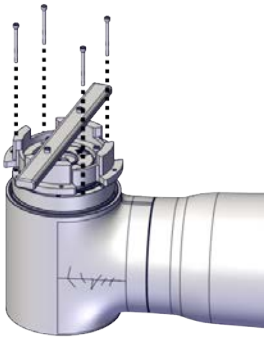
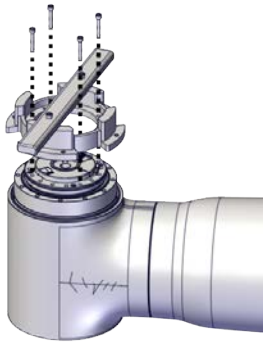
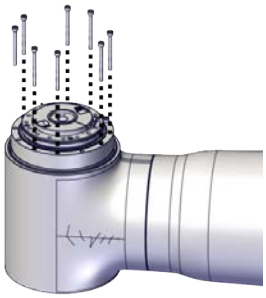
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

	Action	Note
6	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.  xx2300000780	 xx2300000792
7	Check the joint unit position by placing the higher boss of one semicircular block between the lifting aid and swing. The joint unit is properly placed when no gaps between the block and both lifting aid and swing.	 xx2300000794
8	Remove the guide pins.	 xx2300000795

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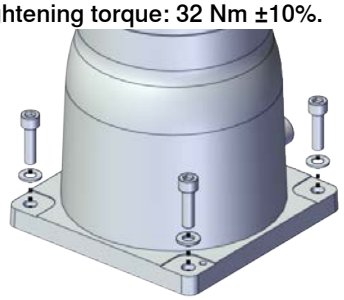
	Action	Note
9	Secure with four attachment screws and pre-tighten the screws crosswise.	 xx2300000796
10	Remove the lifting aid by removing the screws.	 xx2300000797
11	Secure the joint unit with the remaining attachment screws.	Hex socket head cap screw: 3HAB3409-20  xx2300000798
12	Torque tighten all screws crosswise.	M5x55 12.9 Lafre 2C2B/FC6.9, 12 pcs Tightening torque: 8.2 Nm.

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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

Securing the base (-10/1.52 and -12/1.27)

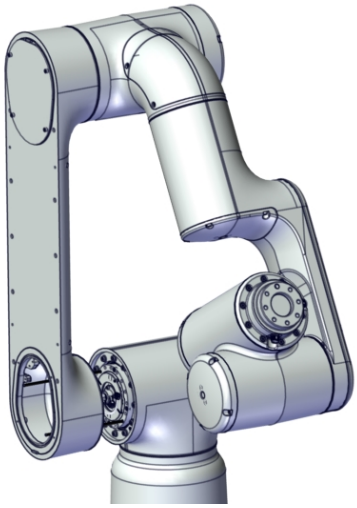
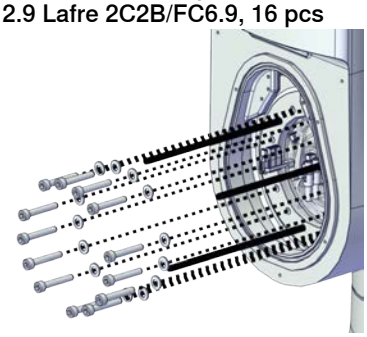
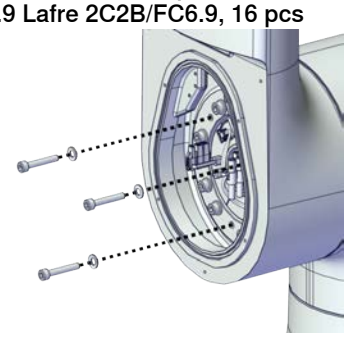
	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 32 Nm ±10%.  xx2300001060

Refitting the lower and upper arm assembled (-10/1.52 and -12/1.27)

	Action	Note
1	Fit three guide pins to the axis-2 joint unit.	Guide pin, M5x125: 3HAC087786-001  xx2300001021
2	**CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	

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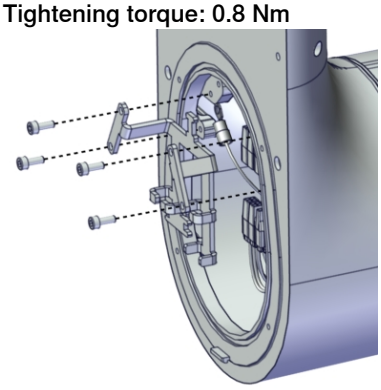
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	Action	Note
3	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000001941
4	Secure the lower arm to the swing with all screws and washers but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001022
5	Remove the guide pins and fasten the remaining two screws and washers. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001023
6	Torque tighten all screws crosswise.	Tightening torque: 8.2 Nm

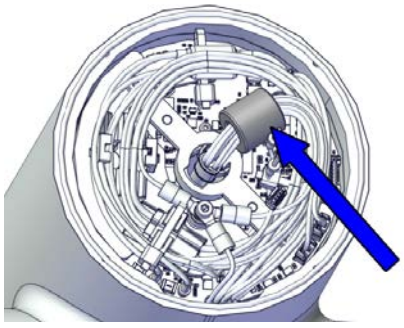
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

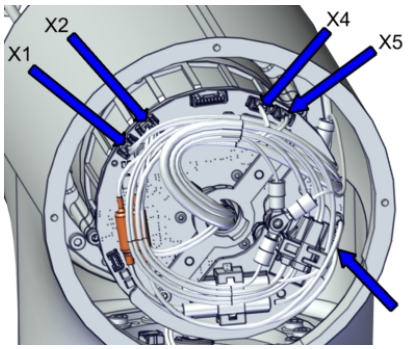
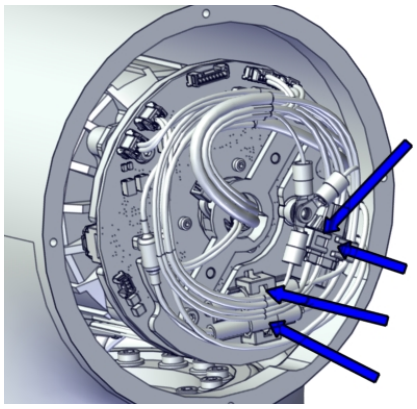
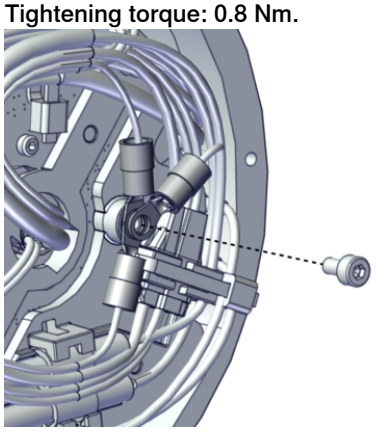
	Action	Note
7	Refit the cable bracket with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm  xx2000001939

Connecting the 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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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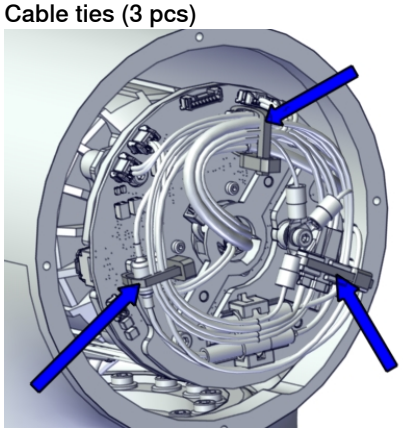
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	Action	Note
4	Reconnect the connectors to the drive board. • D2.X1 to X1 • D2.DC+ to DC+ • D2.DC- to Ground • D2.X4 to X4 • D2.X2 to X2 • D2.X5 to X5	 xx2000002013
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944
6	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

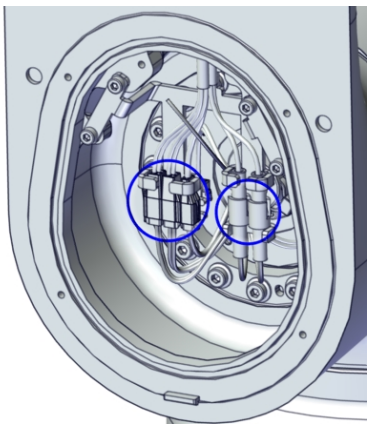
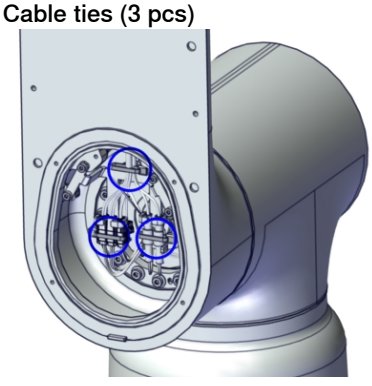
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

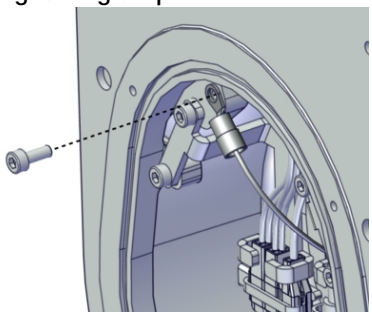
	Action	Note
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

Connecting the cabling between the lower arm and swing

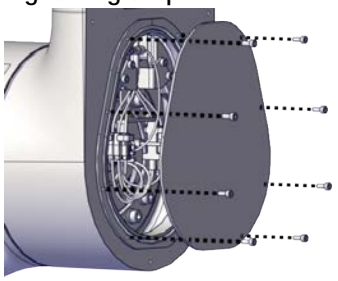
	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938
2	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937

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	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

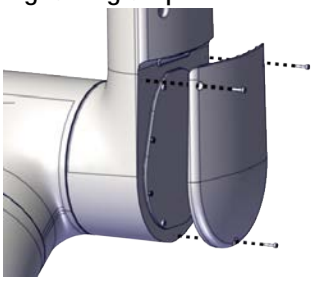
Refitting the lower arm covers (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-075 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.  xx2300000813

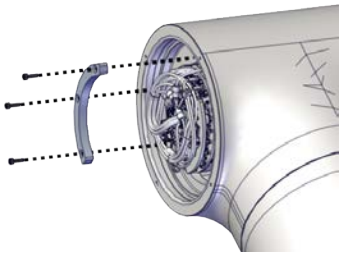
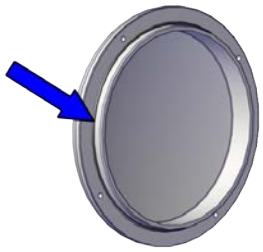
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5.6.2 Replacing the axis-1 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

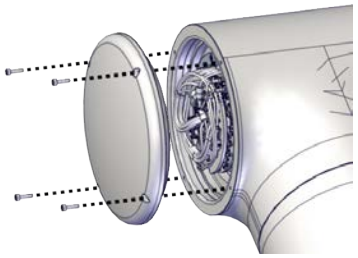
	Action	Note
3	Refit the lower cover of lower arm with three screws.	Lower arm cover, lower: Lower arm, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Tightening torque: 1.4 Nm.  xx2300000812

Refitting the swing cover and insert(-10/1.52 and -12/1.27)

	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000815
2	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-074 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2300000816

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	Action	Note
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000814

Concluding procedure

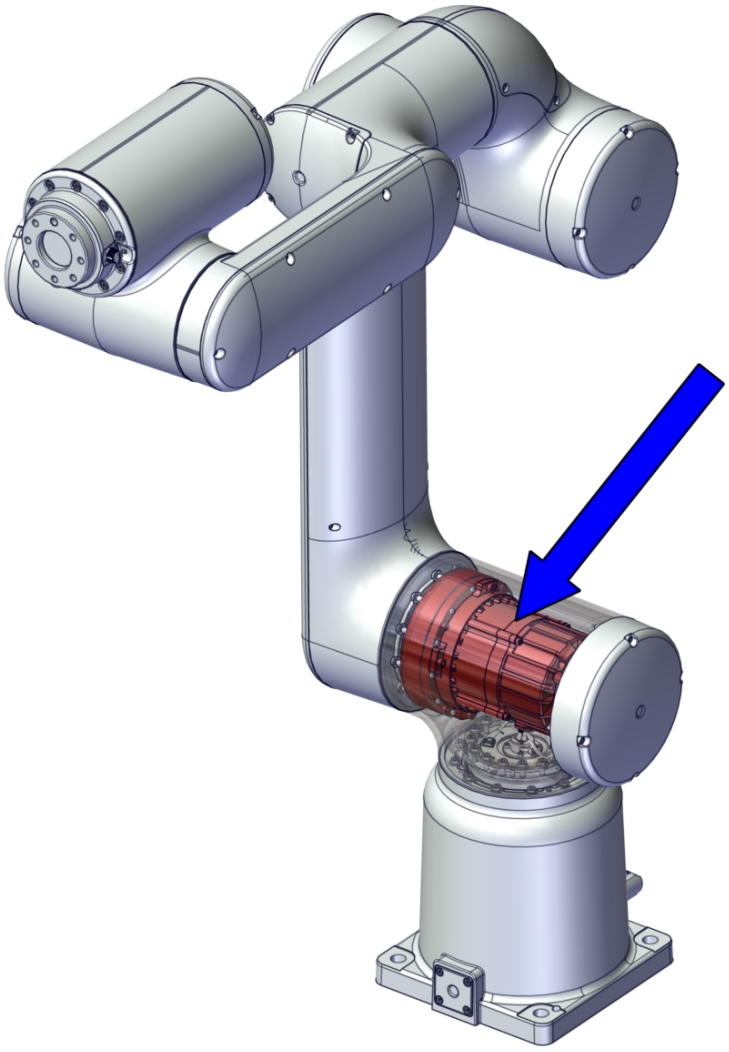
	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047*
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)

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.

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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Joint unit	3HAC079141-001	Used for CRB 15000-5/0.95. New attachment screws and cable tie 3HAC075545-001 are included in the delivery.
Ferrite core	3HAC092224-001	

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95. 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 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint units of CRB 15000-5/0.95.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Cable ties	-	
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-044	Lower arm, inner cover of CRB 15000-5/0.95. 1 pcs / cover. Replace if damaged.

Removing the joint unit

Use these procedures to remove the joint unit.

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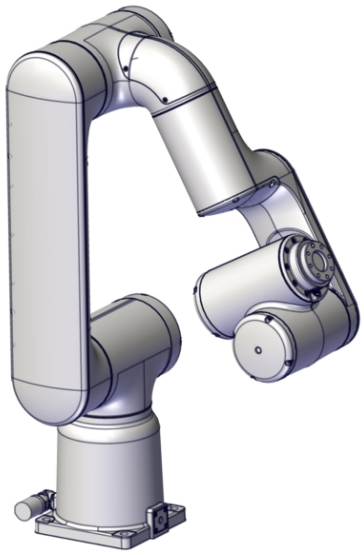
5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)

Continued

Note

If the RobotWare version is older than 7.10, then create a backup of the system before replacing the joint unit. After the replacement, the software must be upgraded to version 7.10 or later.

Preparations before removing the joint unit

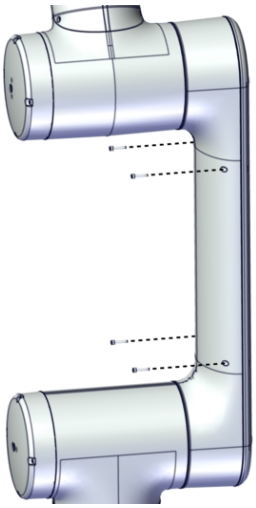
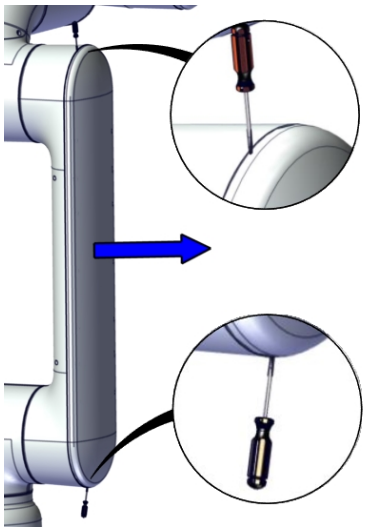
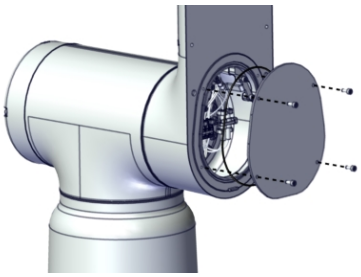
	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 0° (home position) • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. **CAUTION** Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.	 xx2100000044
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the lower arm covers (-5/0.95)

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

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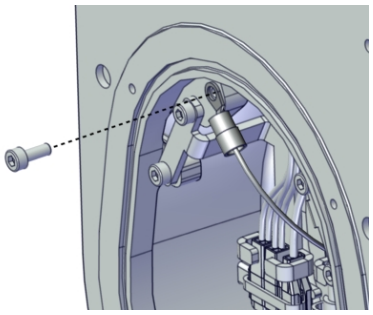
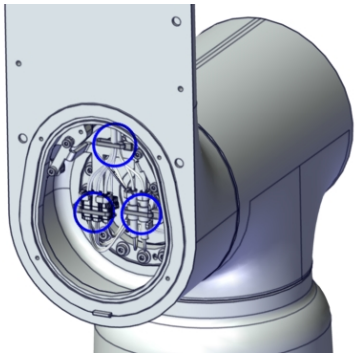
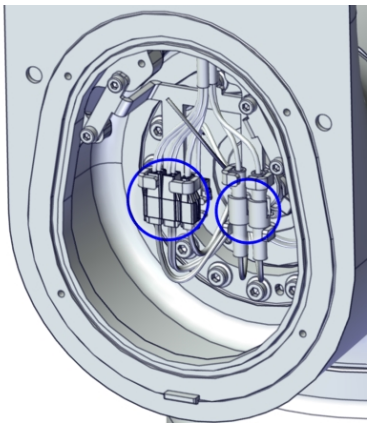
	Action	Note
2	Remove the four lower arm cover screws.	 xx2000001929
3	Remove the cover by inserting a small flat screwdriver to snap open the locks at each end of the cover.	 xx2100000267
4	Remove the inner cover by removing the four screws.	 xx2000001930

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5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)
Continued

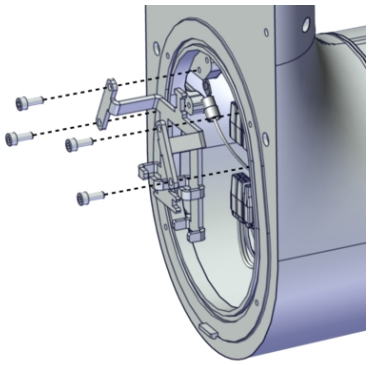
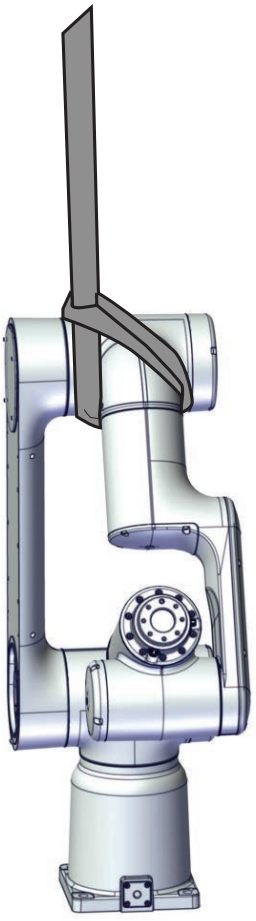
Disconnecting the cabling between the lower arm and the swing

	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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Removing the lower and upper arm assembled

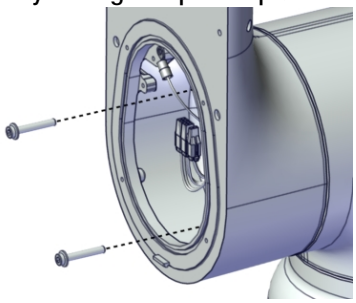
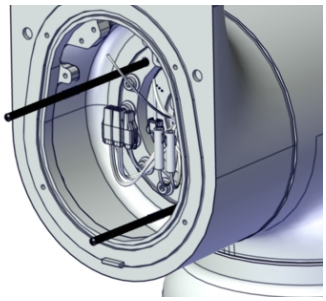
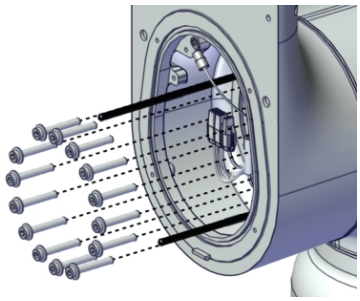
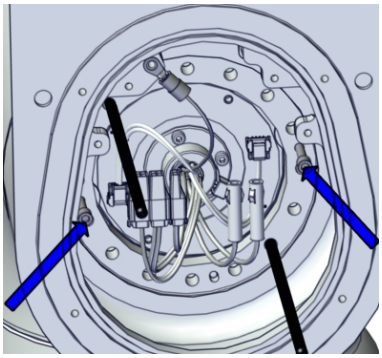
	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939
2	Secure the weight of the upper and lower arm. **CAUTION** The weight of the complete upper and lower arm together is 18 kg	Suggestion with lifting sling and an overhead crane. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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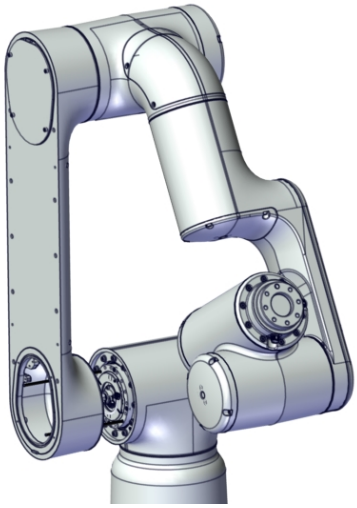
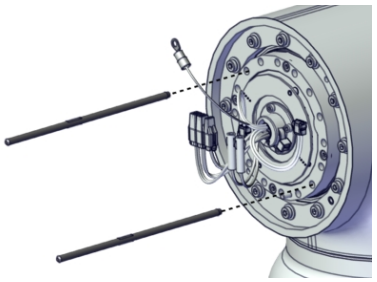
5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)

Continued

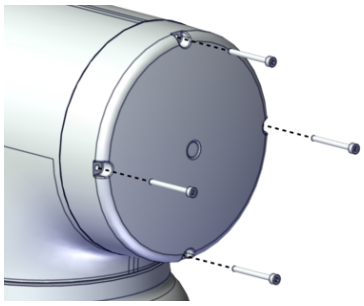
	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

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

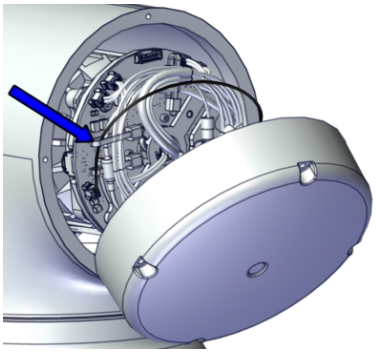
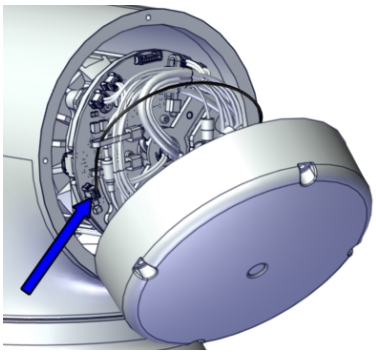
Removing the swing cover (-5/0.95)

	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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5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)
Continued

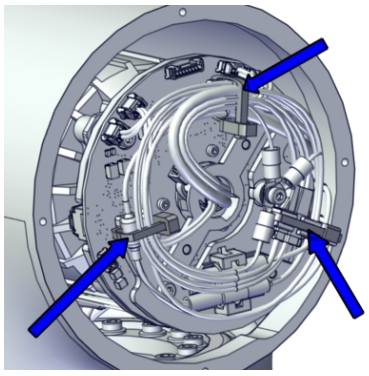
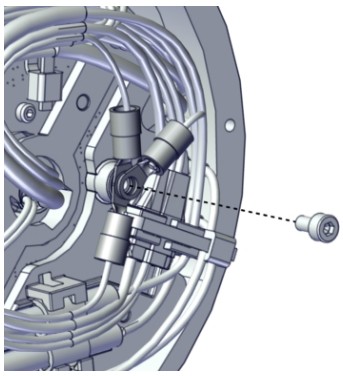
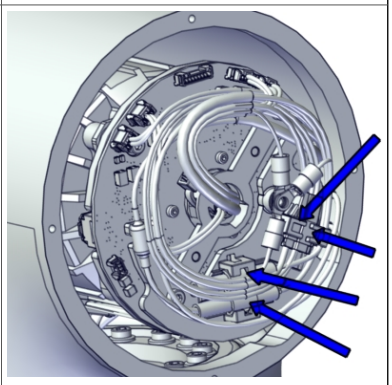
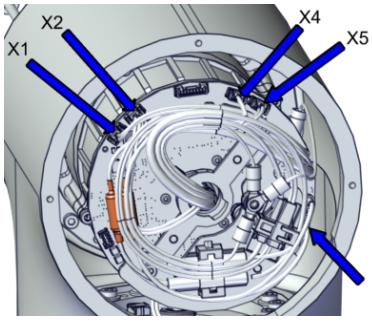
	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000001931
5	**For robots with RobotWare earlier than 7.10** 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 53*.	

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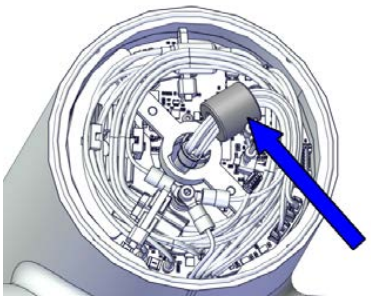
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	Action	Note
2	Cut the cable ties.	 xx2000001946
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: • J2.DC+ • J2.DC- • J2.CS • J2.CP	 xx2000001944
5	Disconnect the connectors from the drive board. • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002013

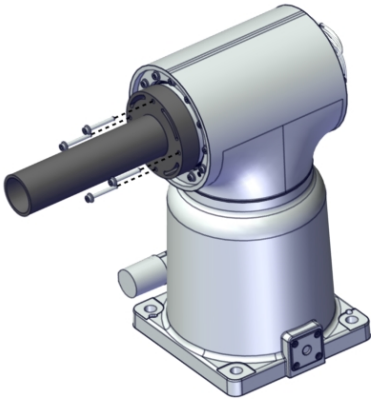
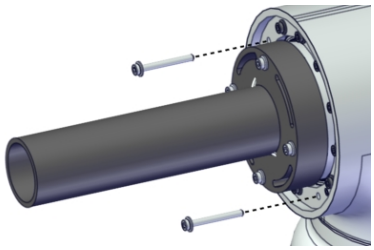
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5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)
Continued

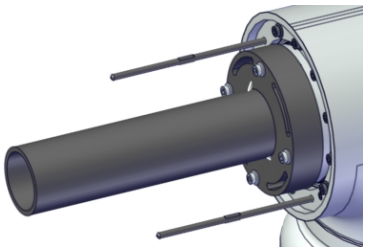
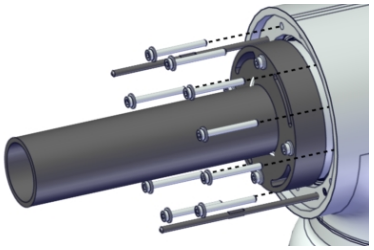
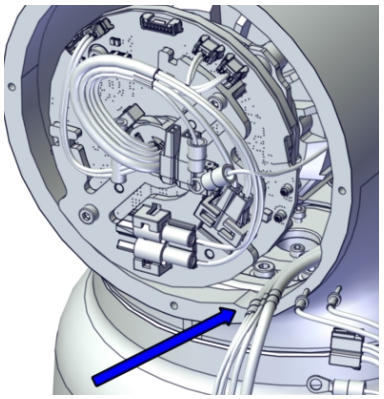
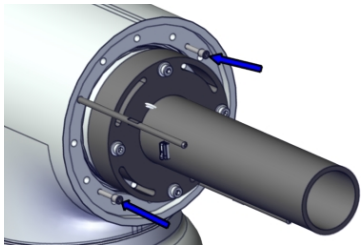
	Action	Note
6	Remove the ferrite core by pulling the cables D2.X4 and D2.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-2 joint unit (-5/0.95)

	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)  xx2000001956
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000295

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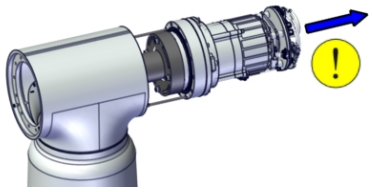
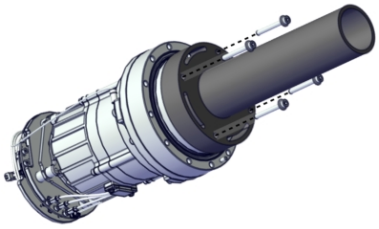
	Action	Note
3	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002433
4	Remove the remaining attachment screws. Use two screws 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.	 xx2000001943
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

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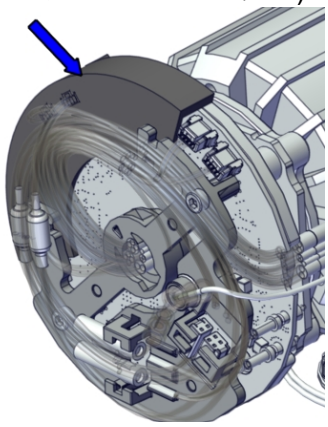
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5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)

Continued

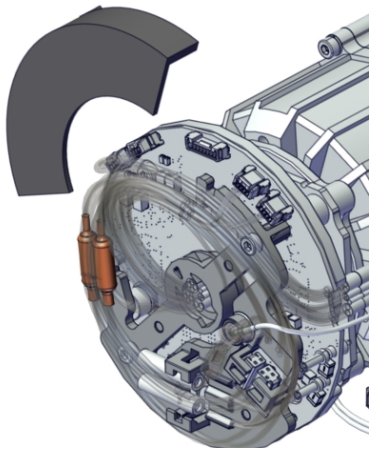
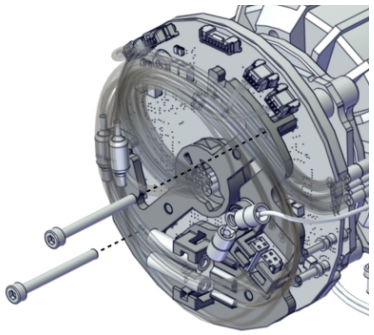
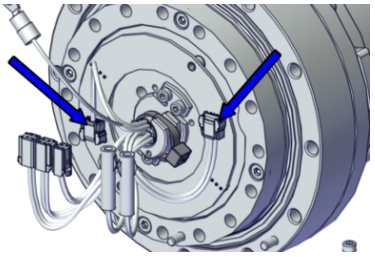
	Action	Note
7	Remove the joint unit from the swing. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000001958
8	Remove the lifting aid and guide pins.	 xx2000001957

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 53*.	
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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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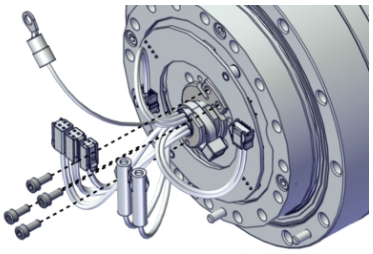
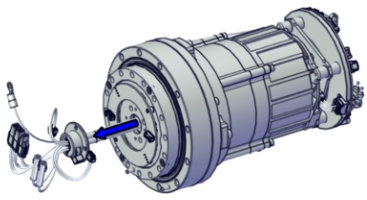
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	Action	Note
3	Cut the cable tie at the drive board.	 xx2000002058
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. • TQ.A • TQ.B	 xx2000002053

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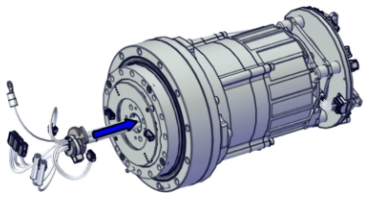
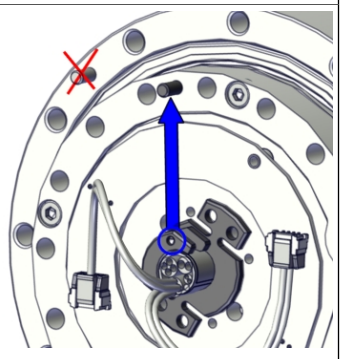
5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)
Continued

	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 unit

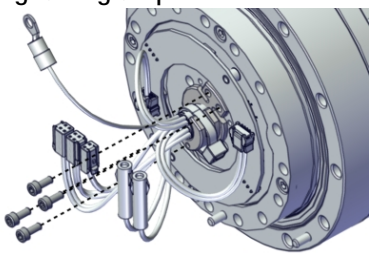
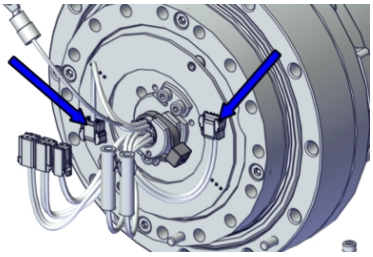
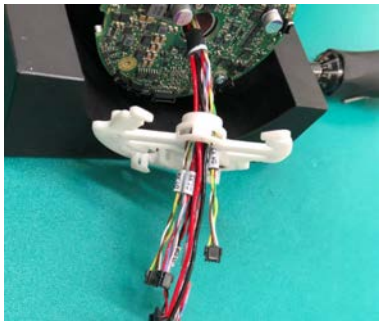
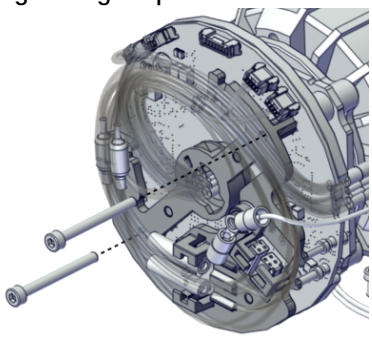
Use these procedures to refit the joint unit.

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 53*.	
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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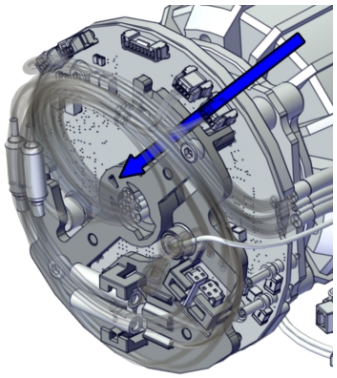
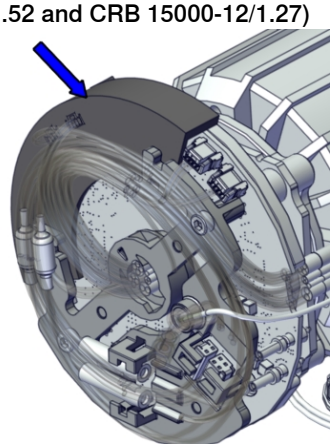
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	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000002049
5	Connect the two connectors to the torque sensor board. • 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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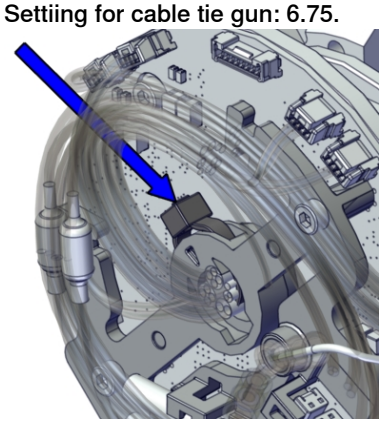
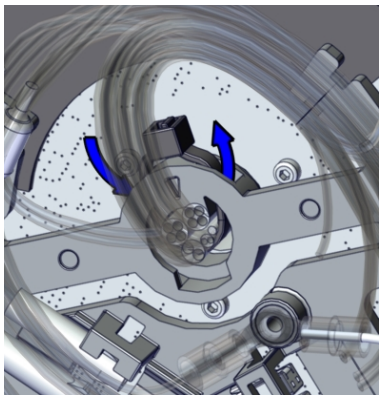
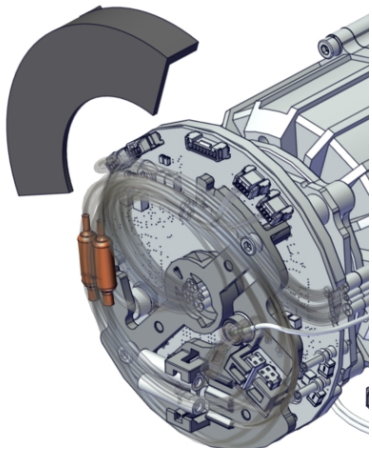
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5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)
Continued

	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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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	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 EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059
10	Remove the protection plate.	 xx2100000301

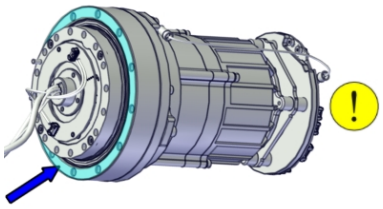
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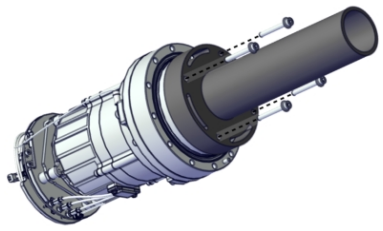
5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)

Continued

Preparations before fitting the joint unit (-5/0.95)

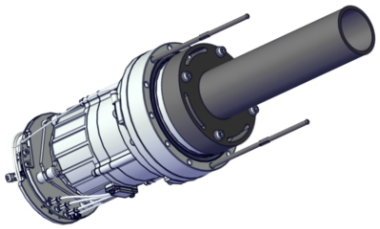
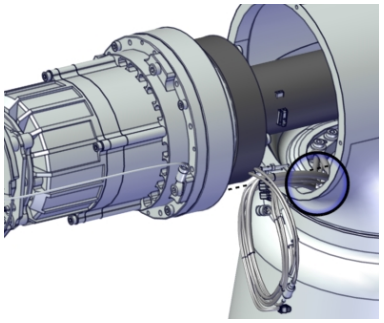
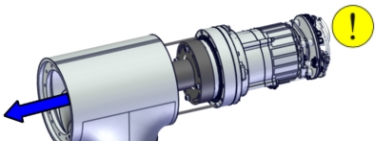
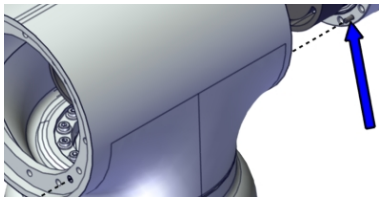
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  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 53*.	

Refitting the axis-2 joint unit (-5/0.95)

	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 53*.	
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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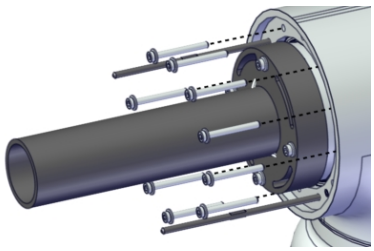
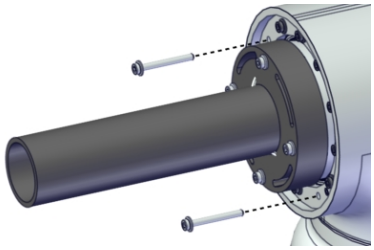
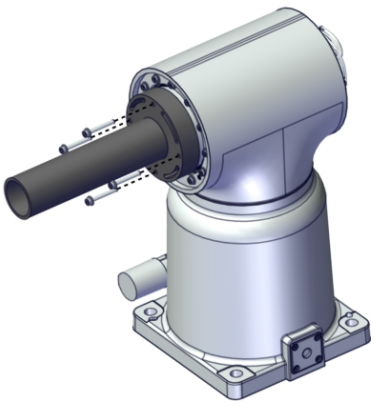
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	Action	Note
3	Fit two guide pins to the joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002438
4	Place 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
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

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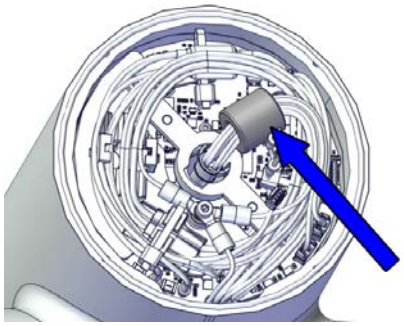
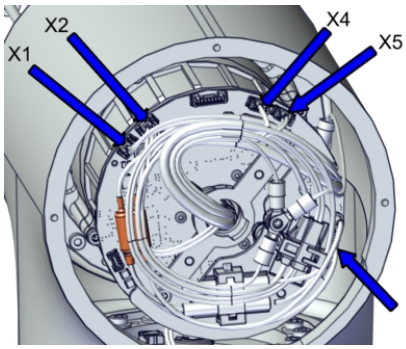
5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)
Continued

	Action	Note
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 Used for joint unit of CRB 15000-5/0.95. 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.
10	Remove the lifting aid by removing the screws.	 xx2000001956
11	Clean pushed-out flange sealant, if any.	

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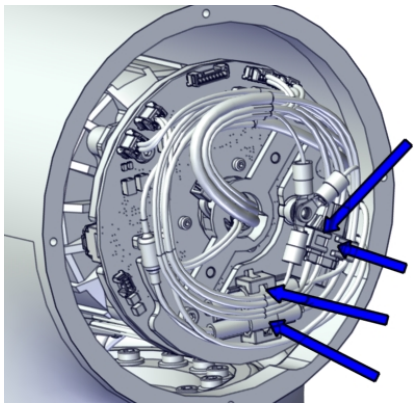
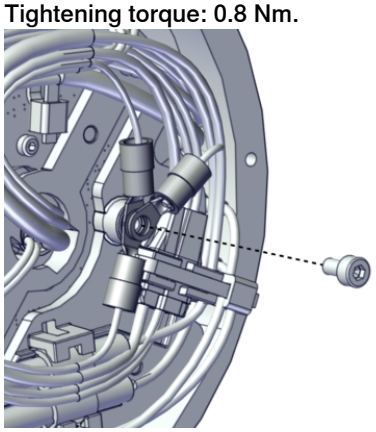
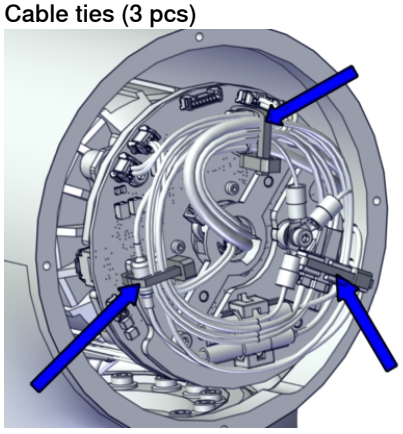
Connecting the axis-2 joint unit cabling

	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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

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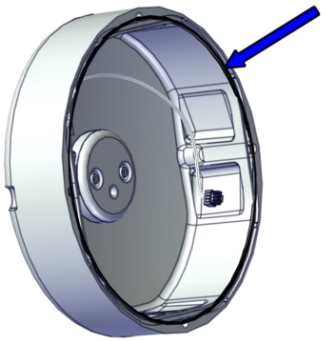
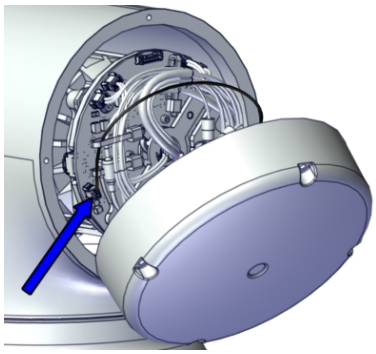
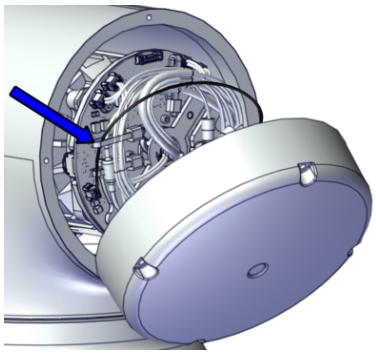
5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)
Continued

	Action	Note
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944
6	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
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

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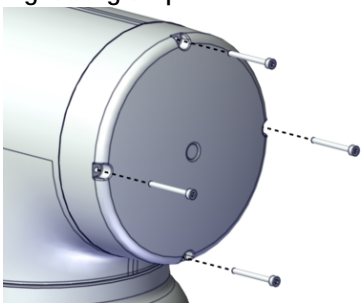
Refitting the swing cover(-5/0.95)

	Action	Note
1	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-047 (for CRB 15000-5/0.95)  xx2000001962
2	**For robots with RobotWare earlier than 7.10** 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	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000001931

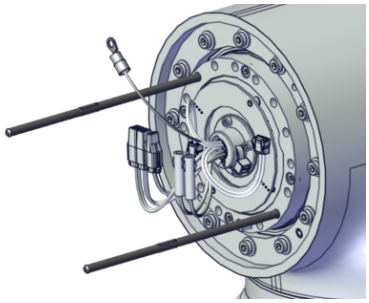
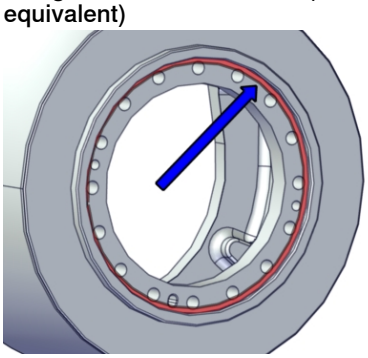
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5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)
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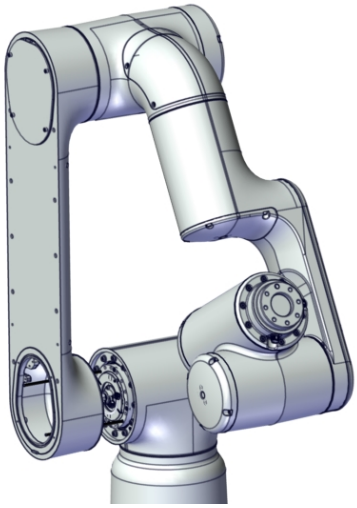
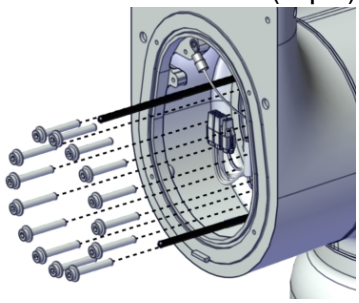
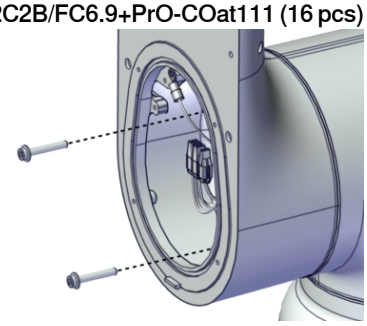
	Action	Note
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000001935

Refitting the lower and upper arm assembled (-5/0.95)

	Action	Note
1	Fit two guide pins to the axis-2 joint unit.	Guide pin, M4x120: 3HAC077786-001  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 (or equivalent)  xx2000001963
3	**CAUTION** The weight of the complete upper and lower arm together is 18 kg	

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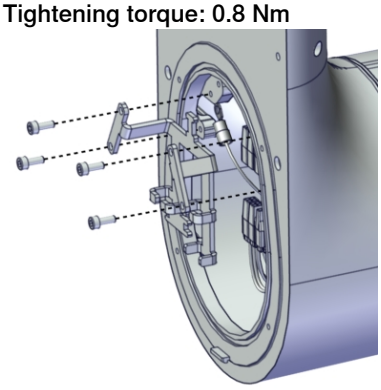
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	Action	Note
4	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	 xx2000001941
5	Secure the lower arm to the swing with all attachment screws but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	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

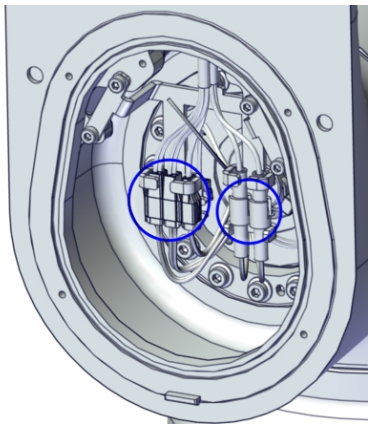
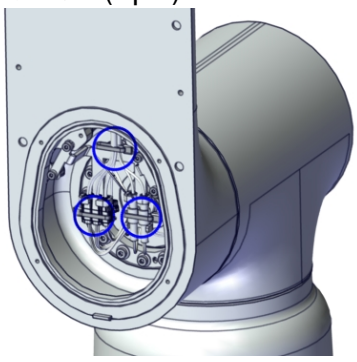
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5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)
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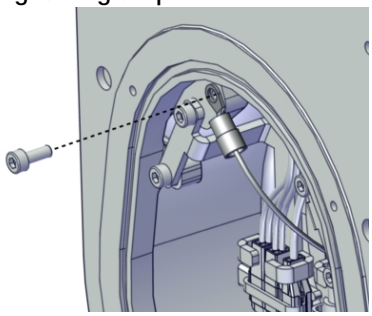
	Action	Note
8	Refit the cable bracket with four screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm  xx2000001939

Connecting the cabling between the lower arm and swing

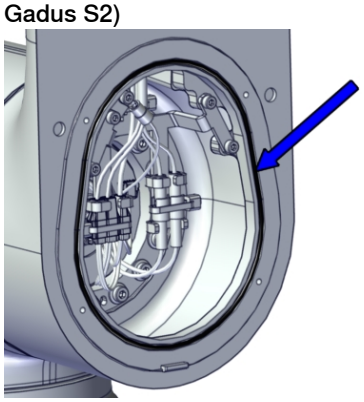
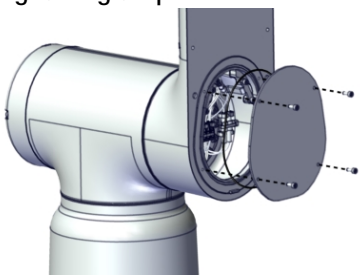
	Action	Note
1	Connect the connectors to each other and snap them to the cable holders.	 xx2000001938
2	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001937

Continues on next page

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	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

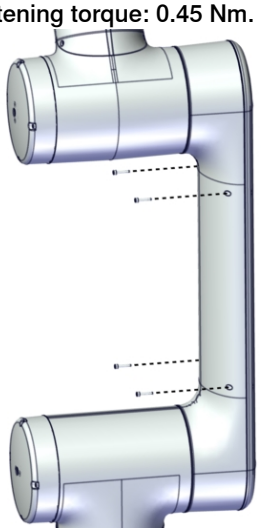
Refitting the lower arm covers (-5/0.95)

	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

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5.6.3 Replacing the axis-2 joint unit (CRB 15000-5/0.95)
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.  xx2000001929
4	Secure the cover with four screws.	

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.

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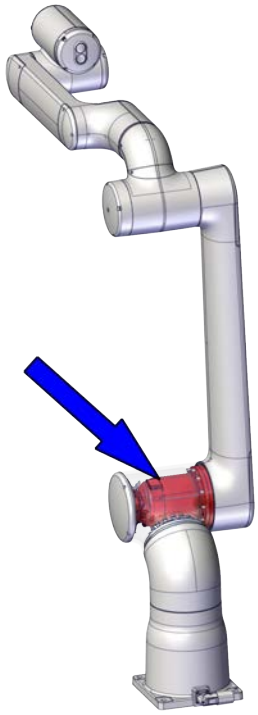
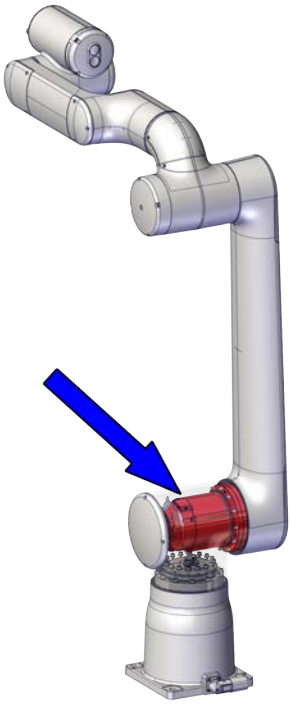
	Action	Note
2	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)

Location of the axis-2 joint unit

The joint unit is located as shown in the figure.

CRB 15000-10/1.52	CRB 15000-12/1.27
	
xx2300000765	xx2300000768

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. Loosen the base from the foundation and lay it down with the torque sensor side upwards.
5. Replace the joint unit. Move the cabling from old to new joint unit.

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*.

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Spare part	Article number	Note
Joint unit	3HAC087472-001	Used for CRB 15000-10/1.52 and CRB 15000-12/1.27. New O-rings 3HAC061327-044 and cable tie 3HAC075545-001 are included in the delivery.

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC087787-001	For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27. A plate, a beam, a pair of semicircular blocks and attachment screws M5x30 (2 pcs) are enclosed.
Guide pin, M5x125	3HAC087786-001	Always use guide pins in pairs. For joint units on axes 1 and 2 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Protection plate	3HAC087789-001	For protection of drive board during cabling installation on joint units of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cable ties	-	
O-ring	3HAC061327-044	Axis-1 and -2 joint unit, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-074	Swing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-075	Lower arm, lower inner cover of CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.

Removing the joint unit

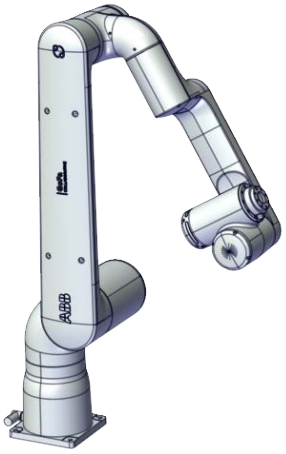
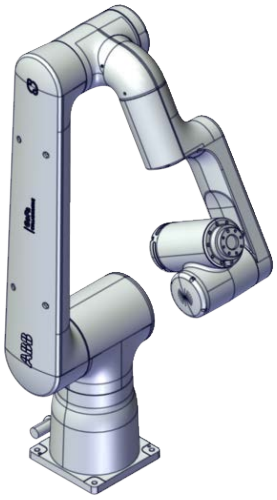
Use these procedures to remove the joint unit.

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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

Preparations before removing the joint unit

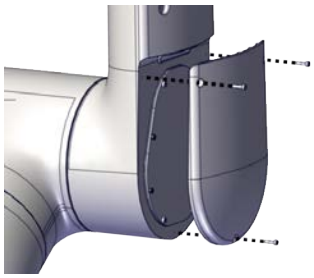
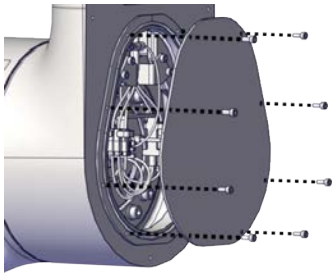
	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 0° (home position) • Axis 3: +60° • Axis 4: 0° • Axis 5: -90° • Axis 6: No significance. **CAUTION** Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.	**Valid for CRB 15000-10/1.52**  xx2300001062 **Valid for CRB 15000-12/1.27**  xx2300001063
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the lower arm covers (-10/1.52 and -12/1.27)

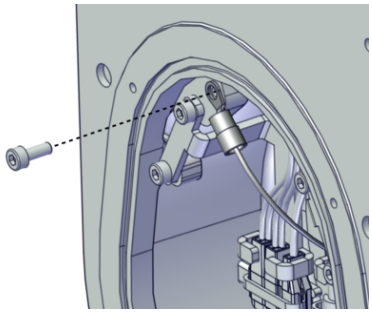
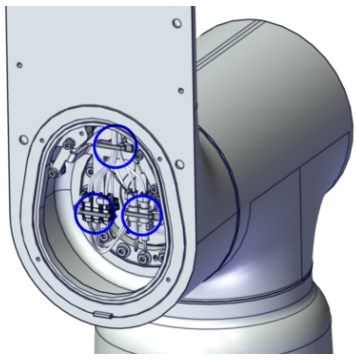
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	

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	Action	Note
2	Remove the lower cover of lower arm by removing the screws.	 xx2300000812
3	Remove the lower inner cover by removing the screws.	 xx2300000813

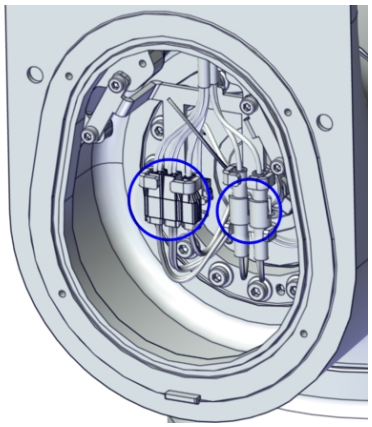
Disconnecting the cabling between the lower arm and the swing

	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001936
2	Cut the cable ties.	 xx2000001937

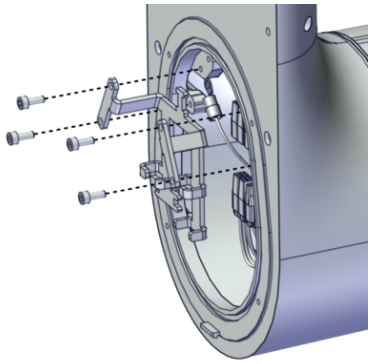
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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

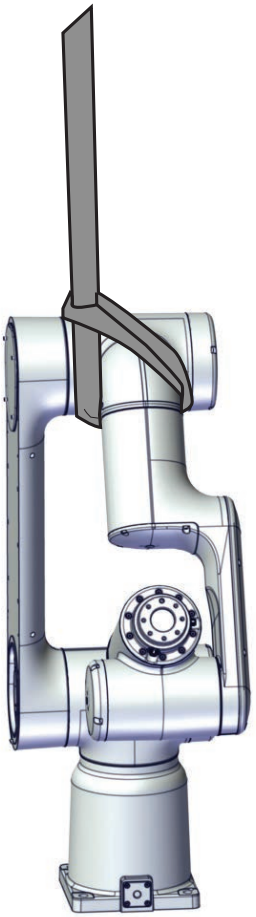
	Action	Note
3	Snap loose and disconnect all connectors.	 xx2000001938

Removing the lower and upper arm assembled

	Action	Note
1	Remove the cable bracket by removing the four screws.	 xx2000001939

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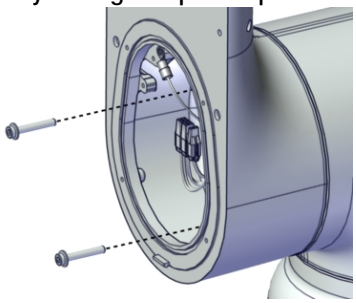
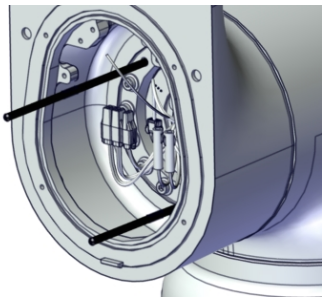
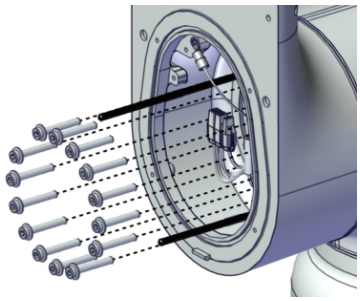
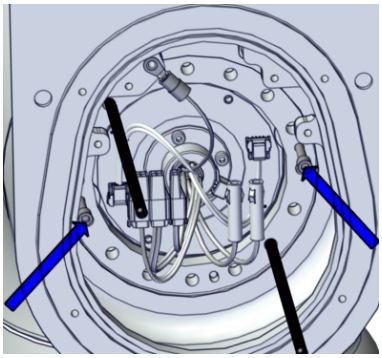
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	Action	Note
2	Secure the weight of the upper and lower arm. **CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	Suggestion with lifting sling and an overhead crane. Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000294

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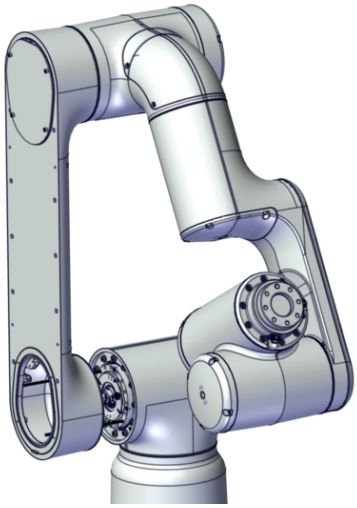
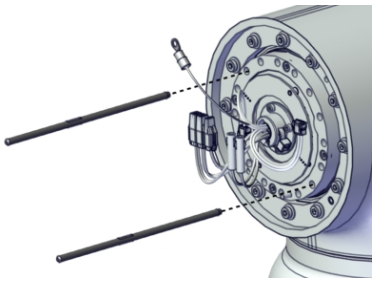
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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

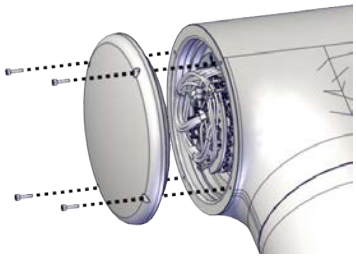
	Action	Note
3	Remove two attachment screws and fit two guide pins to the axis-2 joint unit. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins in pairs.  xx2000001951  xx2000001960
4	Remove the lower arm attachment screws. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	 xx2000001940
5	Use two fully threaded attachment screws as removal tools to press the lower arm out of position.	 xx2000002151

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

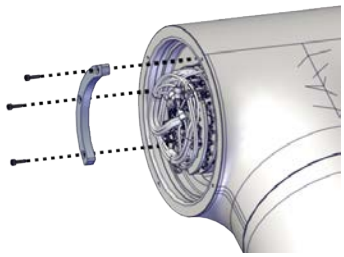
Removing the swing cover and insert (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000814

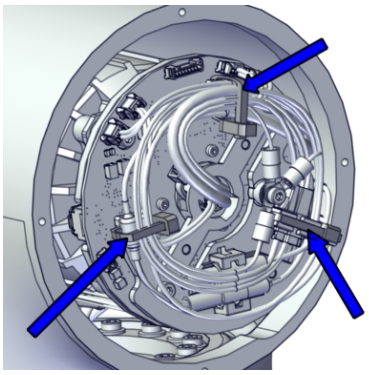
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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

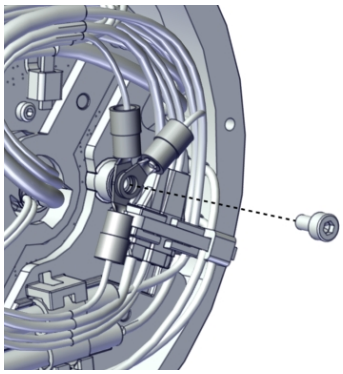
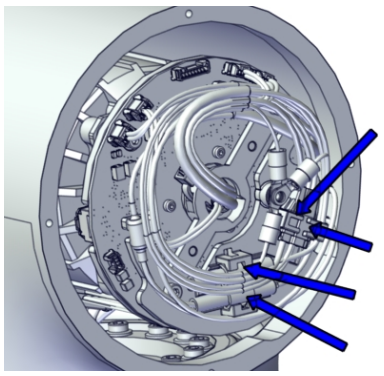
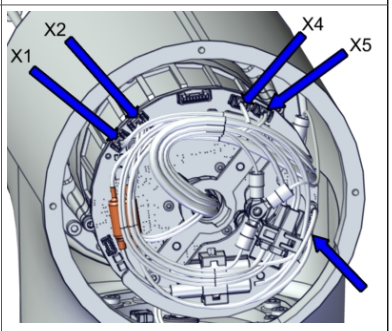
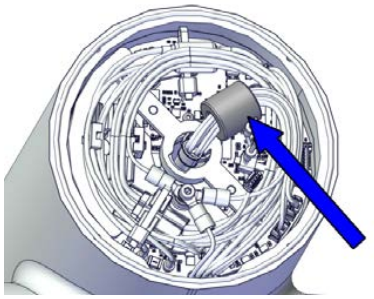
	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	Remove the insert.	 xx2300000815

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 53*.	
2	Cut the cable ties.	 xx2000001946

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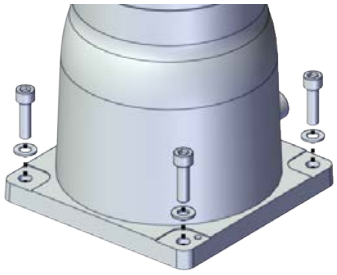
	Action	Note
3	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
4	Snap loose and disconnect the connectors: • J2.DC+ • J2.DC- • J2.CS • J2.CP	 xx2000001944
5	Disconnect the connectors from the drive board. • D2.X1 from X1 • D2.DC+ from DC+ • D2.DC- from ground • D2.X4 from X4 • D2.X2 from X2 • D2.X5 from X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002013
6	Remove the ferrite core by pulling the cables D2.X4 and D2.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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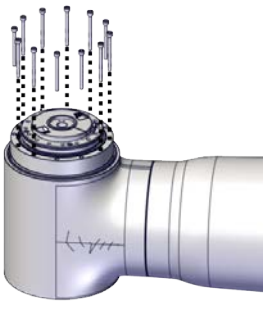
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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

Removing the base from foundation (-10/1.52 and -12/1.27)

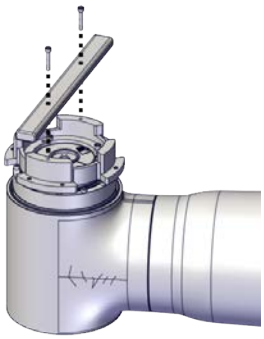
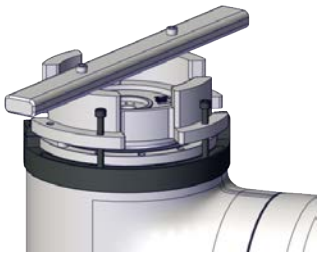
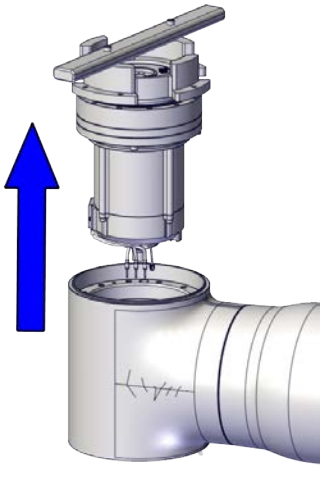
	Action	Note
1	**CAUTION** The weight of the complete swing and base together is up to 25 kg	
2	**WARNING** Personnel must not, under any circumstances, be present under the suspended load.	
3	Loosen the robot base from the foundation by removing the foundation attachment screws.	 xx2300001060
4	Lay the robot down with the torque sensor side upwards on a working bench. Do not damage the base socket. Caution with the cabling. **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.	

Removing the axis-2 joint unit

	Action	Note
1	Removing the attachment screws.	 xx2300000786

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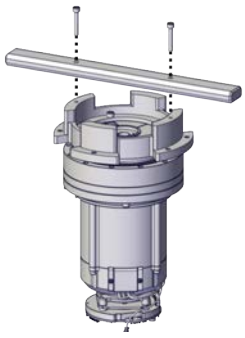
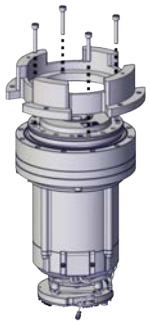
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	Action	Note
2	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000787  xx2300000788
3	Place the two semicircular blocks surrounding the joint unit, and use two fully threaded attachment screws as removal tools to press the joint unit out of position.	 xx2300000789
4	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.	 xx2300000790

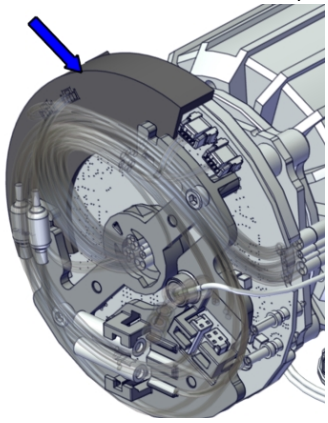
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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

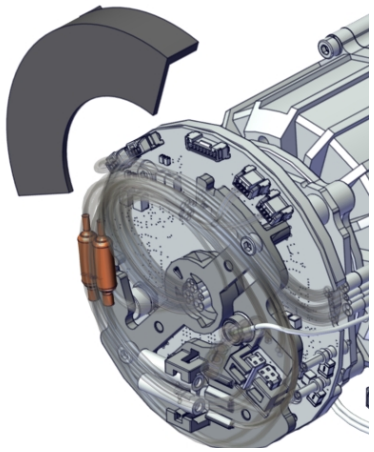
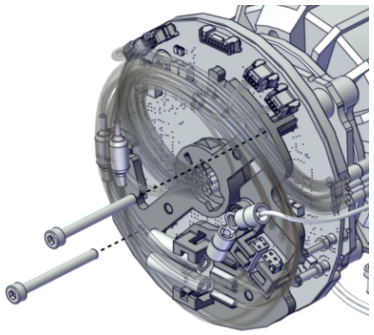
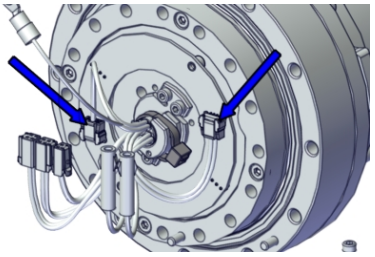
	Action	Note
5	Remove the lifting aid.	 xx2300000778  xx2300000776

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 53*.	
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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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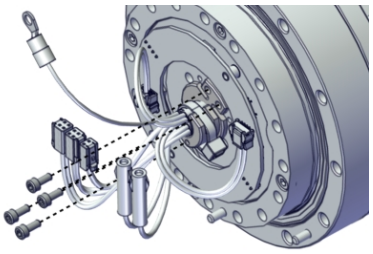
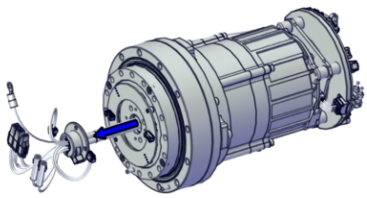
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	Action	Note
3	Cut the cable tie at the drive board.	 xx2000002058
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. • TQ.A • TQ.B	 xx2000002053

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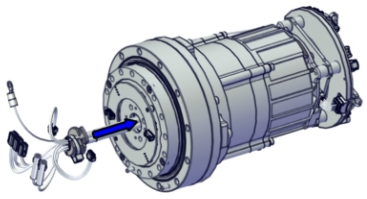
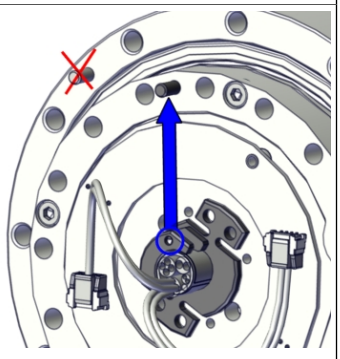
5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

	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 unit

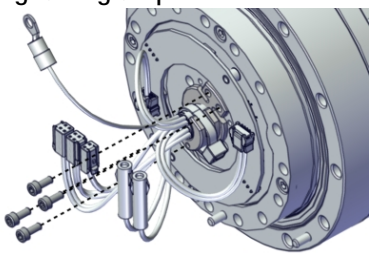
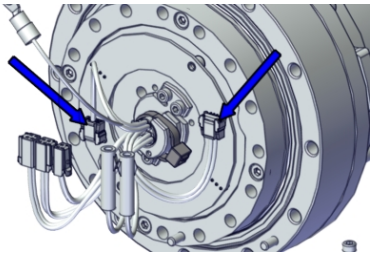
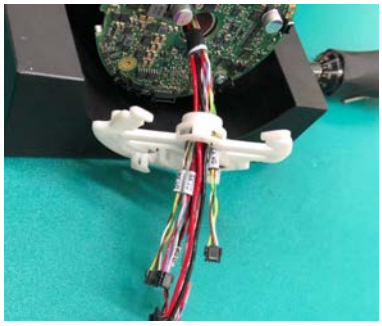
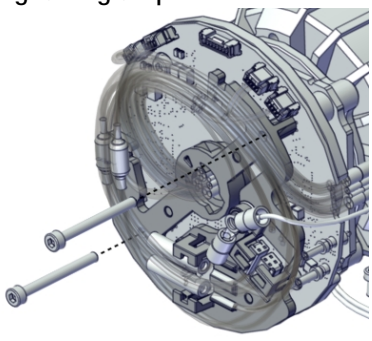
Use these procedures to refit the joint unit.

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 53*.	
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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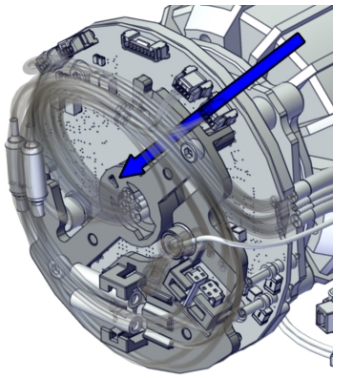
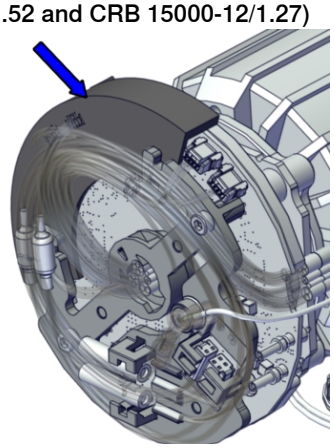
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	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000002049
5	Connect the two connectors to the torque sensor board. • 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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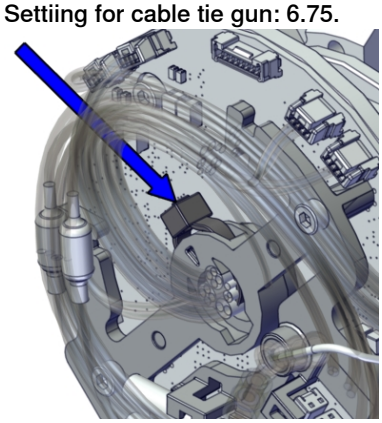
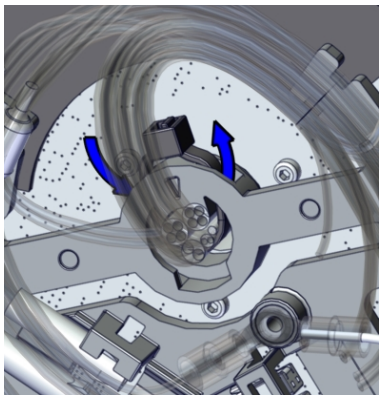
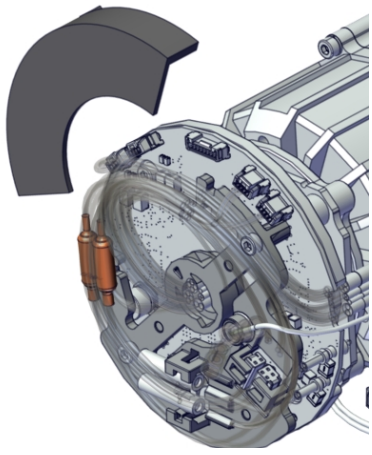
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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

	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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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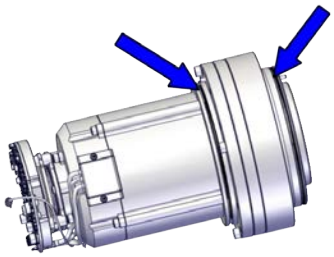
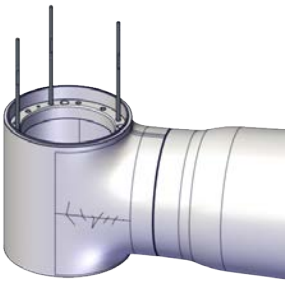
	Action	Note
9	Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.	Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059
10	Remove the protection plate.	 xx2100000301

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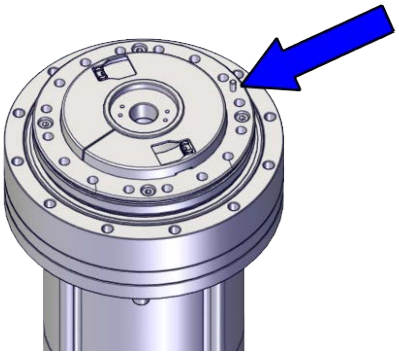
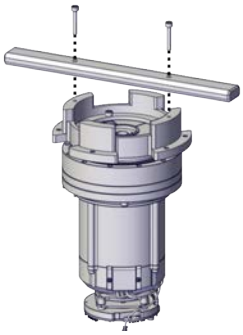
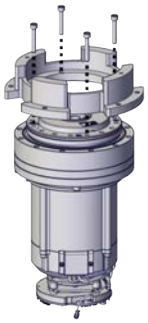
5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

Refitting the axis-2 joint unit (-10/1.52 and -12/1.27)

	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 53*.	
2	Check the o-rings. Replace if damaged.	O-ring: 3HAC061327-044  xx2300000823
3	Fit three guide pins to the swing.	Guide pin, M5x125: 3HAC087786-001 Always use guide pins together.  xx2300000791

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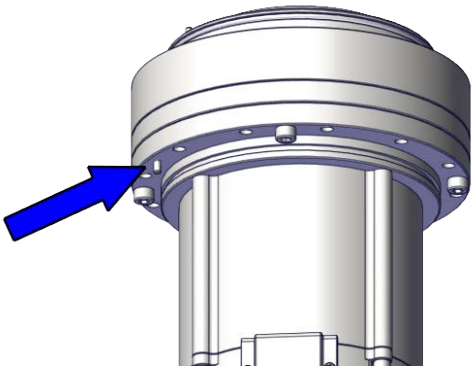
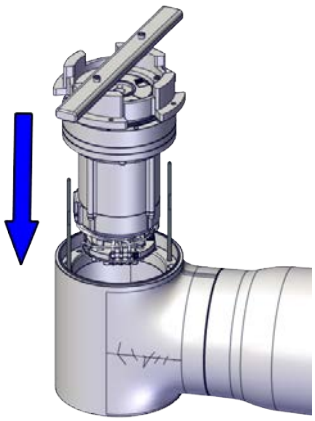
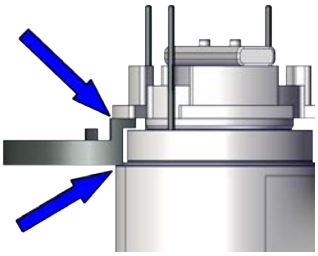
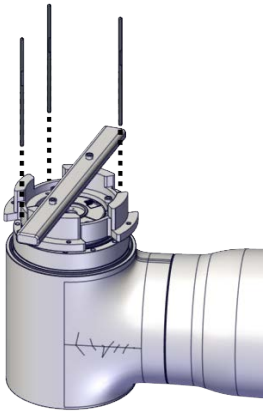
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	Action	Note
4	Fit the lifting aid to the joint unit, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.  xx2300000777	Joint unit: 3HAC087472-001 Lifting aid: 3HAC087787-001 Screws: M5x30 (4 pcs for plate and 2 pcs for beam)  xx2300000778  xx2300000776
5	Place the axis-1 cabling properly to avoid squeezing by the joint unit when putting the joint unit into 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.	

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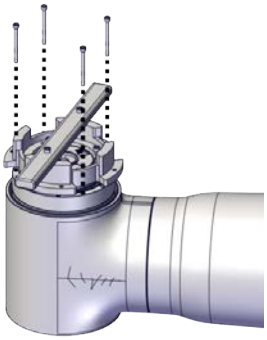
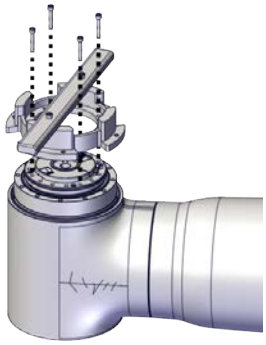
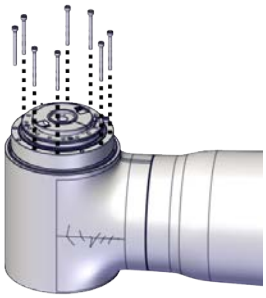
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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

	Action	Note
6	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.  xx2300000780	 xx2300000792
7	Check the joint unit position by placing the higher boss of one semicircular block between the lifting aid and swing. The joint unit is properly placed when no gaps between the block and both lifting aid and swing.	 xx2300000794
8	Remove the guide pins.	 xx2300000795

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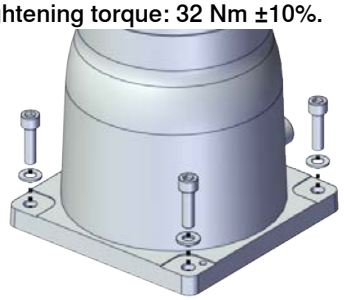
	Action	Note
9	Secure with four attachment screws and pre-tighten the screws crosswise.	 xx2300000796
10	Remove the lifting aid by removing the screws.	 xx2300000797
11	Secure the joint unit with the remaining attachment screws.	Hex socket head cap screw: 3HAB3409-20  xx2300000798
12	Torque tighten all screws crosswise.	M5x55 12.9 Lafre 2C2B/FC6.9, 12 pcs Tightening torque: 8.2 Nm.

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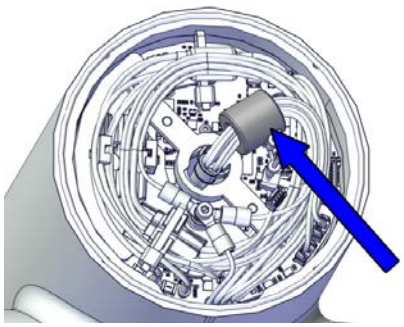
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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

Securing the base (-10/1.52 and -12/1.27)

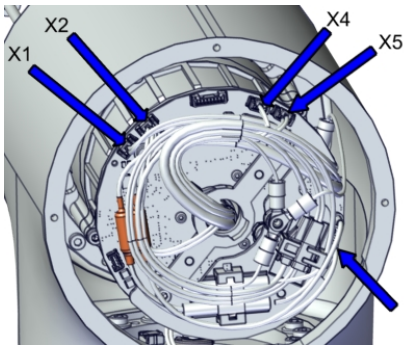
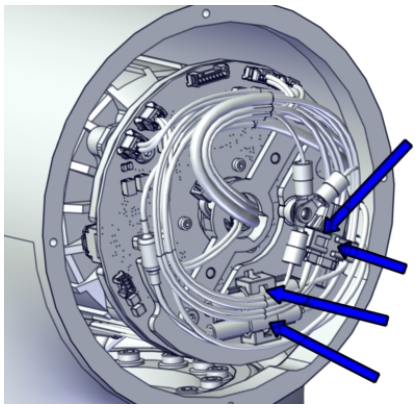
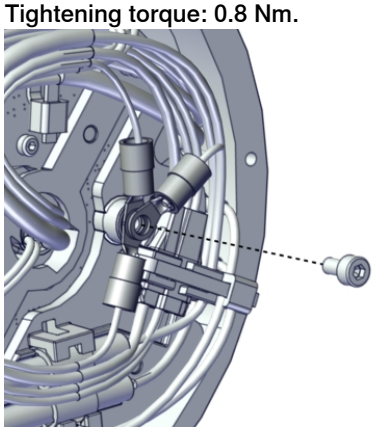
	Action	Note
1	Lift the base to standing and secure it to the foundation with the attachment screws and washers.	Attachment screws: M10x35 8.8 (4 pcs). Washers: 23/10.5/2.5 mm Steel (4 pcs). Tightening torque: 32 Nm ±10%.  xx2300001060

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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D2.X4 and D2.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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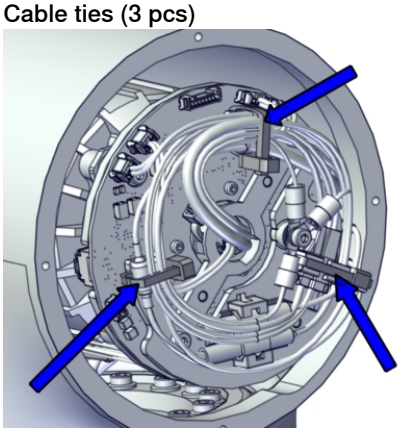
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	Action	Note
4	Reconnect the connectors to the drive board. • D2.X1 to X1 • D2.DC+ to DC+ • D2.DC- to Ground • D2.X4 to X4 • D2.X2 to X2 • D2.X5 to X5	 xx2000002013
5	Connect the connectors to each other and snap them to the cable holders. • J2.DC+ to J2.DC+ • J2.DC- to J2.DC- • J2.CS to J2.CS • J2.CP to J2.CP	 xx2000001944
6	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

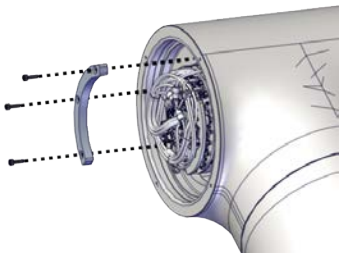
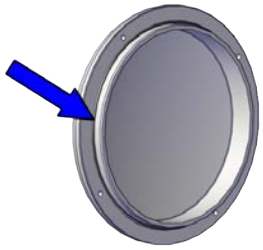
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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

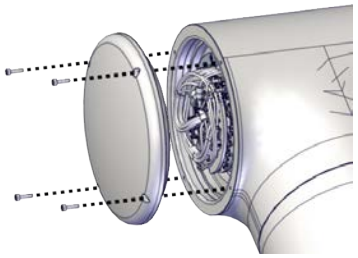
	Action	Note
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000001946

Refitting the swing cover and insert(-10/1.52 and -12/1.27)

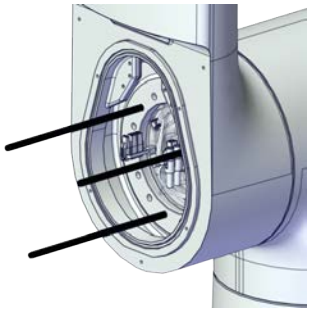
	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000815
2	Fit the o-ring to cover groove. Replace if damaged.	O-ring: 3HAC061327-074 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2300000816

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	Action	Note
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000814

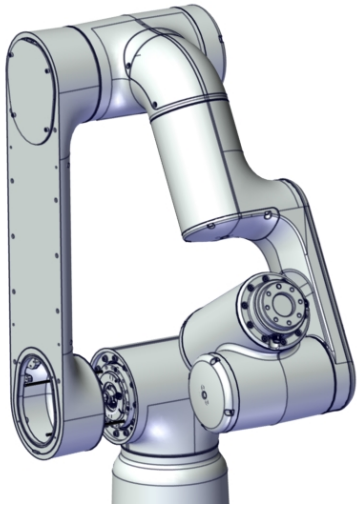
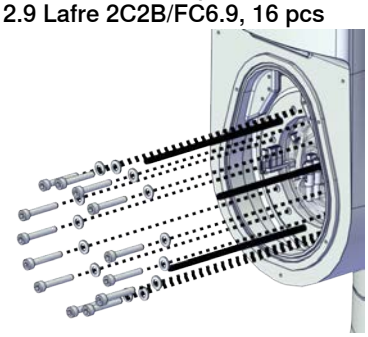
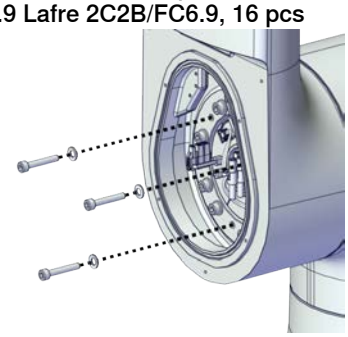
Refitting the lower and upper arm assembled (-10/1.52 and -12/1.27)

	Action	Note
1	Fit three guide pins to the axis-2 joint unit.	Guide pin, M5x125: 3HAC087786-001  xx2300001021
2	**CAUTION** The weight of the complete upper and lower arm together is up to 26 kg	

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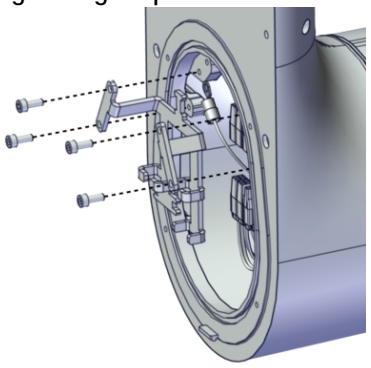
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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

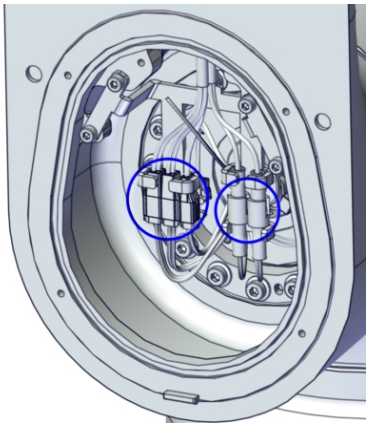
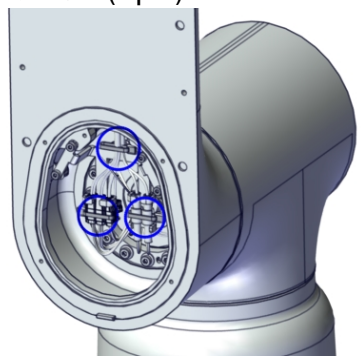
	Action	Note
3	Lift the upper and lower arm assembly to mounting position and slide it onto the guide pins.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000001941
4	Secure the lower arm to the swing with all screws and washers but two. Pre-tighten the screws crosswise firstly. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001022
5	Remove the guide pins and fasten the remaining two screws and washers. **CAUTION** Do not mix the flange screws used for CRB 15000-5/0.95 and the threaded screws used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Always use washers together with the threaded screws for CRB 15000-10/1.52 and CRB 15000-12/1.27. Illustration is for reference only.	Hex socket head cap screw: M5x30 12.9 Lafre 2C2B/FC6.9, 16 pcs  xx2300001023
6	Torque tighten all screws crosswise.	Tightening torque: 8.2 Nm

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	Action	Note
7	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

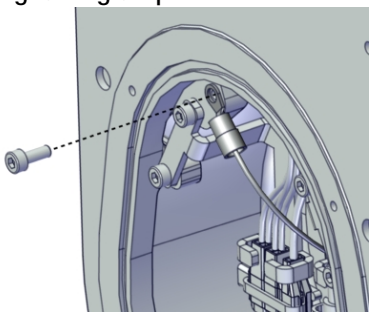
Connecting the cabling between the lower arm and swing

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

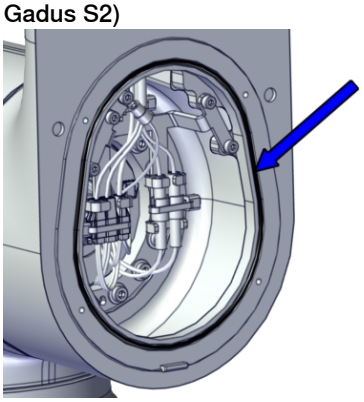
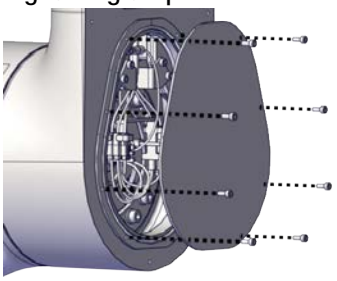
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5.6.4 Replacing the axis-2 joint unit (CRB 15000-10/1.52 and CRB 15000-12/1.27)
Continued

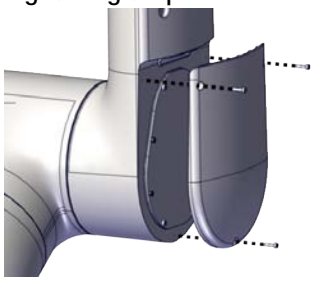
	Action	Note
3	Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001936

Refitting the lower arm covers (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-075 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.  xx2300000813

Continues on next page

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	Action	Note
3	Refit the lower cover of lower arm with three screws.	Lower arm cover, lower: Lower arm, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Tightening torque: 1.4 Nm.  xx2300000812

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

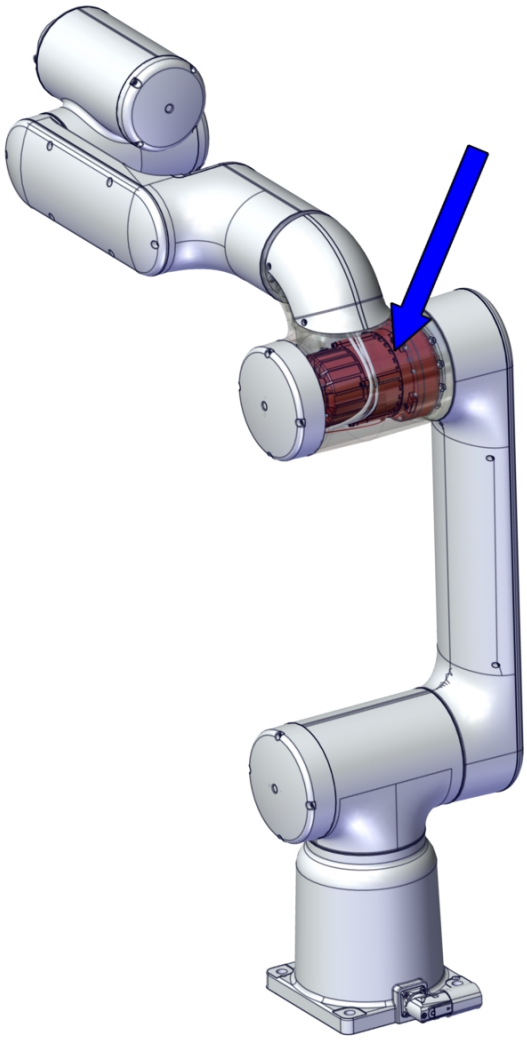
	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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5.6.5 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

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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Joint unit	3HAC079141-001	Used for CRB 15000-5/0.95. New attachment screws and cable tie 3HAC075545-001 are included in the delivery. Used for CRB 15000-5/0.95.
Joint unit	3HAC087474-001	Used for CRB 15000-10/1.52 and CRB 15000-12/1.27. New O-ring 3HAC061327-036 and cable tie 3HAC075545-001 are included in the delivery.
Ferrite core	3HAC092224-001	

Required tools and equipment

Equipment	Article number	Note
Lifting aid	3HAC077788-001	For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95. Attachment screws M4x35 (4 pcs) are enclosed.
Lifting aid	3HAC087788-001	For joint unit on axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Guide pin, M4x120	3HAC077786-001	Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Protection plate	3HAC077790-001	For protection of drive board during cabling installation on joint units of CRB 15000-5/0.95.
Protection plate	3HAC087789-001	For protection of drive board during cabling installation on joint units of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol

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5.6.5 Replacing the axis-3 joint unit
Continued

Consumable	Article number	Note
Flange sealant	-	Loctite 574 (or equivalent)
Cable ties	-	
O-ring	3HAC061327-036	Axis-3 joint unit, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-047	Housing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-044	Lower arm, inner cover of CRB 15000-5/0.95. 1 pcs / cover. Replace if damaged.
O-ring	3HAC061327-044	Lower arm, upper inner cover of CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.

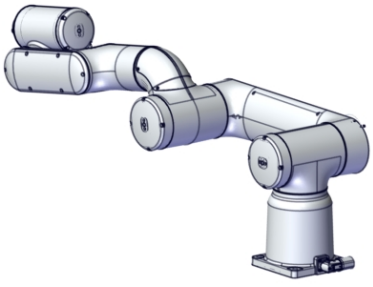
Removing the joint unit

Use these procedures to remove the joint unit.

Note

If the RobotWare version is older than 7.10, then create a backup of the system before replacing the joint unit. After the replacement, the software must be upgraded to version 7.10 or later.

Preparations before removing the joint unit

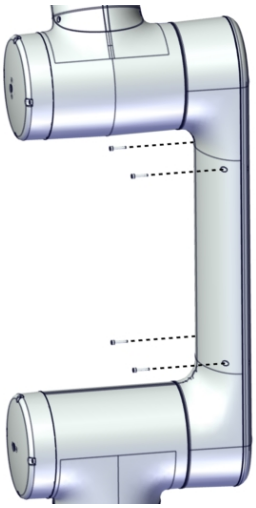
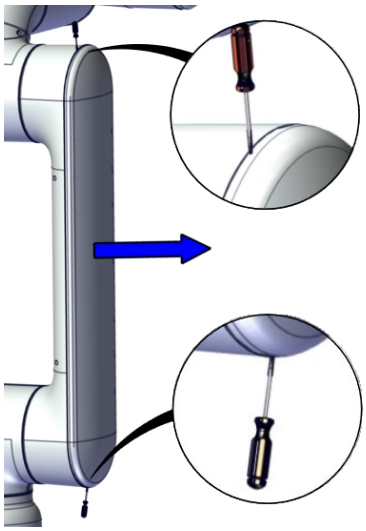
	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: +90° (suggested position for convenient working position) • Axis 3: -80° (home position) • Axis 4: 0° • Axis 5: 0° • Axis 6: 0° **CAUTION** Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000002

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	Action	Note
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

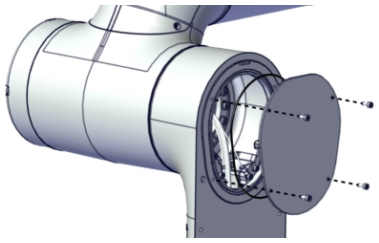
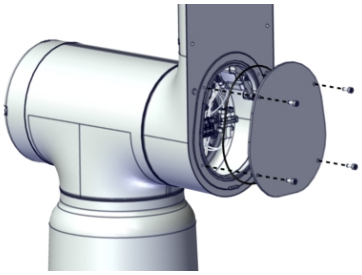
Removing the lower arm covers (-5/0.95)

	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

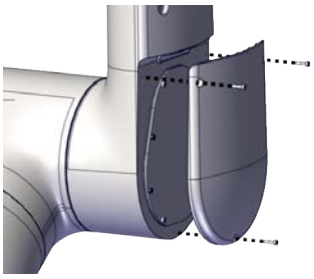
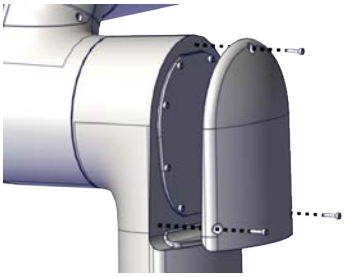
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5.6.5 Replacing the axis-3 joint unit
Continued

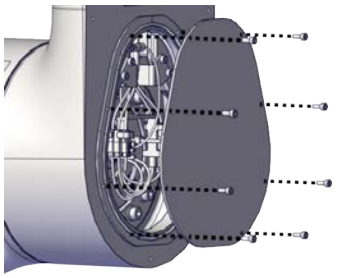
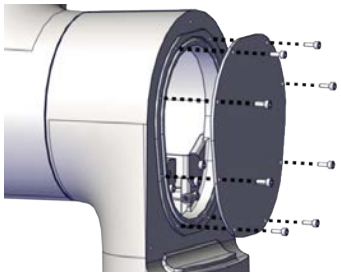
	Action	Note
4	Remove the inner covers by removing the screws.	 xx2000001947  xx2000001930

Removing the lower arm covers (-10/1.52 and -12/1.27)

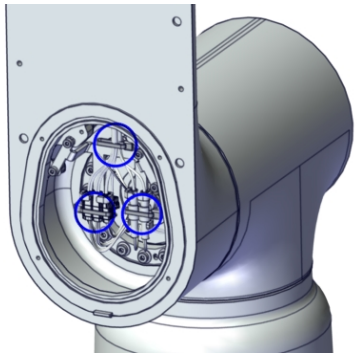
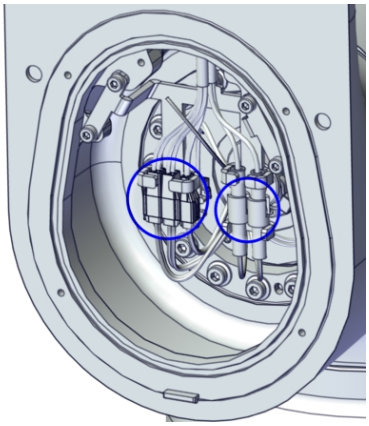
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the lower arm covers by removing the screws.	 xx2300000812  xx2300000829

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	Action	Note
3	Remove the inner covers by removing the screws.	 xx2300000813  xx2300000830

Disconnecting the upper arm cabling

	Action	Note
1	Cut the cable ties.	 xx2000001937
2	Snap loose and disconnect all connectors.	 xx2000001938

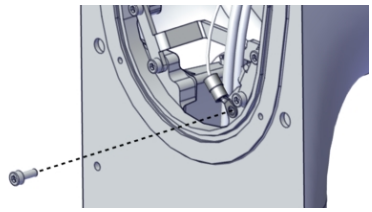
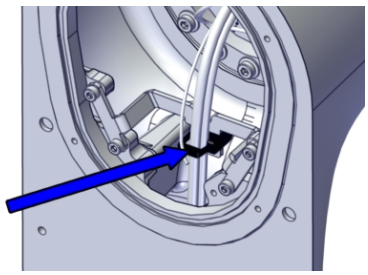
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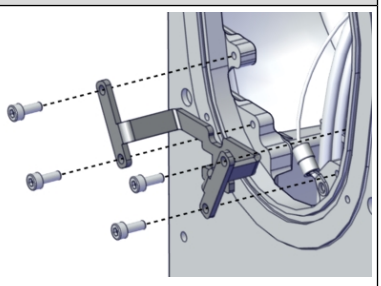
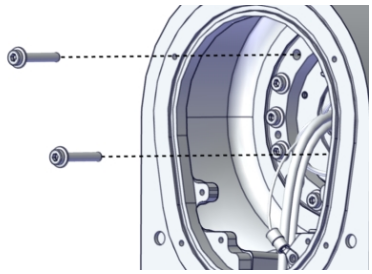
5.6.5 Replacing the axis-3 joint unit

Continued

Loosening the cabling between the lower and upper arm

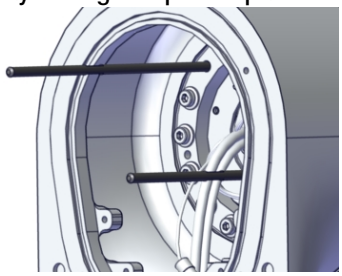
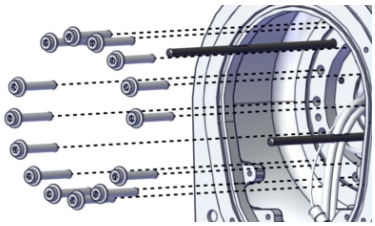
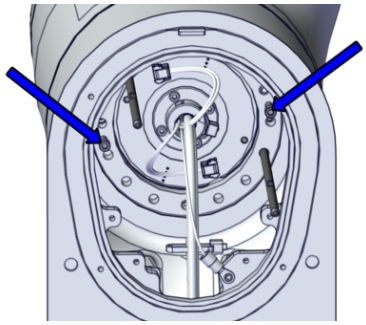
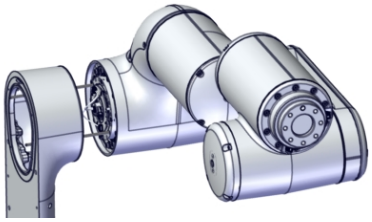
	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000001964
2	Cut the cable tie.	 xx2000001965

Removing the upper arm

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

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	Action	Note
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
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 (-5/0.95)

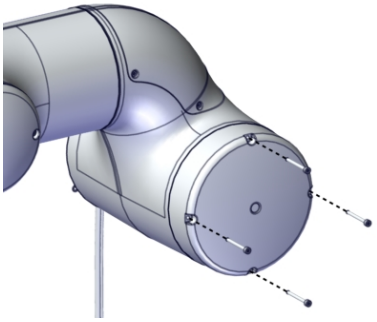
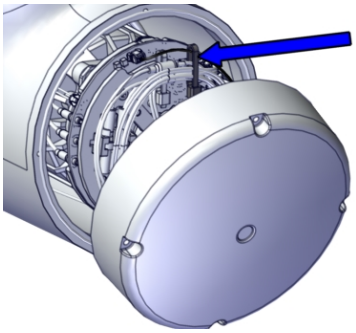
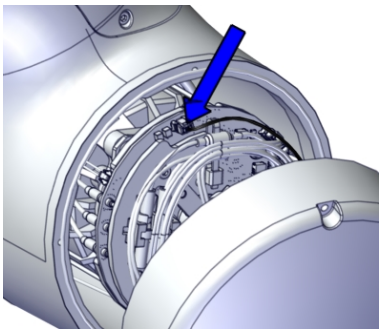
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	

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5.6.5 Replacing the axis-3 joint unit

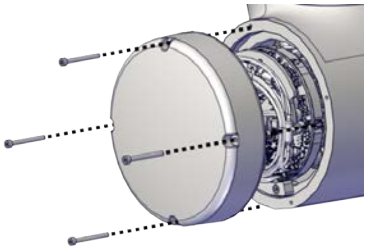
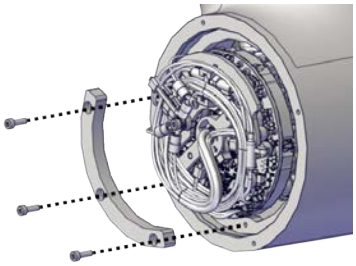
Continued

	Action	Note
2	Remove the cover screws.	 xx2000002021
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002022
5	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002023

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Removing the housing cover and insert (-10/1.52 and -12/1.27)

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000833
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	Remove the insert.	 xx2300000834

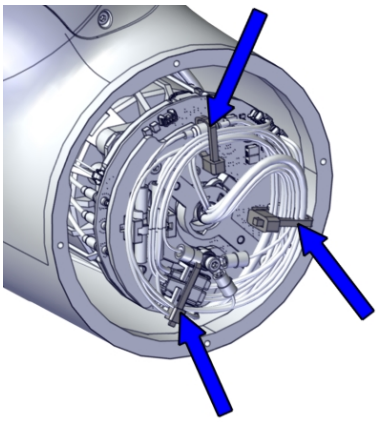
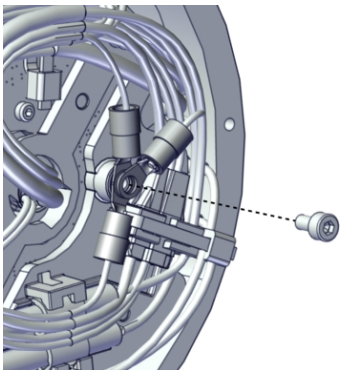
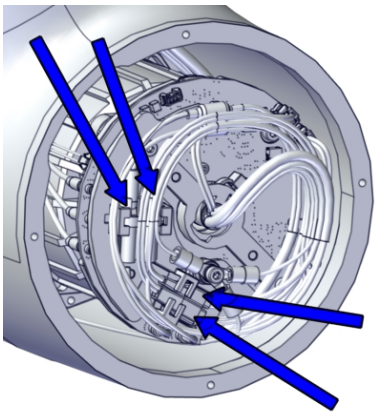
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5.6.5 Replacing the axis-3 joint unit

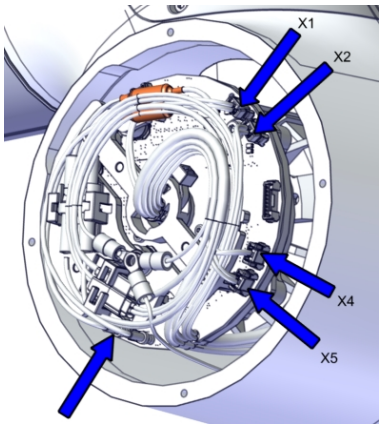
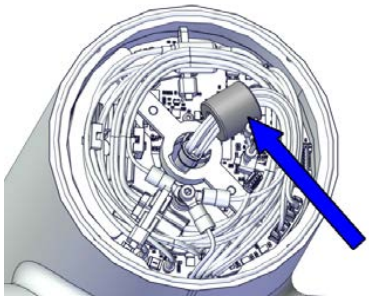
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Disconnecting the axis-3 joint unit cabling

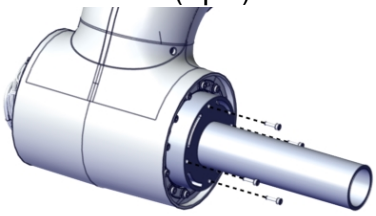
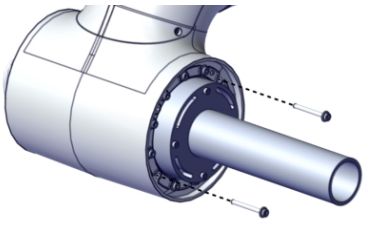
	Action	Note
1	Cut the cable ties.	 xx2000002066
2	Remove the functional and protective earth cables by removing the screw.	 xx2000001945
3	Snap loose and disconnect the connectors: • J4.DC+ • J4.DC- • J4.CS • J4.CP	 xx2000002067

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	Action	Note
4	Disconnect the connectors from the drive board. • D3.X1 • D3/4.DC+ • D3/4.DC- • D3.X4 • D3/4.X2 • D3.X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	 xx2000002068
5	Remove the ferrite core by pulling the cables D3.X4 and D3.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-3 joint unit (-5/0.95)

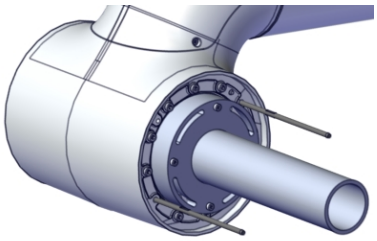
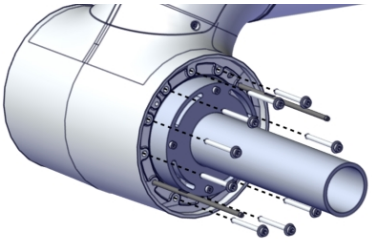
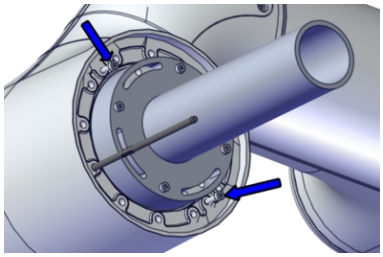
	Action	Note
1	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077788-001 Screws: M4x35 (4 pcs)  xx2000002069
2	Remove two attachment screws. Dispose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

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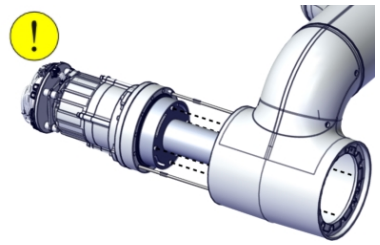
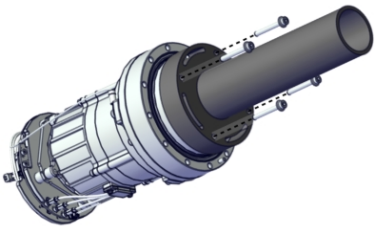
5.6.5 Replacing the axis-3 joint unit

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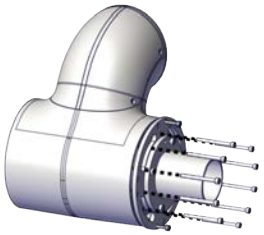
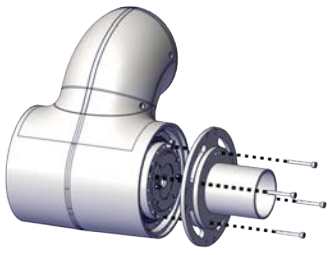
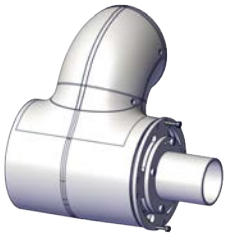
	Action	Note
3	Fit two guide pins to the axis-3 joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002576
4	Remove the remaining attachment screws. Use two screws 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

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

Removing the axis-3 joint unit (-10/1.52 and -12/1.27)

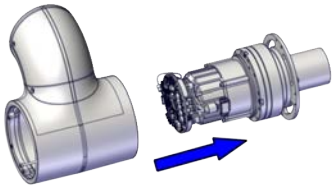
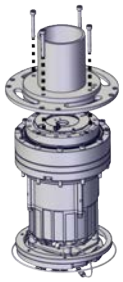
	Action	Note
1	Remove the attachment screws.	 xx2300000799
2	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC087788-001 Screws: M4x30 (4 pcs)  xx2300000800
3	Use two fully attachment screws as removal tools to press the joint unit out of position.	 xx2300000801

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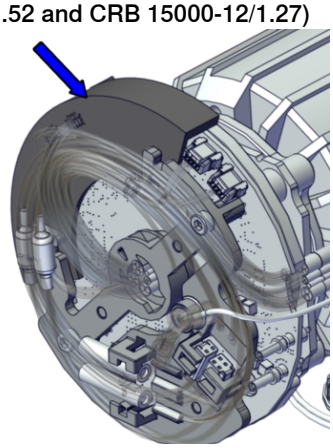
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5.6.5 Replacing the axis-3 joint unit

Continued

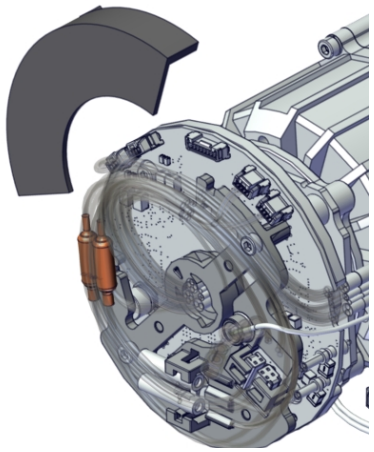
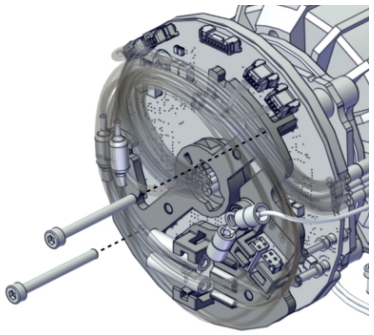
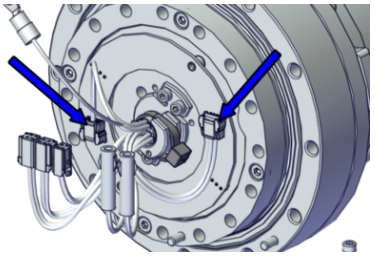
	Action	Note
4	Remove the joint unit from the housing. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2300000802
5	Remove the lifting aid.	 xx2300000804

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 53*.	
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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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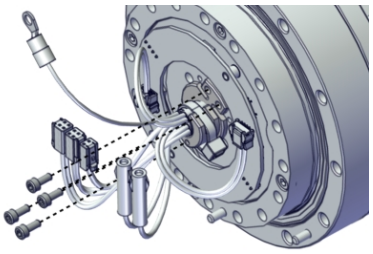
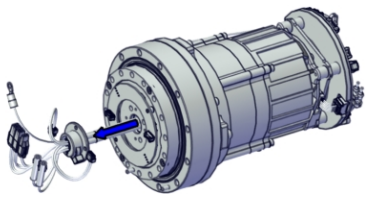
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	Action	Note
3	Cut the cable tie at the drive board.	 xx2000002058
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. • TQ.A • TQ.B	 xx2000002053

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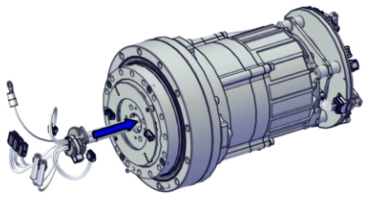
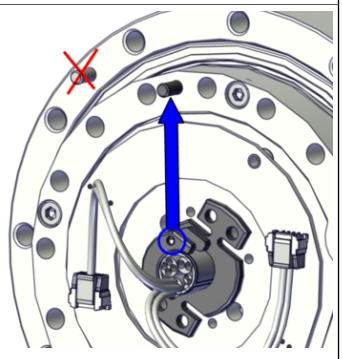
5.6.5 Replacing the axis-3 joint unit
Continued

	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 unit

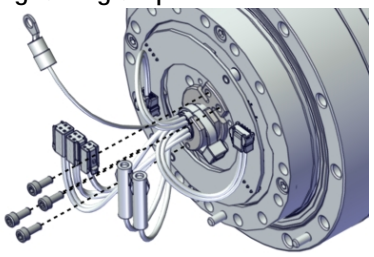
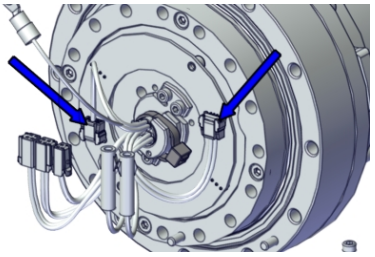
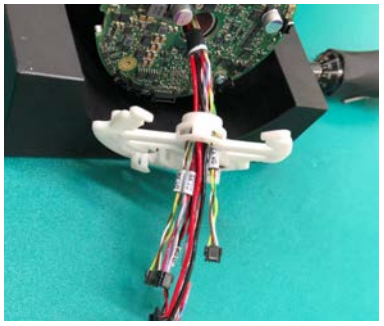
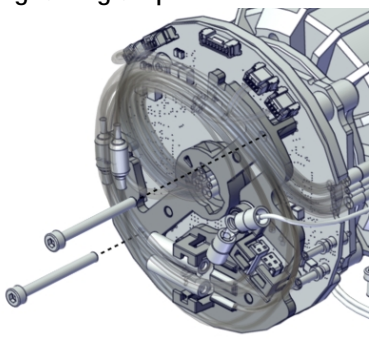
Use these procedures to refit the joint unit.

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 53*.	
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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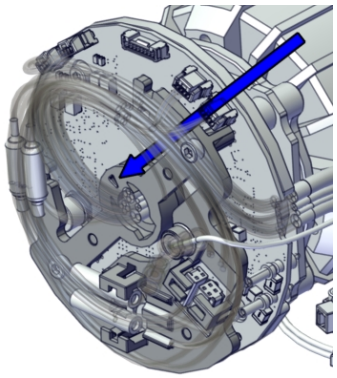
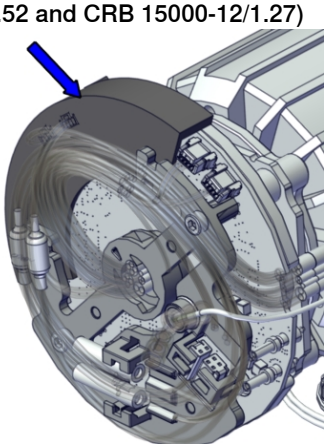
	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000002049
5	Connect the two connectors to the torque sensor board. • TQ.A to CH1/A • TQ.B to CH2/B	 xx2000002053
6	Insert 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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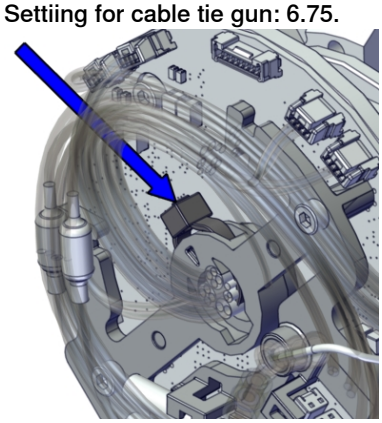
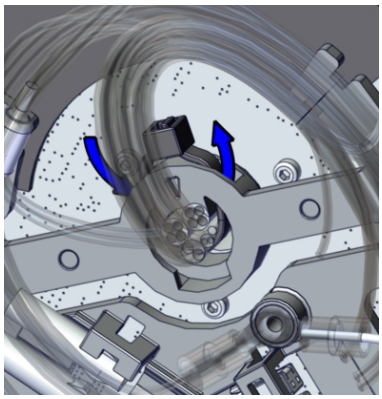
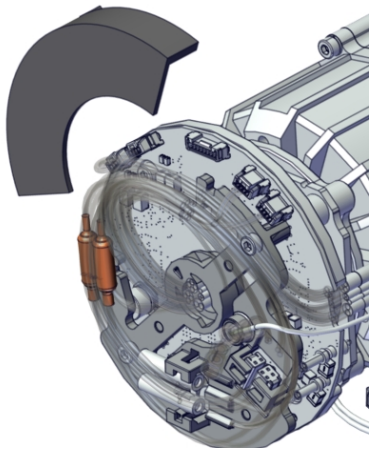
5.6.5 Replacing the axis-3 joint unit

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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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	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 EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059
10	Remove the protection plate.	 xx2100000301

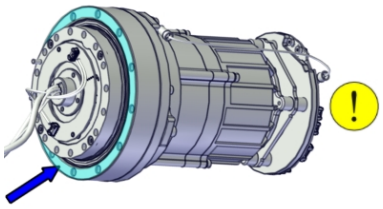
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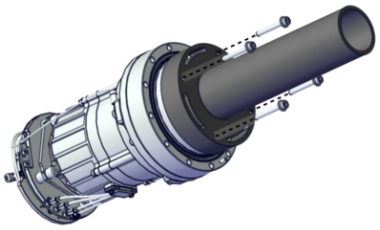
5.6.5 Replacing the axis-3 joint unit

Continued

Preparations before fitting the joint unit (-5/0.95)

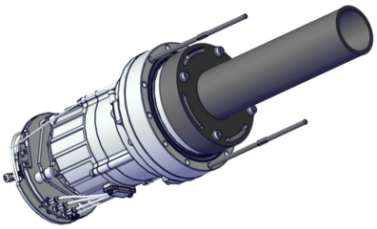
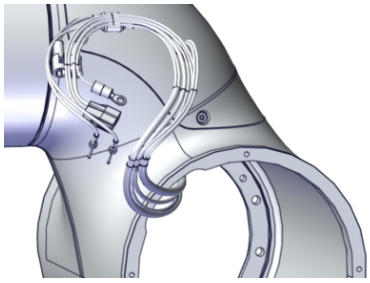
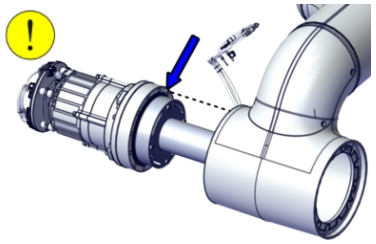
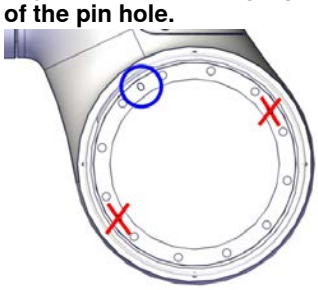
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  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 53*.	

Refitting the axis-3 joint unit (-5/0.95)

	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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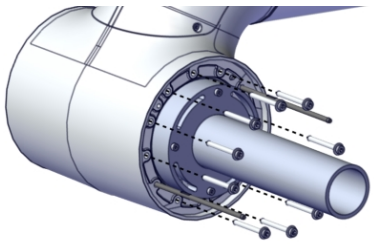
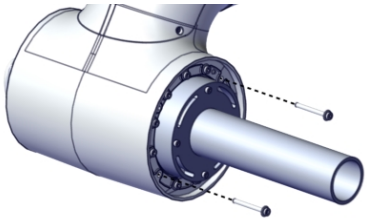
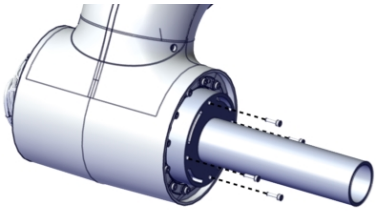
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	Action	Note
2	Fit two guide pins to the joint unit.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2000002438
3	Place the cabling at the slot before refitting the joint unit.	 xx2100000004
4	Fit the joint unit to the housing, 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.	 xx2000002072 **Pay attention to the right position of the pin hole.**  xx2400001485

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5.6.5 Replacing the axis-3 joint unit
Continued

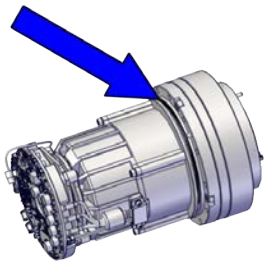
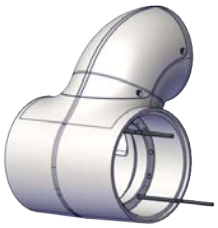
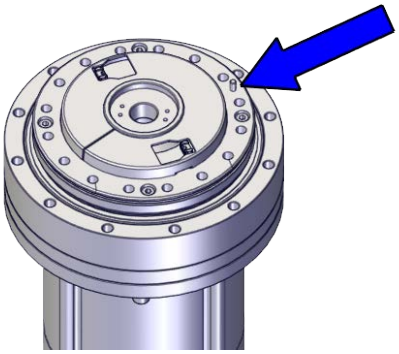
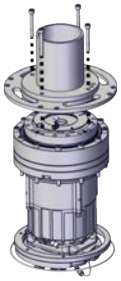
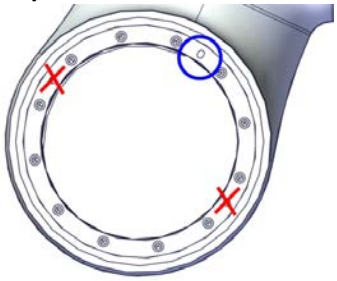
	Action	Note
5	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-435 M4x35 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000320
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.	

Refitting the axis-3 joint unit (-10/1.52 and -12/1.27)

	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 53*.	

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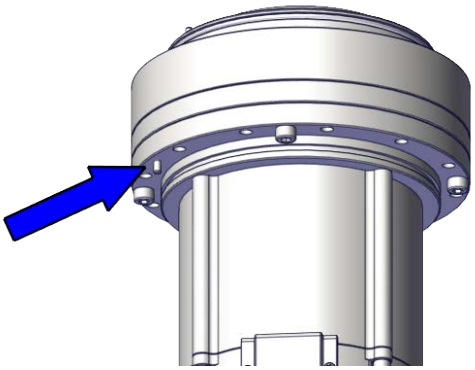
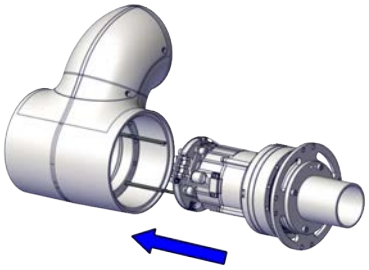
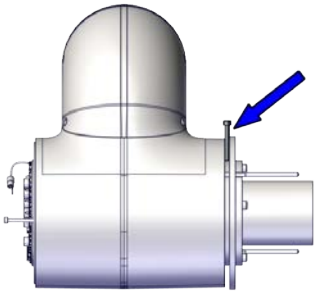
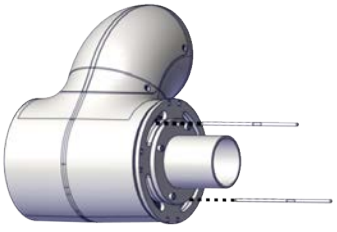
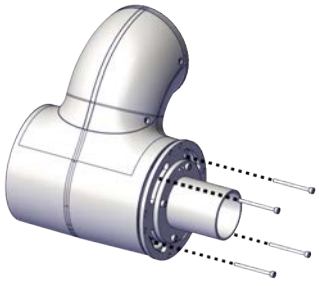
	Action	Note
2	Check the o-ring. Replace if damaged.	O-ring: 3HAC061327-036  xx2300000836
3	Fit two guide pins to the housing.	Guide pin, M4x120: 3HAC077786-001 Always use guide pins in pairs. For joint units on axes 1, 2 and 3 of CRB 15000-5/0.95 and axis 3 of CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2300000803
4	Fit the lifting aid to the joint unit, 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.  xx2300000777	Joint unit: 3HAC087474-001 Lifting aid: 3HAC087788-001 Screws: M4x30 (4 pcs)  xx2300000804 **Pay attention to the right position of the pin hole.**  xx2400001486

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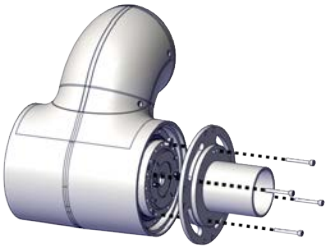
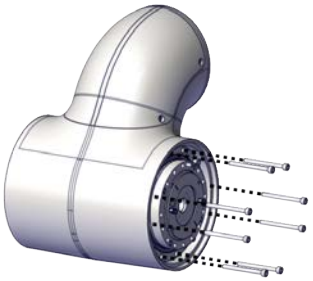
5.6.5 Replacing the axis-3 joint unit

Continued

	Action	Note
5	Fit the joint unit to the housing, 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.  xx2300000780	 xx2300000806
6	Check the joint unit position by placing an M4 screw between the lifting aid and housing. The joint unit is properly placed when no gaps between the lifting aid and housing.	 xx2300000808
7	Remove the guide pins.	 xx2300000809
8	Secure with four attachment screws and pretighten the screws crosswise.	 xx2300000810

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	Action	Note
9	Remove the lifting aid by removing the screws.	 xx2300000800
10	Secure the joint unit with the remaining attachment screws.	Hex socket head cap screw: 3HAB3409-262  xx2300000811
11	Torque tighten all screws crosswise.	M4x45 12.9 Lafre 2C2B/FC6.9, 12 pcs Tightening torque: 4.3 Nm.

Connecting the axis-3 joint unit cabling

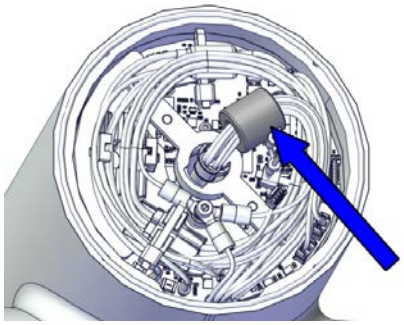
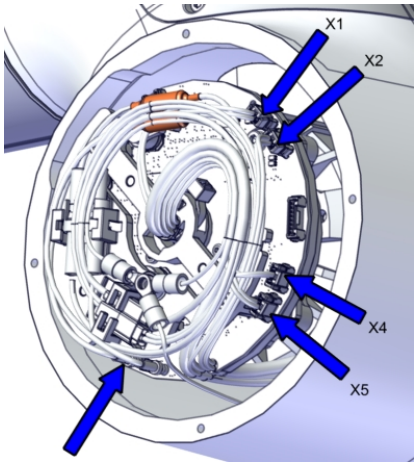
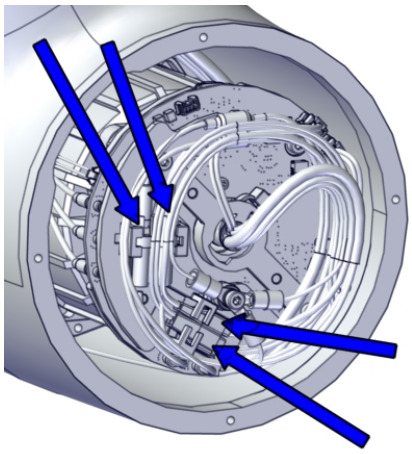
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484

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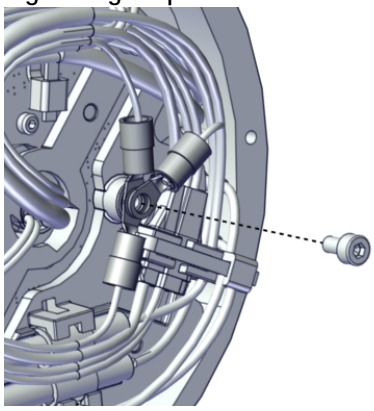
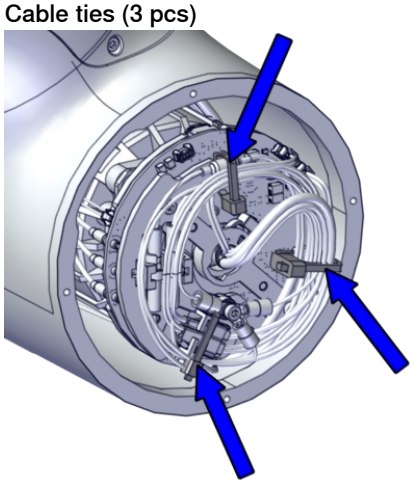
5.6.5 Replacing the axis-3 joint unit

Continued

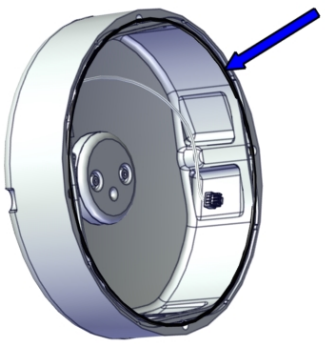
	Action	Note
3	Thread the cables D3.X4 and D3.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • D3.X1 to X1 • D3/4.DC+ to DC+ • D3/4.DC- to Ground • D3.X4 to X4 • D3/4.X2 to X2 • D3.X5 to X5	 xx2000002068
5	Connect the connectors to each other and snap them to the cable holders. • 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

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	Action	Note
6	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
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002066

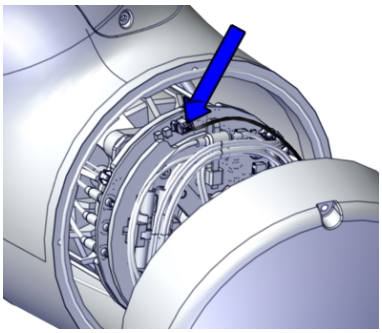
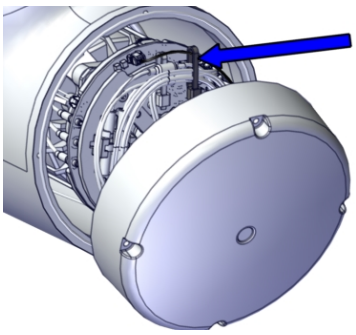
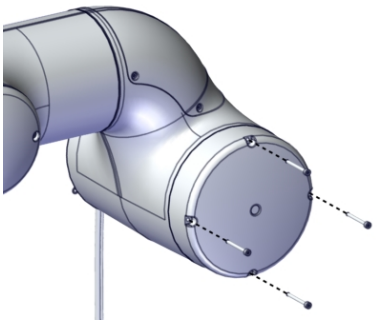
Refitting the housing cover (-5/0.95)

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

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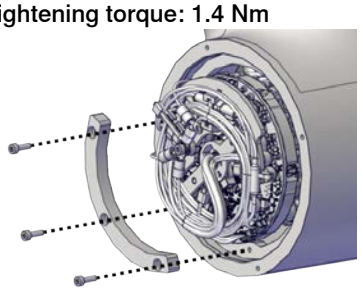
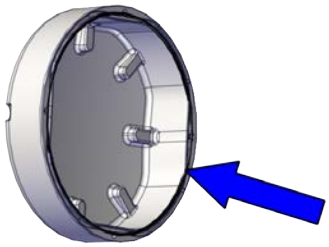
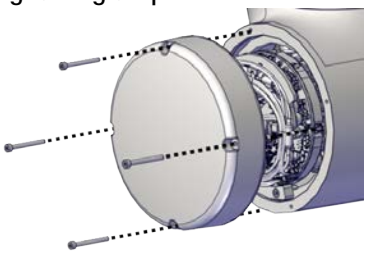
5.6.5 Replacing the axis-3 joint unit
Continued

	Action	Note
2	**For robots with RobotWare earlier than 7.10** 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	**For robots with RobotWare earlier than 7.10** 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

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Refitting the housing cover and insert (-10/1.52 and -12/1.27)

	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000834
2	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2300000835
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000833

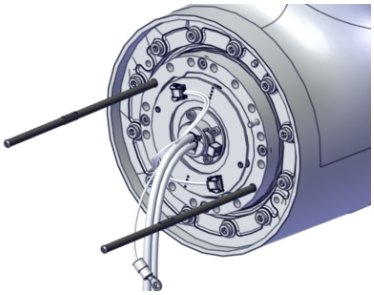
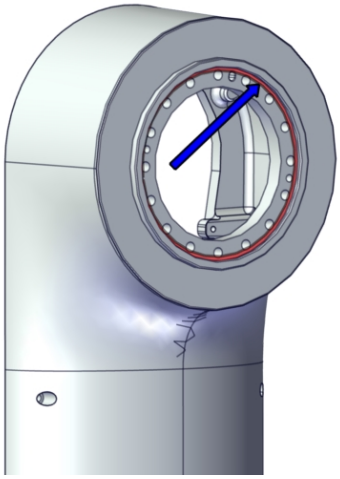
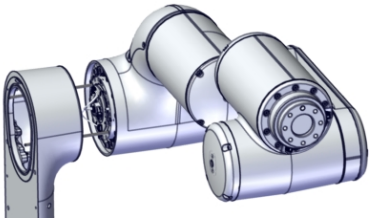
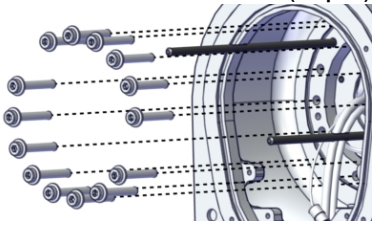
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5.6.5 Replacing the axis-3 joint unit

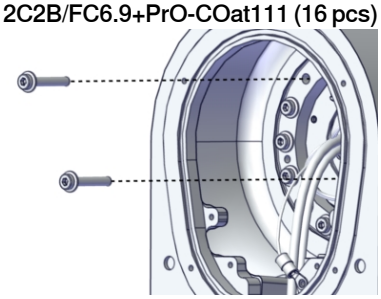
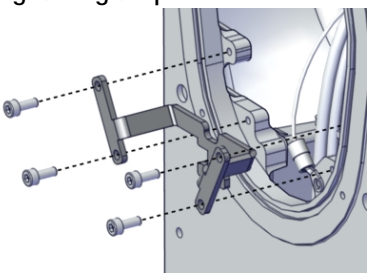
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Refitting the upper arm

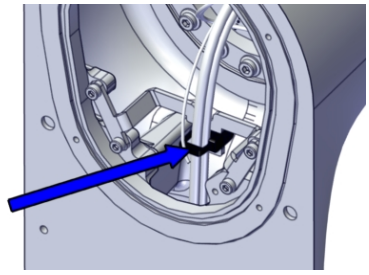
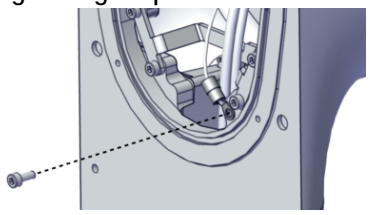
	Action	Note
1	Fit two guide pins to the axis-3 joint.	Guide pin, M4x120: 3HAC077786-001  xx2000001971
2	**Valid for CRB 15000-5/0.95** Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the lower arm mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000001973
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

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	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)  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

Fastening the cabling between the lower and upper arm

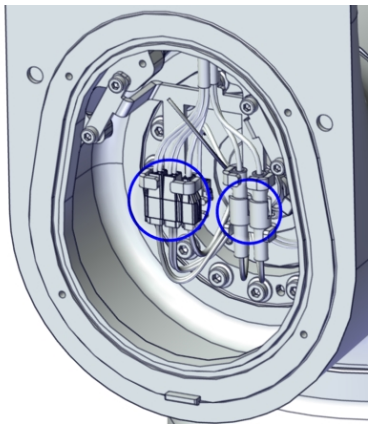
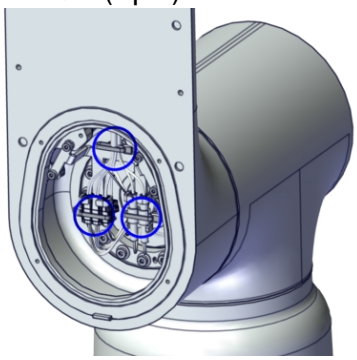
	Action	Note
1	Secure the cabling with the cable tie.	Cable ties  xx2000001965
2	Connect the functional earth cable with the screw.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (1 pcs). Tightening torque: 0.8 Nm  xx2000001964

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5.6.5 Replacing the axis-3 joint unit
Continued

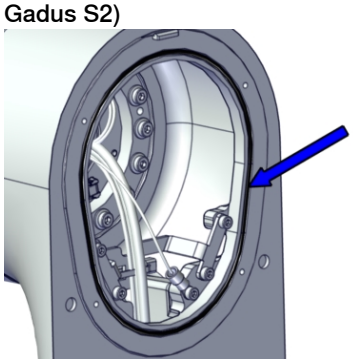
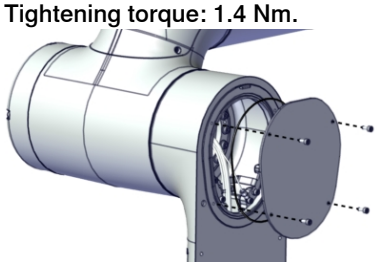
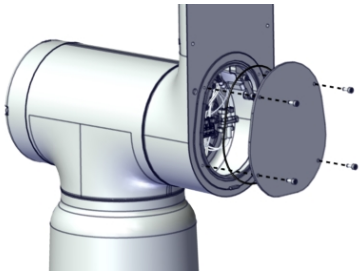
Connecting the upper arm cabling

	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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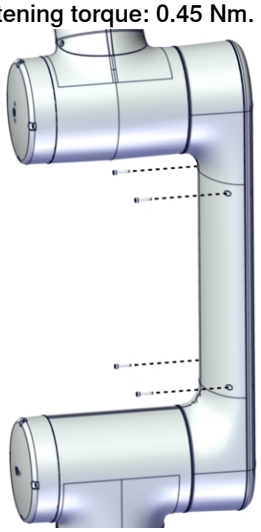
Refitting the lower arm covers (-5/0.95)

	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

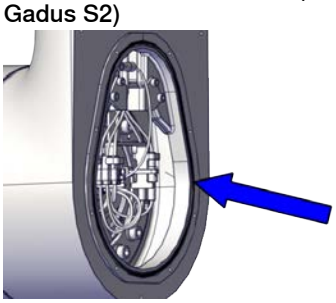
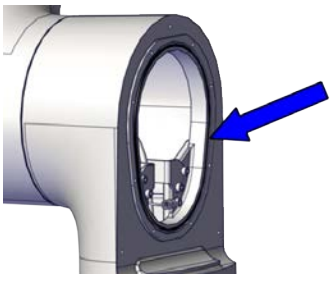
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5.6.5 Replacing the axis-3 joint unit
Continued

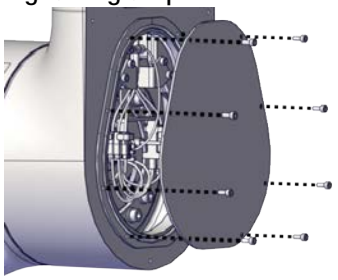
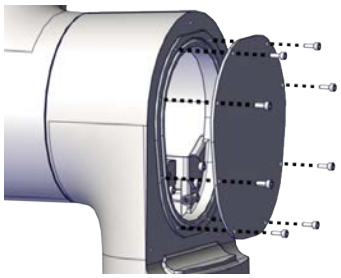
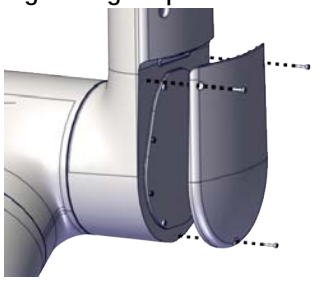
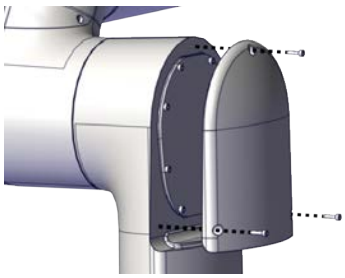
	Action	Note
3	Snap the lower arm cover into place.	Hex socket head cap screw: M3x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000001929
4	Secure the cover with four screws.	

Refitting the lower arm covers (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-075 O-ring: 3HAC061327-044 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2300000832  xx2300000831

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	Action	Note
2	Refit the inner covers with eight screws each.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (8 pcs) x 2 Tightening torque: 1.4 Nm.  xx2300000813  xx2300000830
3	Snap the lower arm cover into place.	Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) x 2 Tightening torque: 1.4 Nm.  xx2300000812  xx2300000829
4	Secure the cover with three screws.	

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5.6.5 Replacing the axis-3 joint unit
Continued

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

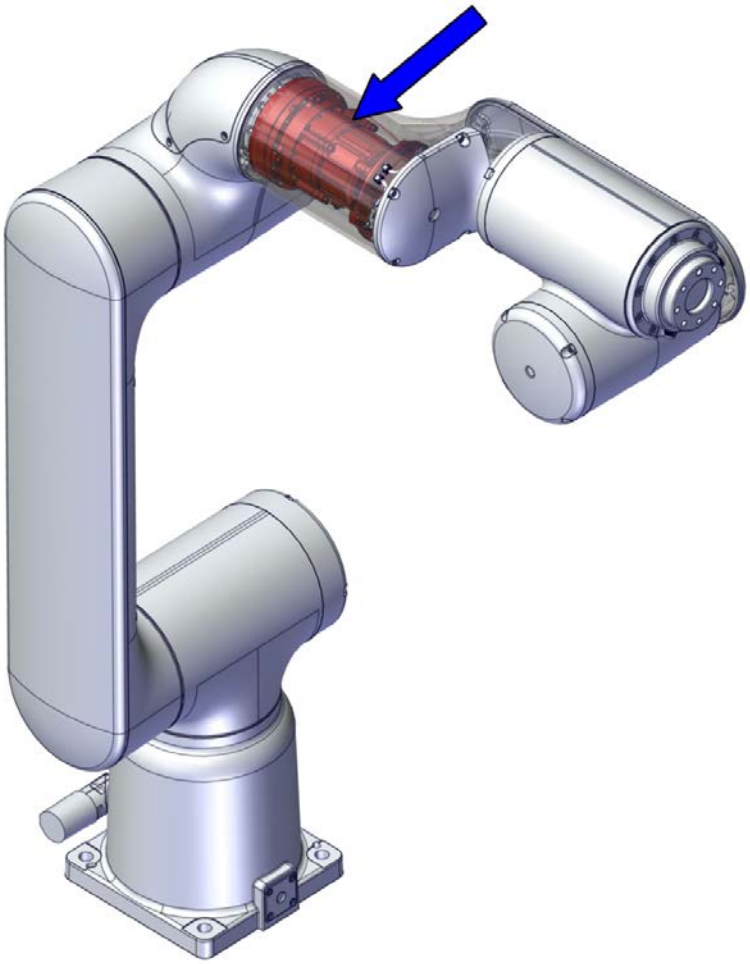
	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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5.6.6 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.

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5.6.6 Replacing the axis-4 joint unit
Continued

Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Joint unit	3HAC079143-001	Used for CRB 15000-5/0.95. New attachment screws and cable tie 3HAC075545-001 are included in the delivery.
Joint unit	3HAC087546-001	New attachment screws and cable tie 3HAC075545-001 are included in the delivery.
Ferrite core	3HAC092224-001	

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 units of CRB 15000-5/0.95.
Protection plate	3HAC087789-001	For protection of drive board during cabling installation on joint units of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Tweezers	-	Used to handle drive board connectors.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Cable ties	-	
O-ring	3HAC061327-043	Tubular cover, used for CRB 15000-5/0.95. Replace if damaged.

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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 of CRB 15000-5/0.95. 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	3HAC061327-076	Tubular cover, lower, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAB3772-166	Tubular cover, upper, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-051	Axis-4 cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-051	Axis-4 cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
Gasket	3HAC075056-001	Cover inside housing Replace if damaged.
O-ring	3HAC061327-047	Cover for axis 2/3, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-047	Housing cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.

Removing the joint unit

Use these procedures to remove the joint unit.

Note

If the RobotWare version is older than 7.10, then create a backup of the system before replacing the joint unit. After the replacement, the software must be upgraded to version 7.10 or later.

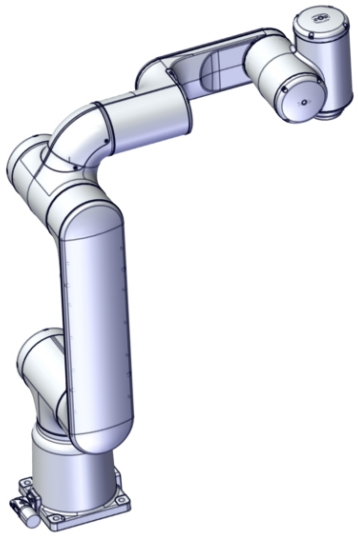
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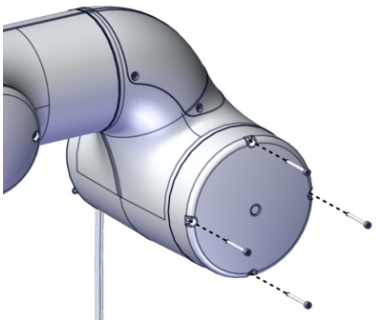
5.6.6 Replacing the axis-4 joint unit

Continued

Preparations before removing the joint unit

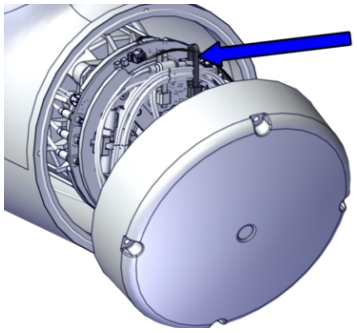
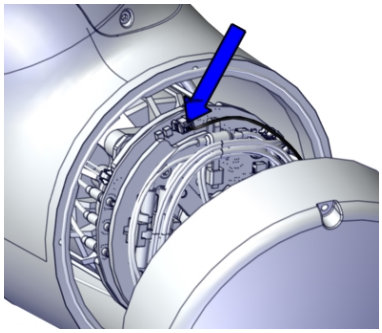
	Action	Note
1	Jog the robot to the specified position: • Axis 1: No significance. • Axis 2: 0° • Axis 3: 0° • Axis 4: 0° (home position) • Axis 5: +90° • Axis 6: No significance. **CAUTION** Jog the axis on which the joint unit is to be replaced to home position, to achieve correct cable routing during replacement of the joint unit.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000005
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the housing cover (-5/0.95)

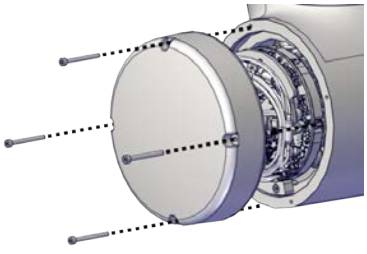
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover screws.	 xx2000002021

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	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** 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	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002022
5	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002023

Removing the housing cover and insert (-10/1.52 and -12/1.27)

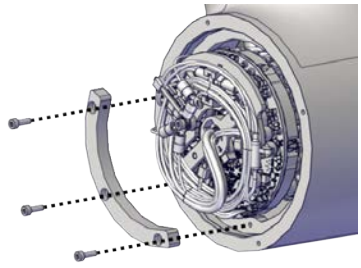
	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off.	
2	Remove the cover by removing the screws.	 xx2300000833

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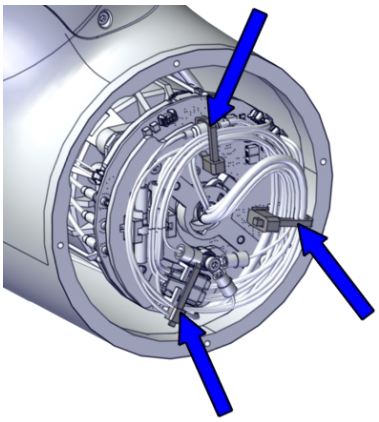
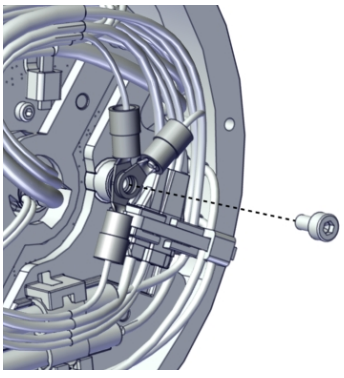
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5.6.6 Replacing the axis-4 joint unit

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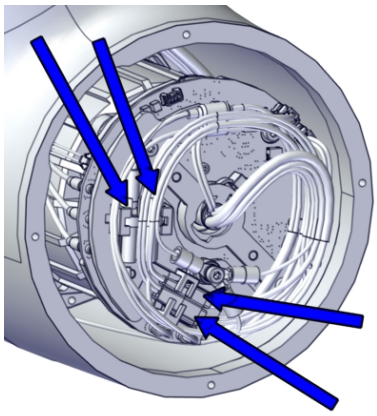
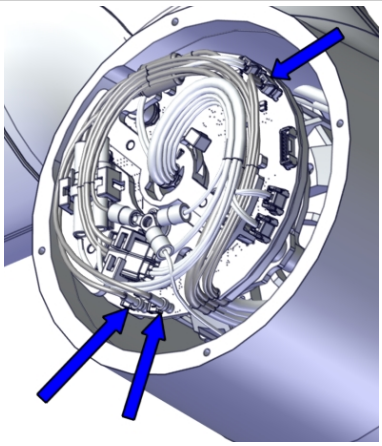
	Action	Note
3	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
4	Remove the insert.	 xx2300000834

Separating the cabling between the housing and the tubular

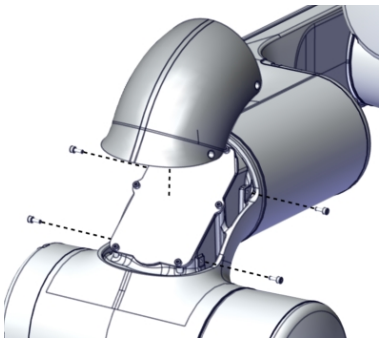
	Action	Note
1	Cut the cable ties.	 xx2000002066
2	Remove the functional and protective earth cables by removing the screw.	 xx2000001945

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	Action	Note
3	Snap loose and disconnect the connectors: • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP	 xx2000002067
4	Disconnect the connectors from the drive board. • D3/4.X2 • D3/4.DC+ • D3/4.DC-	 xx2000002120

Opening the housing top cover

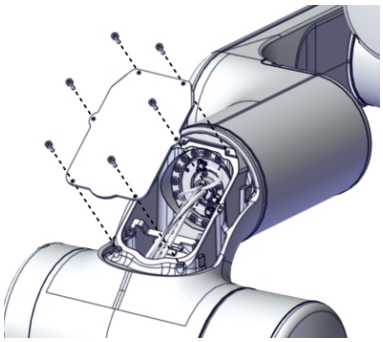
	Action	Note
1	Remove the cover by removing the four screws.	 xx2000002075

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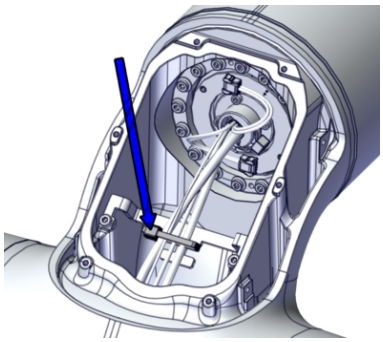
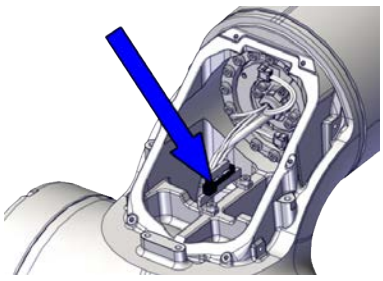
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5.6.6 Replacing the axis-4 joint unit

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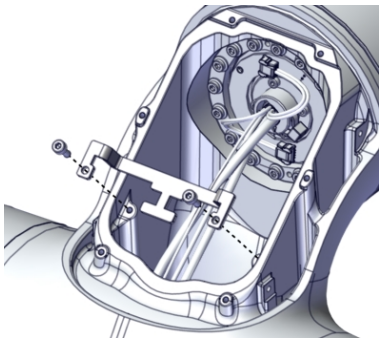
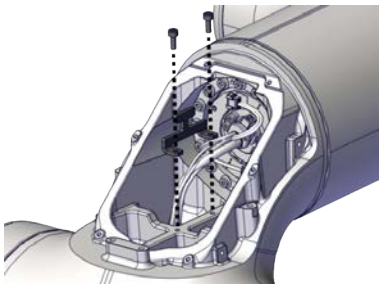
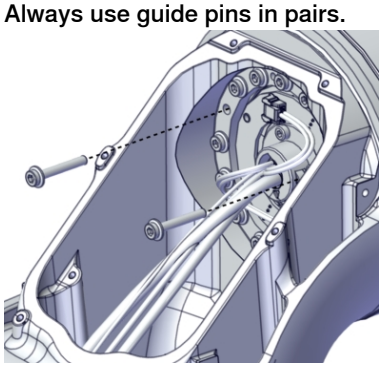
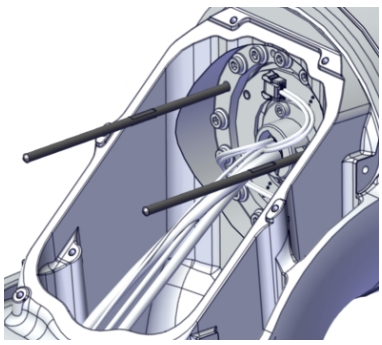
	Action	Note
2	Remove the inner plate by removing the screws.	 xx2000002076

Removing the tubular

	Action	Note
1	Cut the cable tie.	**Valid for CRB 15000-5/0.95**  xx2000002077 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000839

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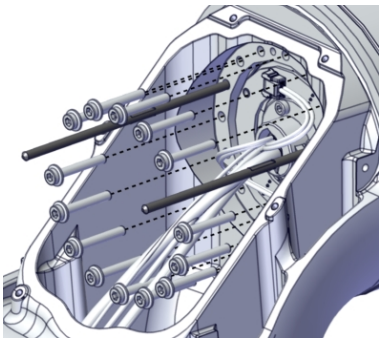
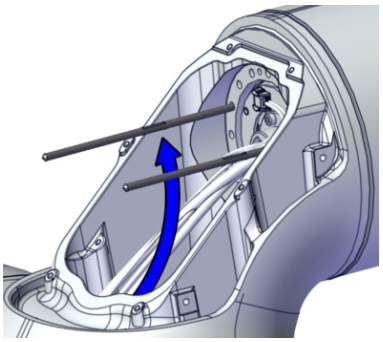
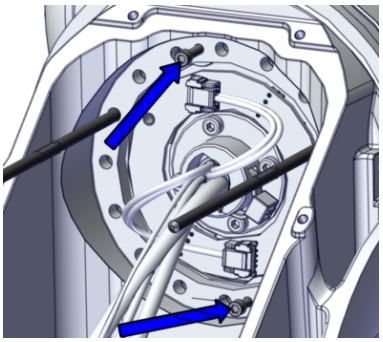
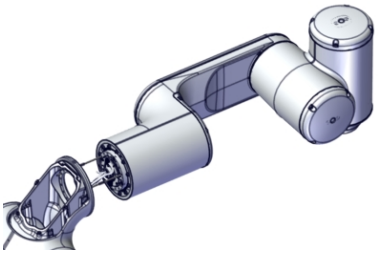
	Action	Note
2	Remove the cable bracket by removing the two screws.	**Valid for CRB 15000-5/0.95**  xx2000002078 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000840
3	Remove two attachment screws and fit two guide pins to the axis-4 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs.  xx2000002079  xx2000002080

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5.6.6 Replacing the axis-4 joint unit

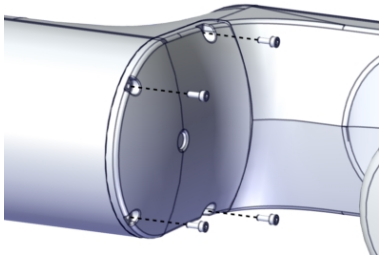
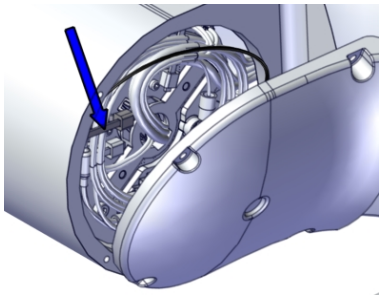
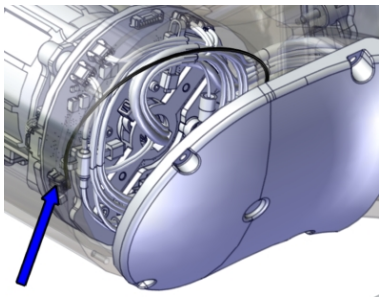
Continued

	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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Removing the axis-4 cover

	Action	Note
1	Remove the cover screws.	 xx2000002083
2	**CAUTION** **Valid for CRB 15000-5/0.95** 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	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002084
4	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	Tweezers  xx2000002085

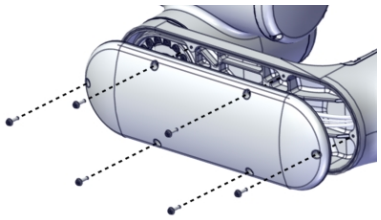
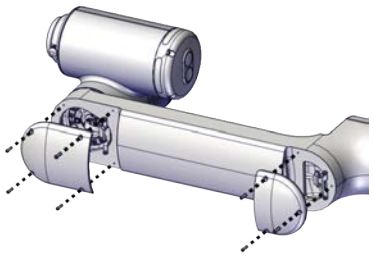
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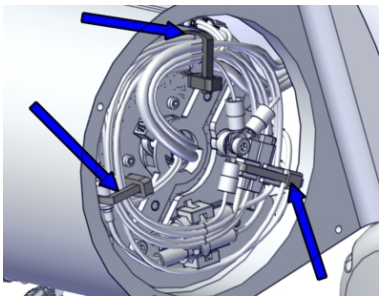
5.6.6 Replacing the axis-4 joint unit

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Removing the tubular cover

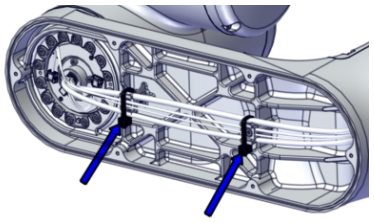
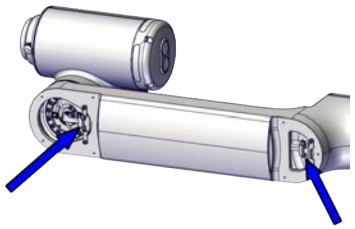
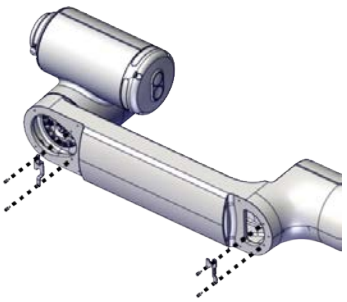
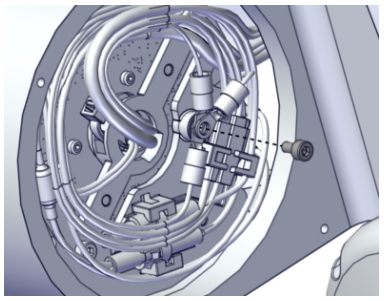
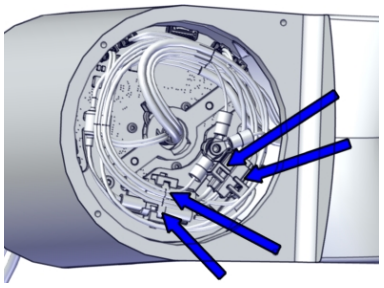
	Action	Note
1	**Valid for CRB 15000-5/0.95** Remove the cover by removing the six screws. Dispose the screws. New screws must be used when refitting the cover. New screws are included in the spare part delivery of the joint unit.	 xx2000002123
2	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the covers by removing the screws.	 xx2300000841

Separating the cabling between the tubular and the tilt

	Action	Note
1	Cut the cable ties on joint unit.	 xx2000002086

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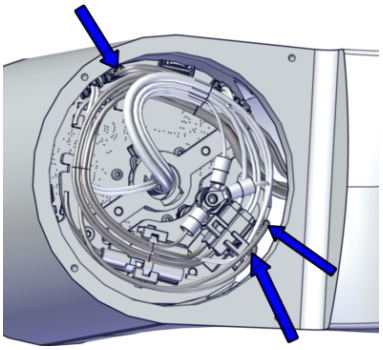
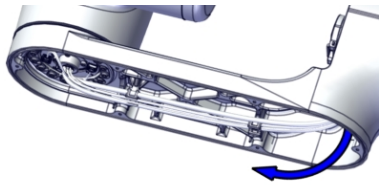
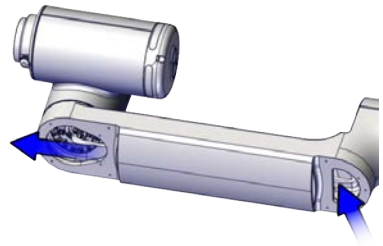
	Action	Note
2	Cut the cable ties on tubular, if needed.	**Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842
3	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the cable brackets.	 xx2300000843
4	Remove the functional and protective earth cables by removing the screw.	 xx2000002087
5	Snap loose and disconnect the connectors: • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP	 xx2000002089

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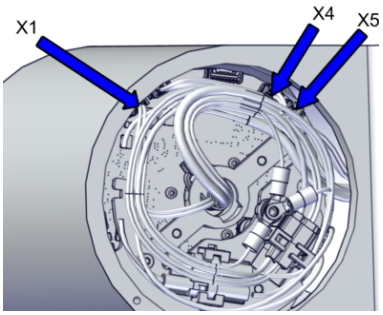
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5.6.6 Replacing the axis-4 joint unit

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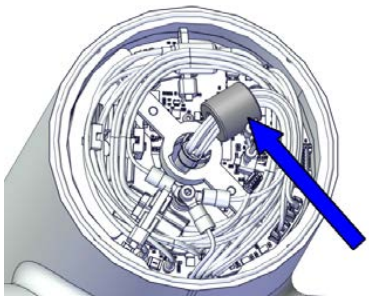
	Action	Note
6	Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board: • D3/4.X2 • D3/4.DC- • D3/4.DC+ Use tweezers, if needed.	Tweezers  xx2000002125
7	Pull out the cabling carefully from the tubular.	**Valid for CRB 15000-5/0.95**  xx2000002126 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000844

Disconnecting the axis-4 joint unit cabling

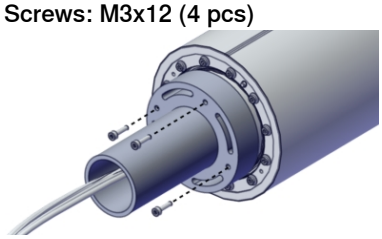
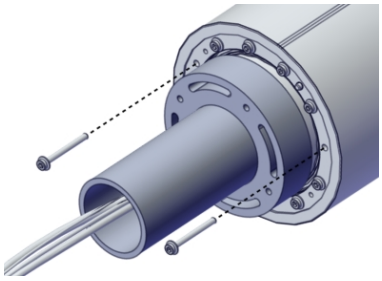
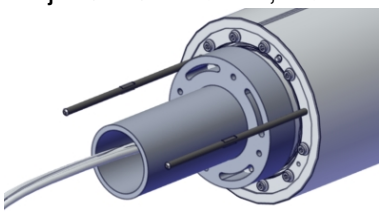
	Action	Note
1	Disconnect the connectors from the drive board. **CAUTION** Use tweezers to unlock connectors and pull them off. • D4/5.X1 • D4/5.X4 • D4/5.X5	Tweezers  xx2000002088

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	Action	Note
2	Remove the ferrite core by pulling the cables D4/5.X4 and D4/5.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

Removing the axis-4 joint unit

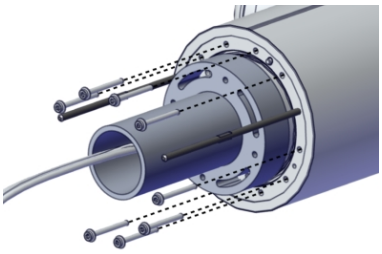
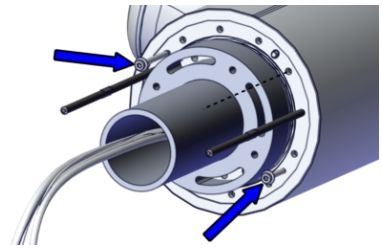
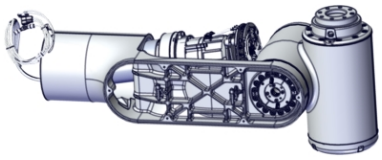
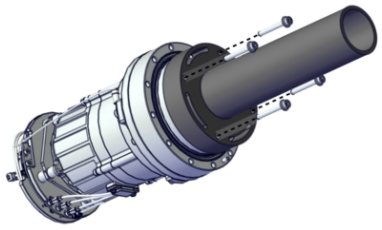
	Action	Note
1	Fit the lifting aid to the joint unit, on the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000002090
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2000002091
3	Fit two guide pins to the axis-4 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2000002578

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5.6.6 Replacing the axis-4 joint unit

Continued

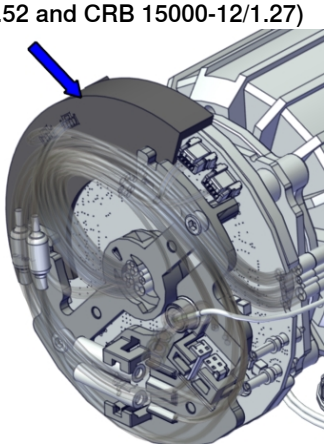
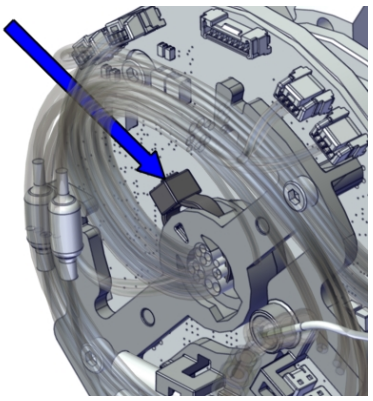
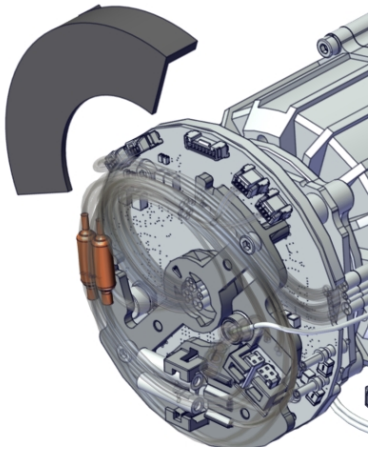
	Action	Note
4	Remove the remaining attachment screws. Use two screws as press out screws in the upcoming step, then dispose all screws. New screws are included in the spare part delivery of the joint unit.	 xx2100000326
5	Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2100000327
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.	 xx2000002116
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 53*.	

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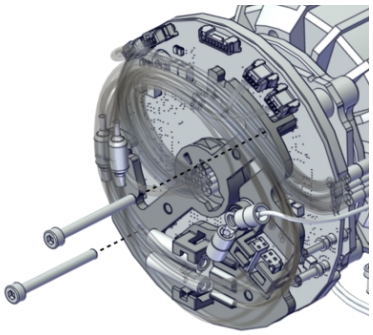
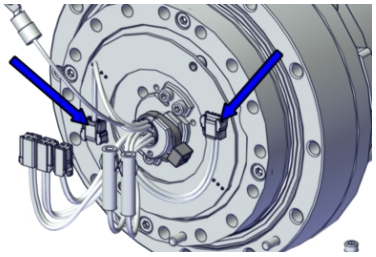
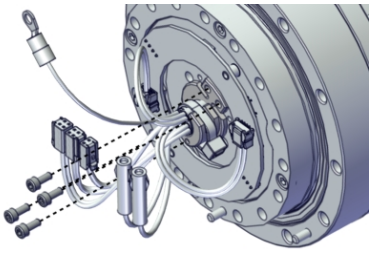
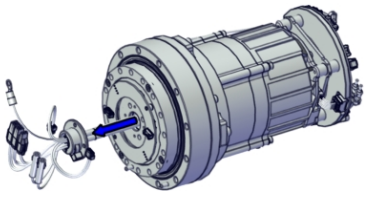
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	Action	Note
2	Fit the protection plate to the drive board unit. **Tip** Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
3	Cut the cable tie at the drive board.	 xx2000002058
4	Remove the protection plate.	 xx2100000301

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5.6.6 Replacing the axis-4 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. • 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

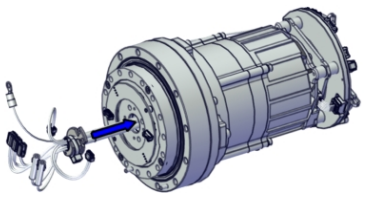
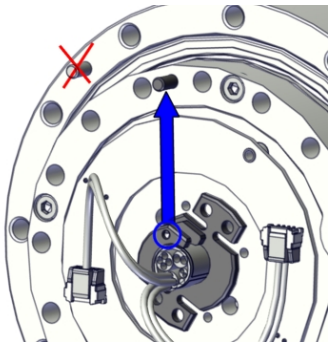
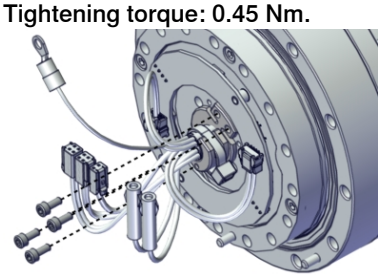
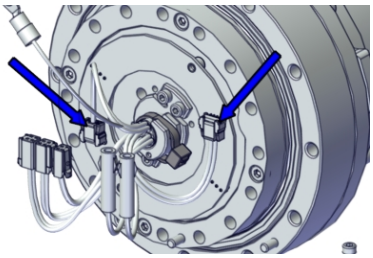
Use these procedures to refit the joint unit.

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 53*.	

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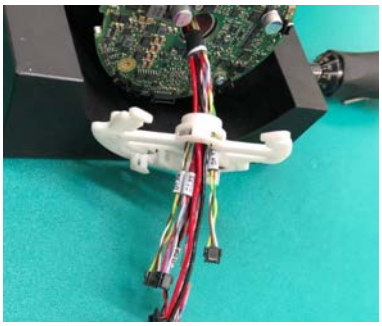
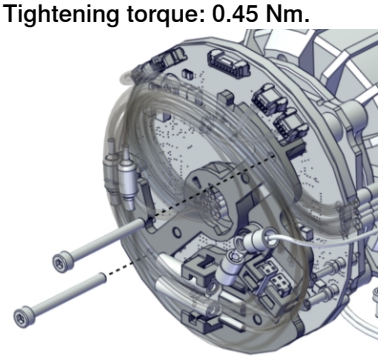
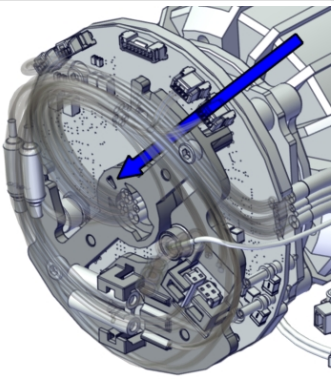
	Action	Note
2	Place the joint cable through the hollow shaft from the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002048
3	Orient the cable plate according to the figure. The circle on the cable plate should point towards the guide pin on the torque sensor.	 xx2000002051
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. • TQ.A to CH1/A • TQ.B to CH2/B	 xx2000002053

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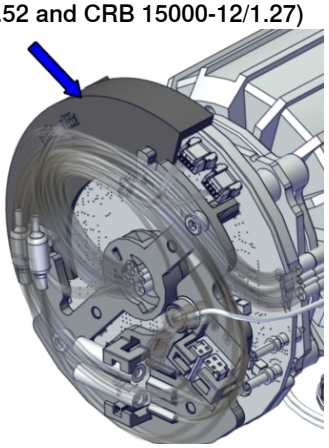
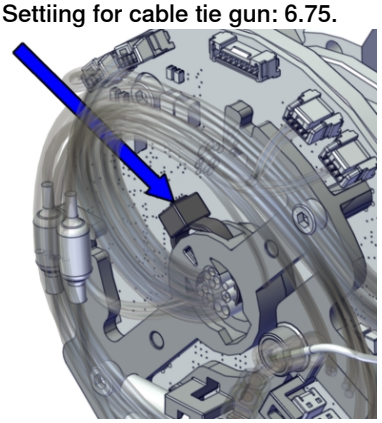
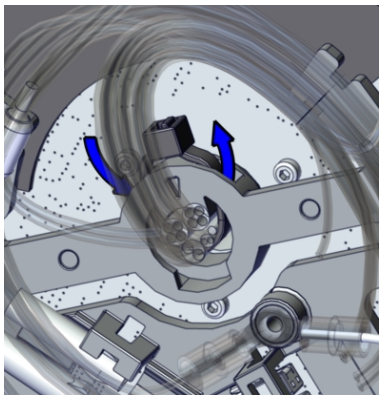
5.6.6 Replacing the axis-4 joint unit

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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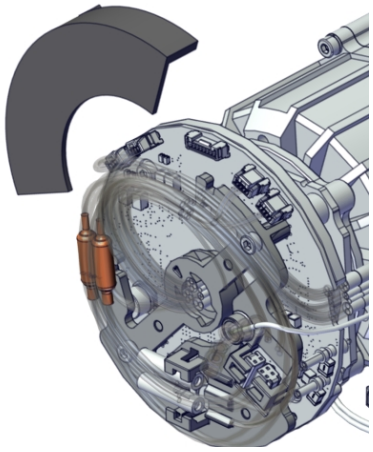
	Action	Note
8	Fit the protection plate to the drive board unit.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
9	Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.	Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059

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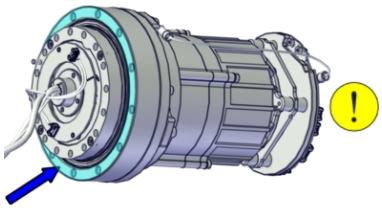
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5.6.6 Replacing the axis-4 joint unit

Continued

	Action	Note
10	Remove the protection plate.	 xx2100000301

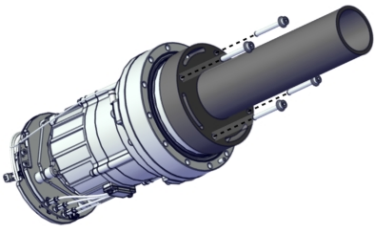
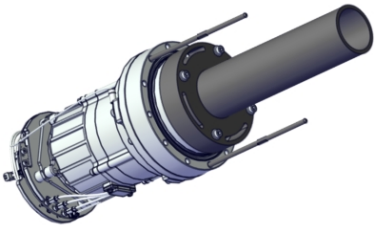
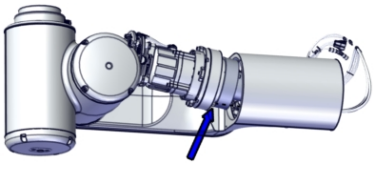
Preparations before fitting the joint unit

	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 53*.	
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 (or equivalent)  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 53*.	

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Refitting the axis-4 joint unit

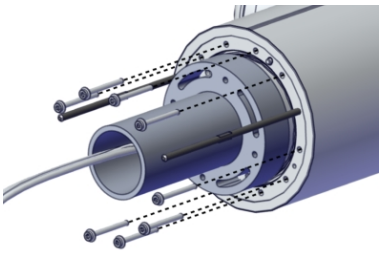
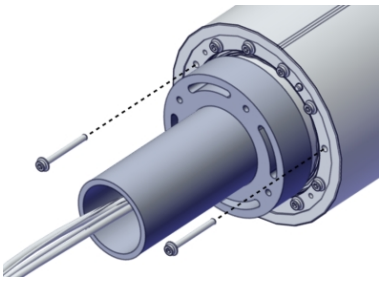
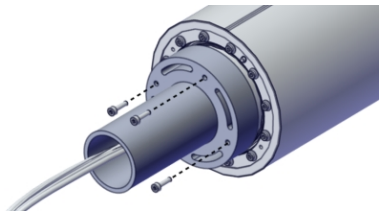
	Action	Note
1	**CAUTION** Axis-4 joint unit used for CRB 15000-5/0.95 has the same appearance as that used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Do not mix the joint units for different manipulator variants. Always check the mark or label on the joint units before refitting.	
2	Fit the lifting 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: 3HAC079143-001 (for CRB 15000-5/0.95) / 3HAC087546-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
3	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
4	Fit the joint unit to the tubular, 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.	 xx2000002117

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5.6.6 Replacing the axis-4 joint unit

Continued

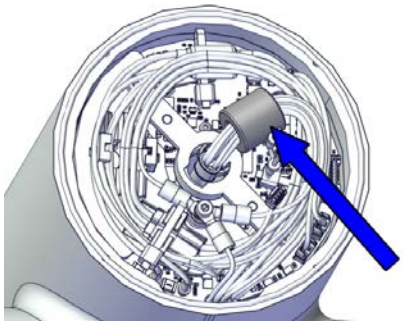
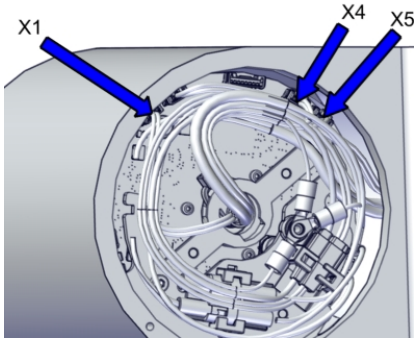
	Action	Note
5	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000326
6	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002091
7	Pre-tighten the screws crosswise.	
8	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm (for CRB 15000-5/0.95) / 1.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)
9	Remove the lifting aid by removing the screws.	 xx2000002090
10	Clean pushed-out flange sealant, if any.	

Connecting the axis-4 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 53*.	

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	Action	Note
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D4/5.X4 and D4/5.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • D4/5.X1 to X1 • D4/5.X4 to X4 • D4/5.X5 to X5	 xx2000002088

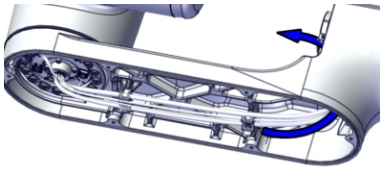
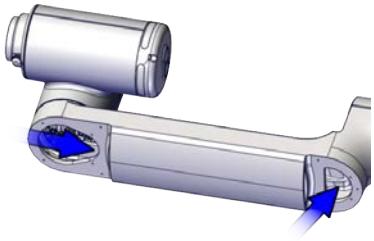
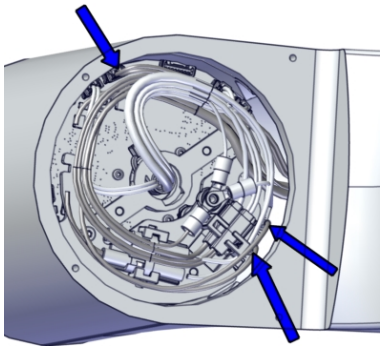
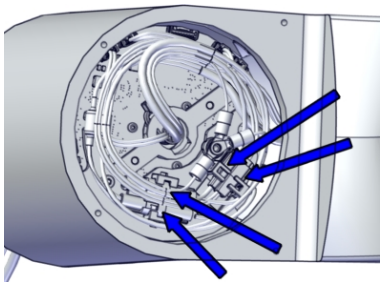
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5.6.6 Replacing the axis-4 joint unit

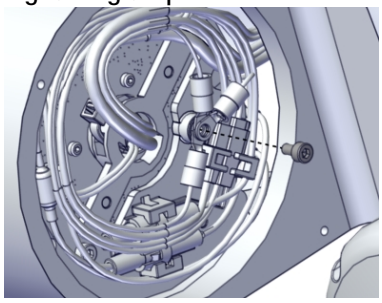
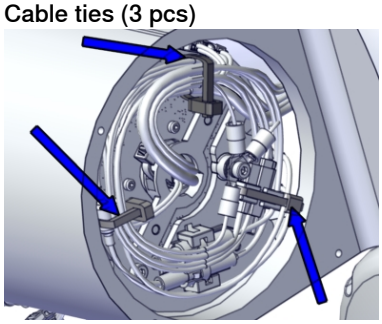
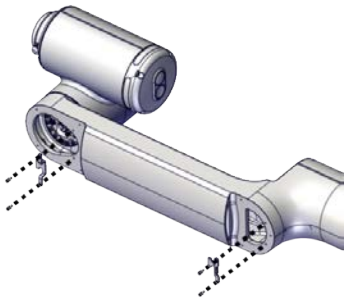
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Connecting the tilt cabling

	Action	Note
1	Insert the cabling into the tubular.	**Valid for CRB 15000-5/0.95**  xx2000002148 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000845
2	Reconnect the connectors to the drive board. • 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. • 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

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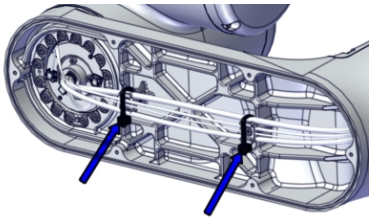
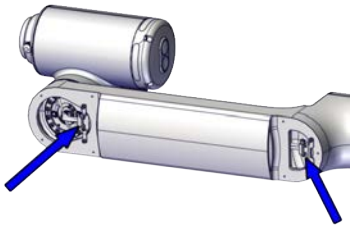
	Action	Note
4	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002087
5	Secure the cabling to joint unit with cable ties.	Cable ties (3 pcs)  xx2000002086
6	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Refit the cable brackets.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs for each). Tightening torque: 0.8 Nm.  xx2300000843

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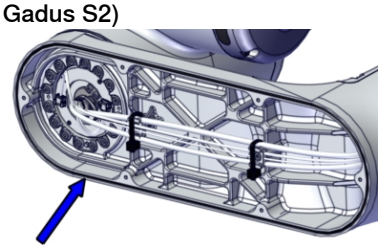
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5.6.6 Replacing the axis-4 joint unit

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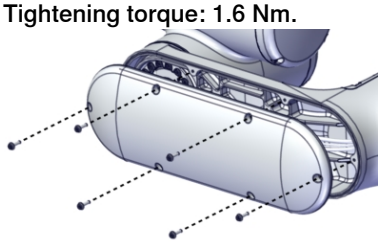
	Action	Note
7	Secure the cabling to tubular with cable ties.	Cable ties (2 pcs) **Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842

Refitting the tubular cover (-5/0.95)

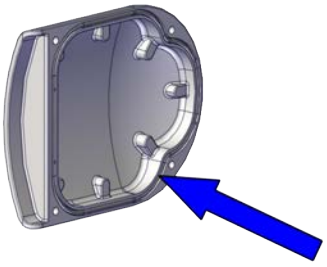
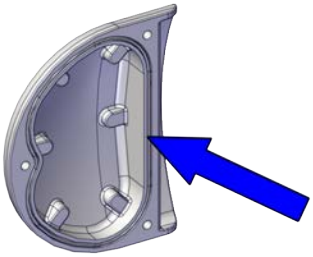
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-043 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002149

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	Action	Note
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 of CRB 15000-5/0.95. 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

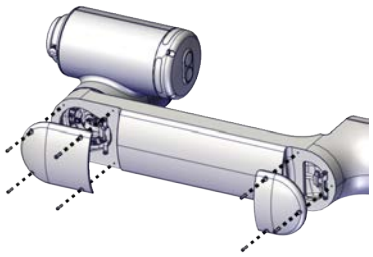
Refitting the tubular cover (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-076 O-ring: 3HAB3772-166 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2300000846  xx2300000847

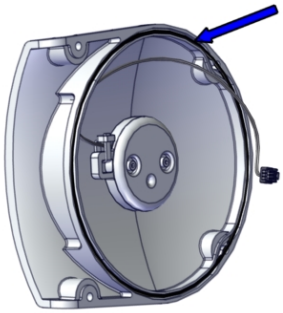
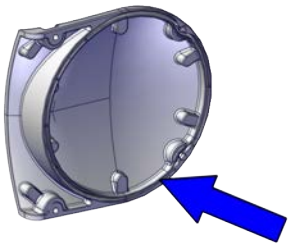
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5.6.6 Replacing the axis-4 joint unit
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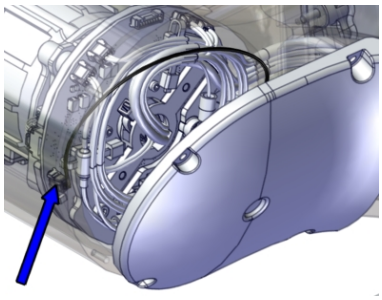
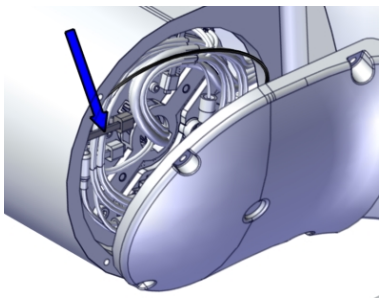
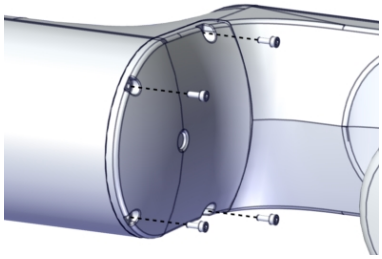
	Action	Note
2	Refit the covers with new attachment screws.	Hex socket head cap screw:M3x12 12.9 Lafre 2C2B/FC6.9 (7 pcs in total) Tightening torque: 1.4 Nm.  xx2300000841

Refitting the axis-4 cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	**Valid for CRB 15000-5/0.95** O-ring: 3HAC061327-051  xx2000002092 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 O-ring: 3HAC061327-051  xx2300000848

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	Action	Note
2	**For robots with RobotWare earlier than 7.10** Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	Tweezers  xx2000002085
3	**For robots with RobotWare earlier than 7.10** 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 (for CRB 15000-5/0.95) / 0.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Tightening torque: 0.9 Nm  xx2000002083

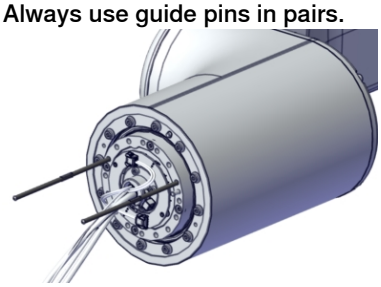
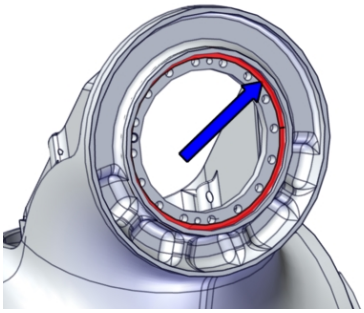
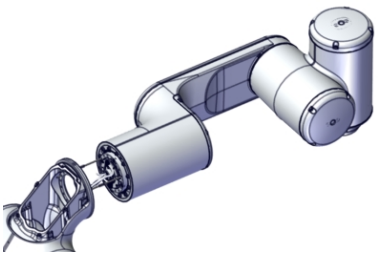
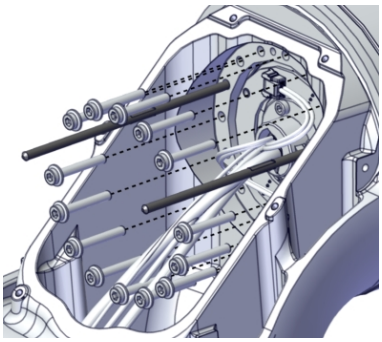
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5.6.6 Replacing the axis-4 joint unit

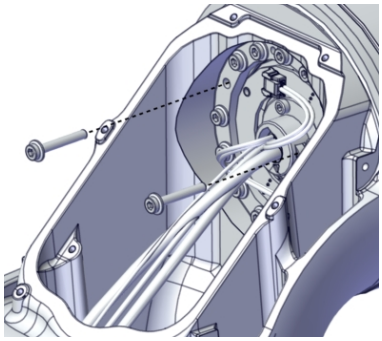
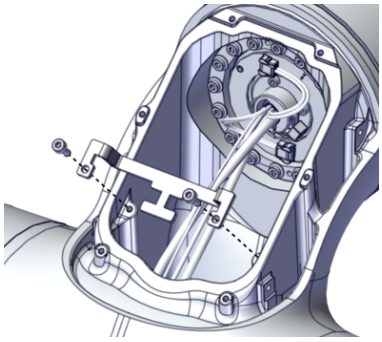
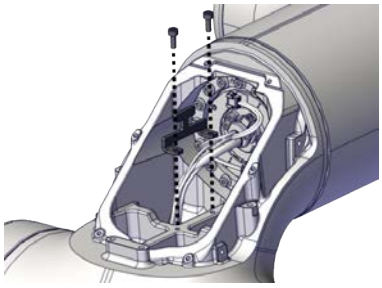
Continued

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 (or equivalent)  xx2000002094
3	Lift the tubular into mounting position while inserting the cabling into the housing.	 xx2000002082
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.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111  xx2000002081

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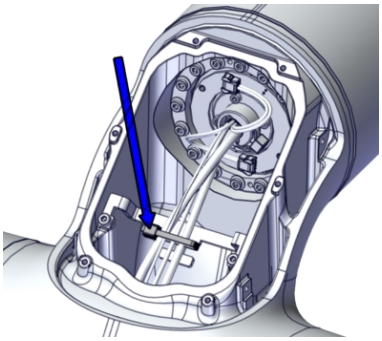
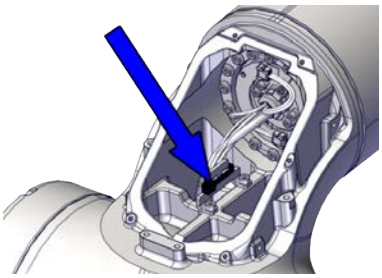
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	Action	Note
6	Remove the guide pins and fasten the remaining two screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111  xx2000002079
7	Torque tighten all screws crosswise.	Tightening torque: 1.8 Nm.
8	Refit the cable bracket with the two screws.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs). Tightening torque: 0.8 Nm **Valid for CRB 15000-5/0.95**  xx2000002078 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27  xx2300000840

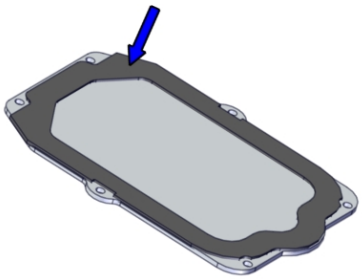
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5.6.6 Replacing the axis-4 joint unit
Continued

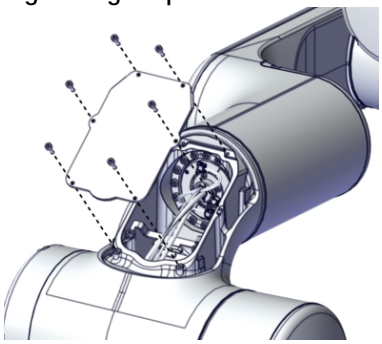
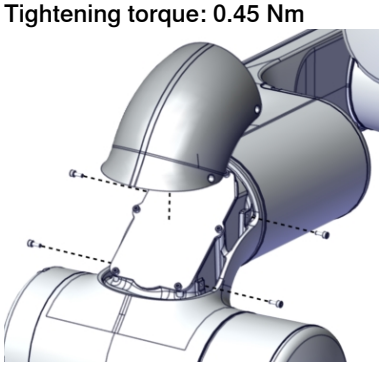
	Action	Note
9	Secure the cabling with a cable tie.	Cable ties (1 pcs) **Valid for CRB 15000-5/0.95**  xx2000002077 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27  xx2300000839

Closing the housing top cover

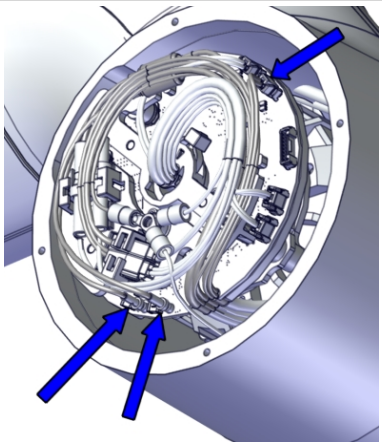
	Action	Note
1	Check the inner plate gasket. Replace if damaged.	Gasket: 3HAC075056-001  xx2000002095

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	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

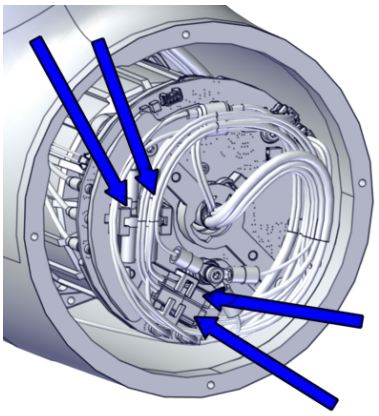
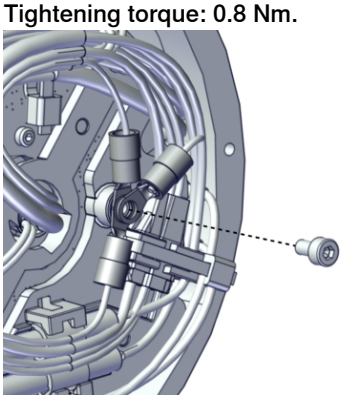
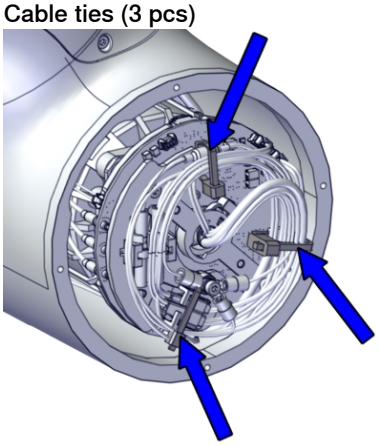
	Action	Note
1	Reconnect the connectors to the drive board. • D3/4.DC+ to DC+ • D3/4.DC- to Ground • D3/4.X2 to X2	 xx2000002120

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5.6.6 Replacing the axis-4 joint unit

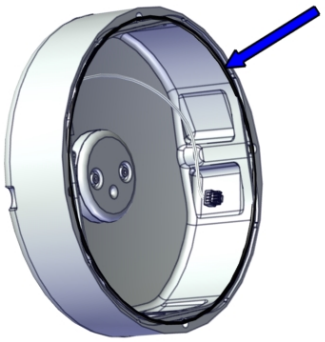
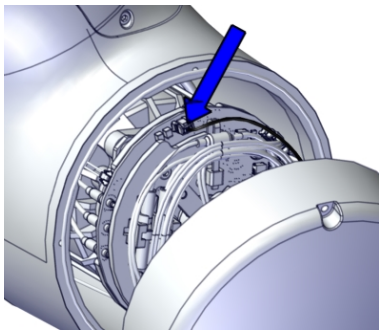
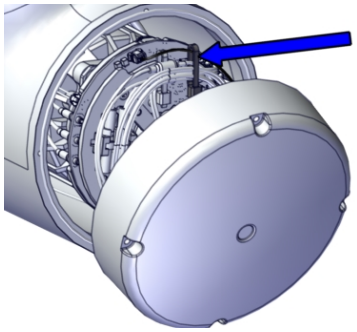
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	Action	Note
2	Connect the connectors to each other and snap them to the cable holders. • J3.DC+ to J3.DC+ • J3.DC- to J3.DC- • J3.CS to J3.CS • J3.CP to J3.CP	 xx2000002067
3	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000001945
4	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002066

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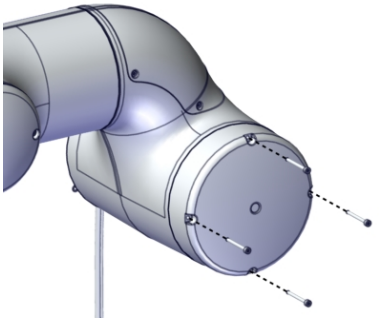
Refitting the housing cover (-5/0.95)

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2000001962
2	**For robots with RobotWare earlier than 7.10** 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	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000002022

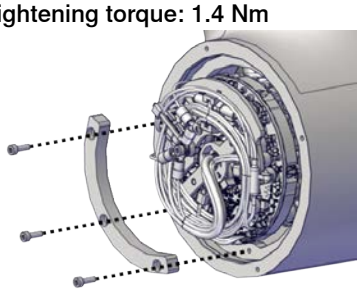
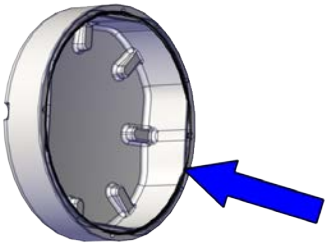
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5.6.6 Replacing the axis-4 joint unit
Continued

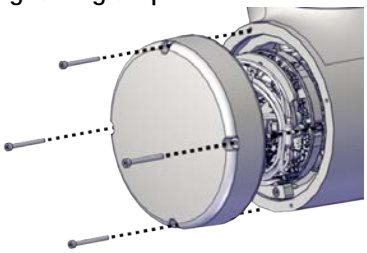
	Action	Note
4	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002021

Refitting the housing cover and insert (-10/1.52 and -12/1.27)

	Action	Note
1	Refit the insert.	Insert: 3HAC084002-001 Hex socket head cap screw: M3x10 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.4 Nm  xx2300000834
2	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-047  xx2300000835

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	Action	Note
3	Refit the cover with the four screws.	Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2300000833

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

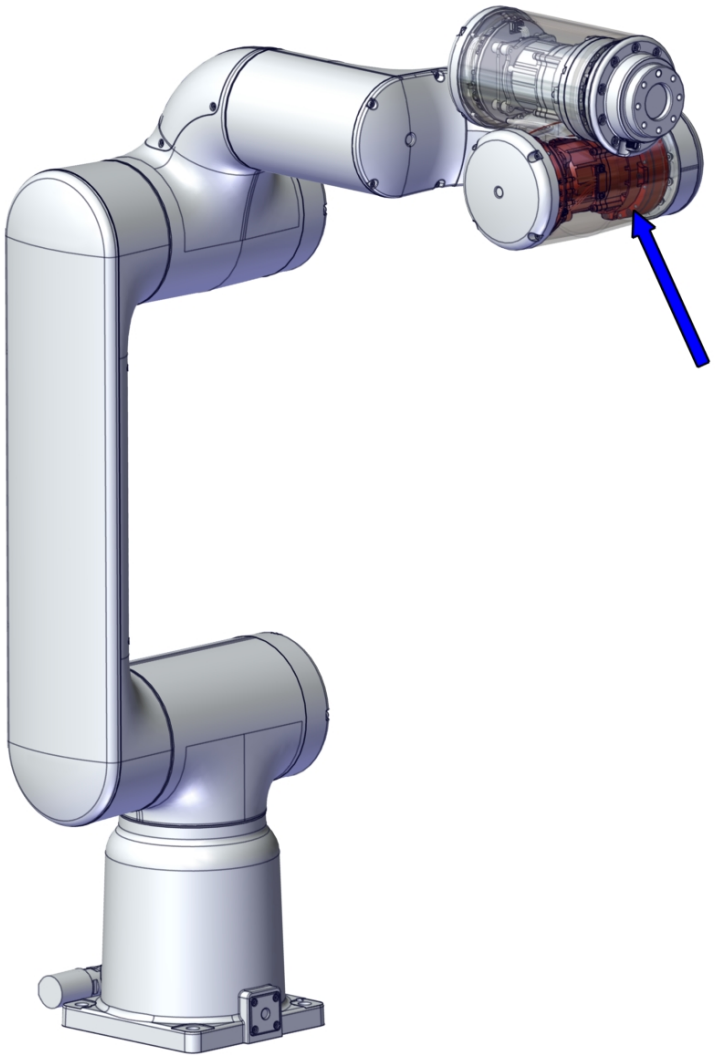
	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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5.6.7 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.



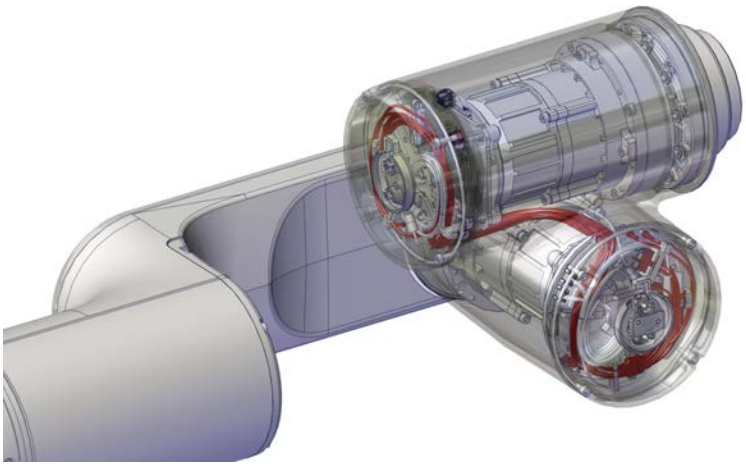
xx2000002121

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Location of the axis-5 to axis-6 transition cabling

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. 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	Used for CRB 15000-5/0.95. New attachment screws and cable tie 3HAC075545-001 are included in the delivery.
Joint unit	3HAC087546-001	New attachment screws and cable tie 3HAC075545-001 are included in the delivery.
Cable harness, transition joint-5 and joint-6	3HAC083726-001	

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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Spare part	Article number	Note
Ferrite core	3HAC092224-001	

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 units of CRB 15000-5/0.95.
Protection plate	3HAC087789-001	For protection of drive board during cabling installation on joint units of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Tweezers	-	Used to handle drive board connectors.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Grease	3HAC042536-001	Shell Gadus S2
Cable ties	-	
O-ring	3HAC061327-051	Axis-5 cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-051	Axis-5 cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-051	Arm-side interface Replace if damaged.
O-ring	3HAC061327-043	Tubular cover, used for CRB 15000-5/0.95. Replace if damaged.

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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 of CRB 15000-5/0.95. 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	3HAC061327-076	Tubular cover, lower, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAB3772-166	Tubular cover, upper, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.
O-ring	3HAC061327-051	Axis-4 cover, used for CRB 15000-5/0.95. Replace if damaged.
O-ring	3HAC061327-051	Axis-4 cover, used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Replace if damaged.

Removing the joint unit and transition cabling

Use these procedures to remove the joint unit and transition cabling.

Note

If the RobotWare version is older than 7.10, then create a backup of the system before replacing the joint unit. After the replacement, the software must be upgraded to version 7.10 or later.

Preparations before removing the joint unit and transition cabling

	Action	Note
1	Jog the robot to the specified position: • 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. **CAUTION** 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.	

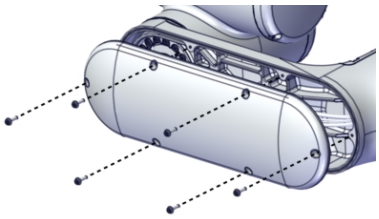
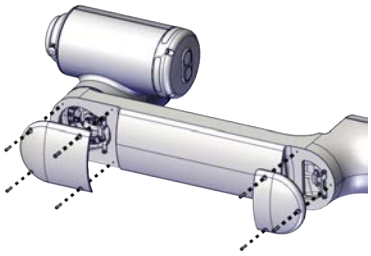
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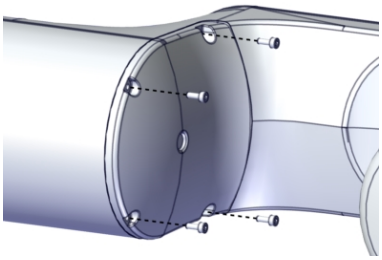
5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

	Action	Note
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

Removing the tubular cover

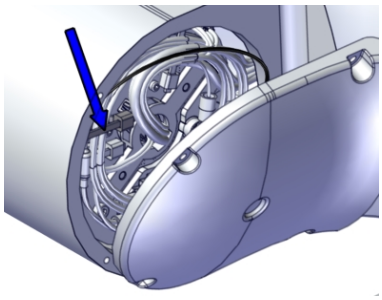
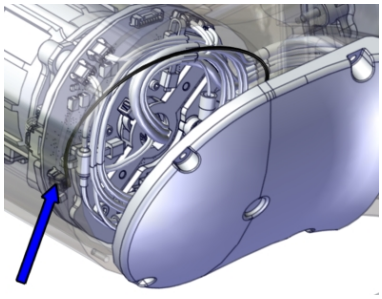
	Action	Note
1	**Valid for CRB 15000-5/0.95** Remove the cover by removing the six screws. Dispose the screws. New screws must be used when refitting the cover. New screws are included in the spare part delivery of the joint unit.	 xx2000002123
2	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the covers by removing the screws.	 xx2300000841

Removing the axis-4 cover

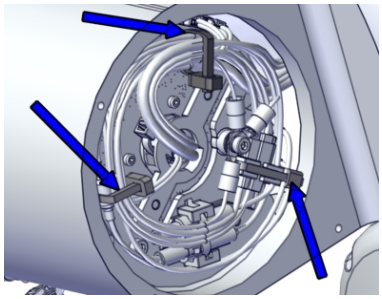
	Action	Note
1	Remove the cover screws.	 xx2000002083
2	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	

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	Action	Note
3	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002084
4	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	Tweezers  xx2000002085

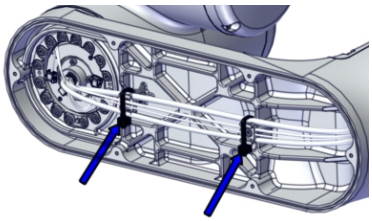
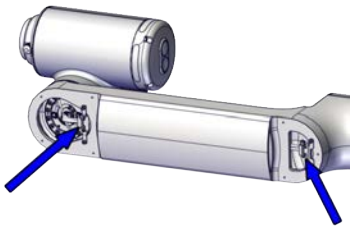
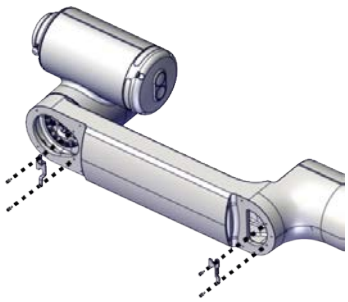
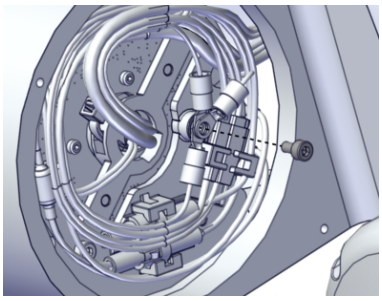
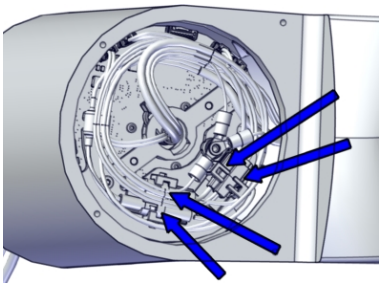
Separating the cabling between the tubular and the tilt

	Action	Note
1	Cut the cable ties on joint unit.	 xx2000002086

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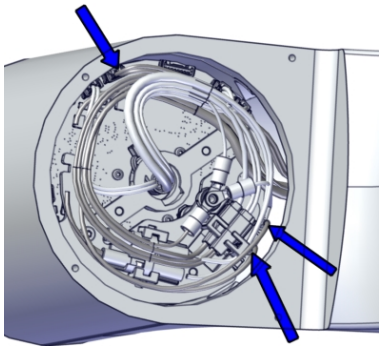
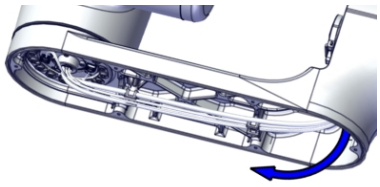
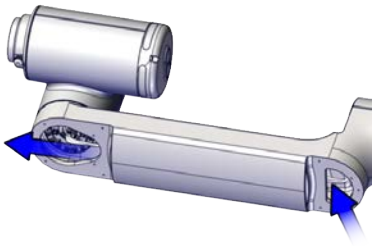
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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

	Action	Note
2	Cut the cable ties on tubular, if needed.	**Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842
3	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Remove the cable brackets.	 xx2300000843
4	Remove the functional and protective earth cables by removing the screw.	 xx2000002087
5	Snap loose and disconnect the connectors: • J4/5.DC+ • J4/5.DC- • J4/5.CS • J4/5.CP	 xx2000002089

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	Action	Note
6	Disconnect the connectors that belongs to the axis-5 cabling, from the axis-4 drive board: • D3/4.X2 • D3/4.DC- • D3/4.DC+ Use tweezers, if needed.	Tweezers  xx2000002125
7	Pull out the cabling carefully from the tubular.	**Valid for CRB 15000-5/0.95**  xx2000002126 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000844

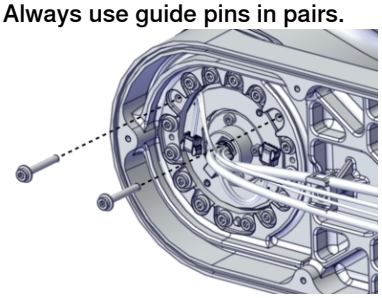
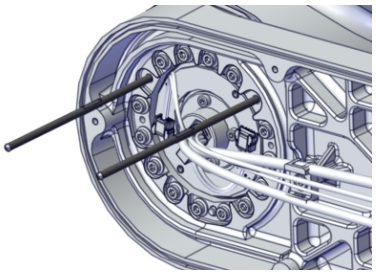
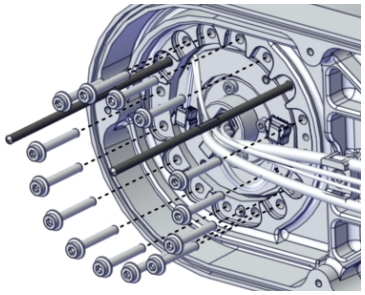
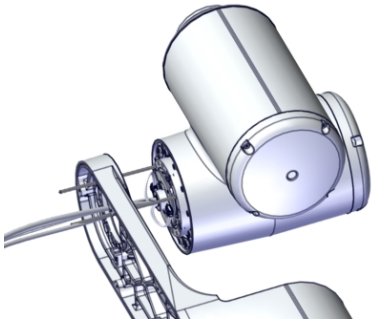
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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

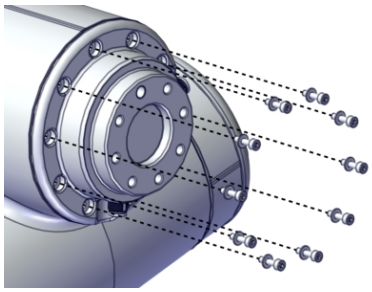
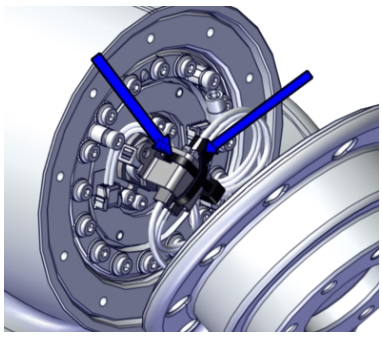
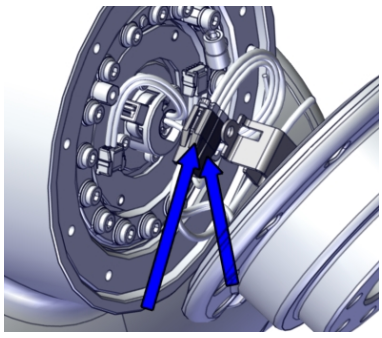
Removing the tilt

	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.	
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

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Removing the tool flange

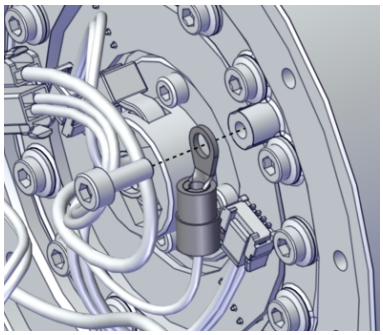
	Action	Note
1	Remove the tool flange screws and washers.	 xx2000002155
2	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
3	Cut the cable ties.	 xx2000002157
4	Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

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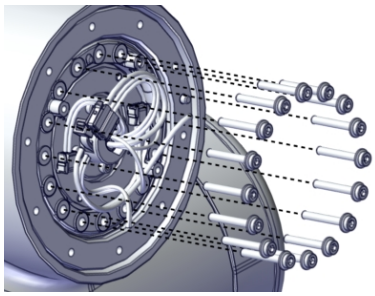
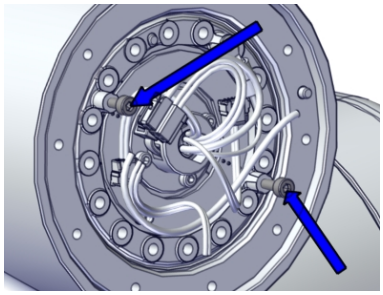
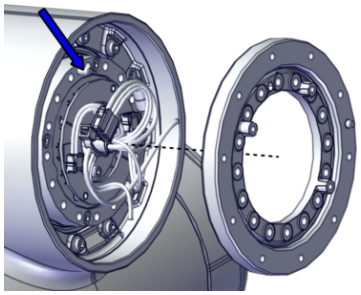
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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Disconnecting the tool flange functional earth cable

	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000002159

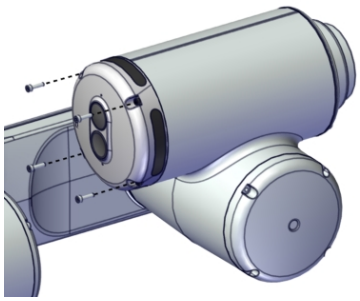
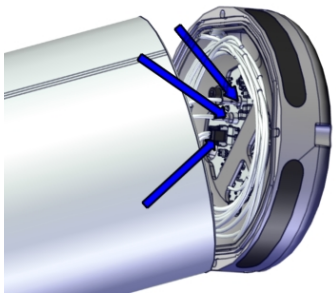
Removing the tool flange adapter

	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
3	Remove the tool flange adapter.	 xx2000002167

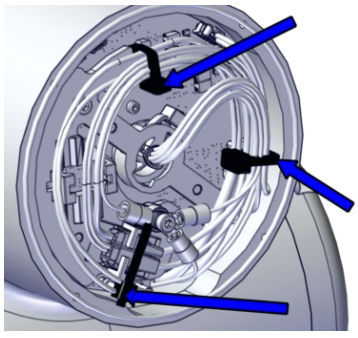
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Removing the arm-side interface

	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. • ASI.DC+ • ASI.DC- • ASI.X1	 xx2100000335

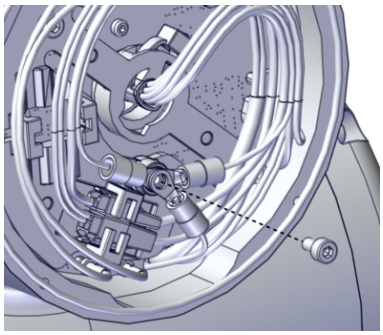
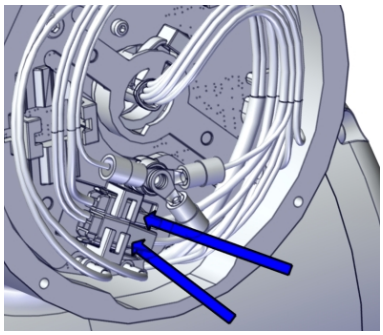
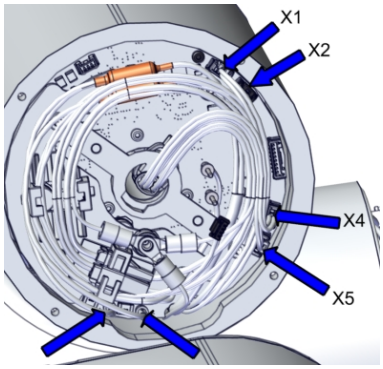
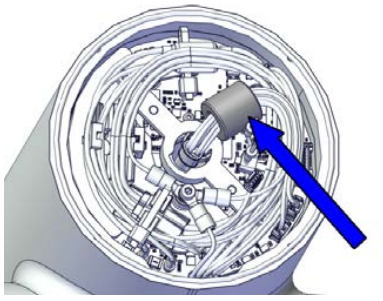
Disconnecting the axis-6 joint unit cabling

	Action	Note
1	Cut the cable ties.	 xx2000002161

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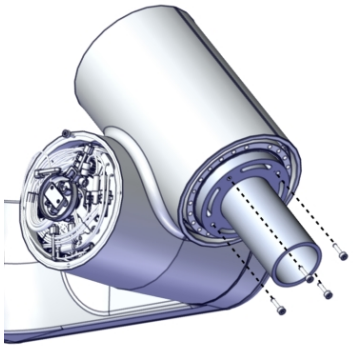
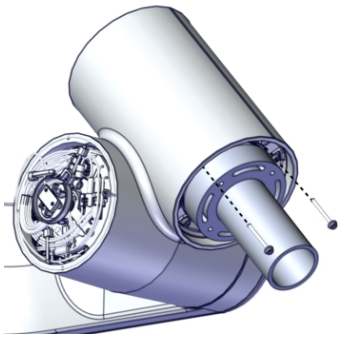
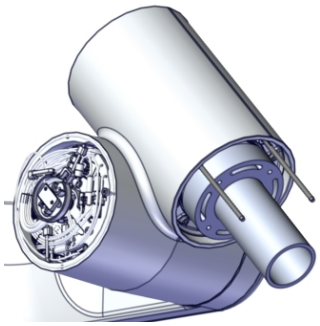
5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

	Action	Note
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002162
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 **CAUTION** Use tweezers to unlock connectors and pull them off.	Tweezers  xx2000002164
5	Remove the ferrite core by pulling the cables D6.X4 and D6.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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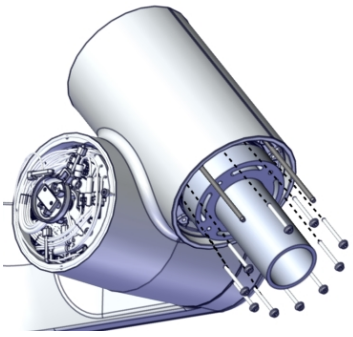
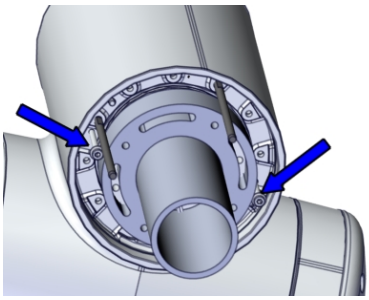
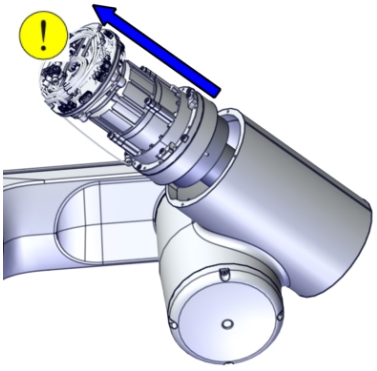
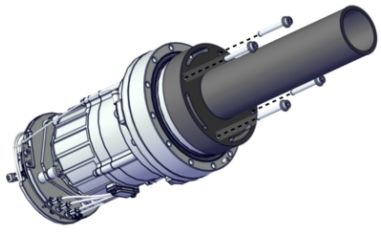
Removing the axis-6 joint unit

	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.
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

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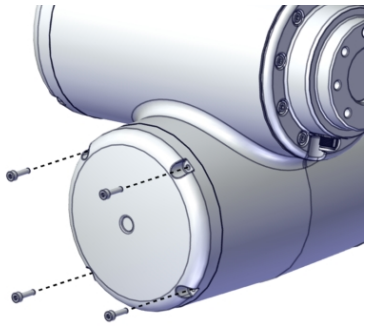
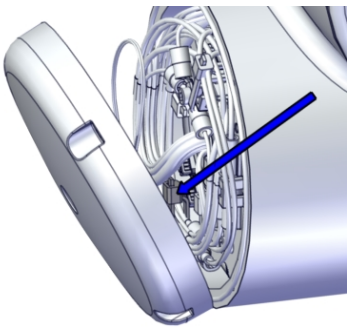
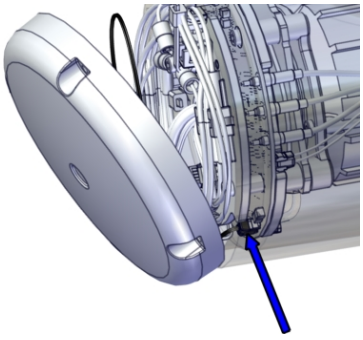
5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

	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.	 xx2100000329
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

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Removing the axis-5 cover

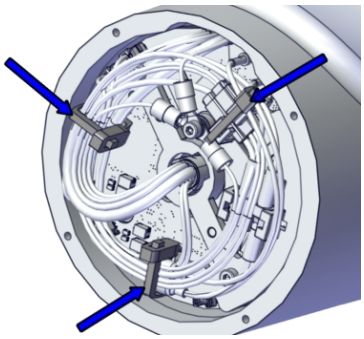
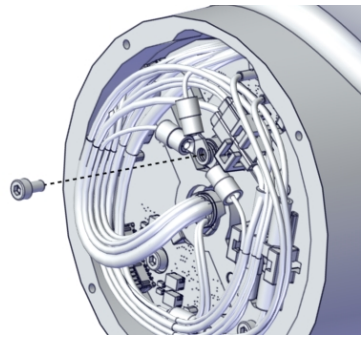
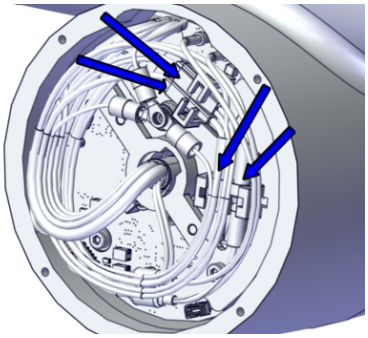
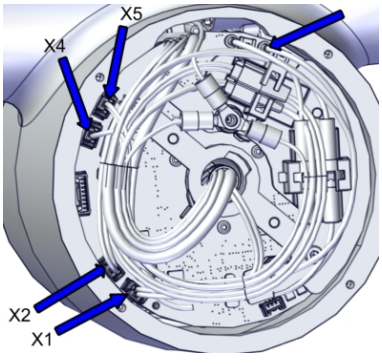
	Action	Note
1	Remove the cover by removing the four screws.	 xx2000002132
2	**CAUTION** **Valid for CRB 15000-5/0.95** There is cabling connected between the cover and the joint unit drive board. Open the cover with care to avoid damage to the cabling or the connector(s). Do not leave the cover in location without being secured with the attachment screws.	
3	**For robots with RobotWare earlier than 7.10** Open the cover and cut the cable tie that holds the brake release cable.	 xx2000002133
4	**For robots with RobotWare earlier than 7.10** Disconnect the brake release connector DR.X8 from the drive board. Remove the cover.	 xx2000002134

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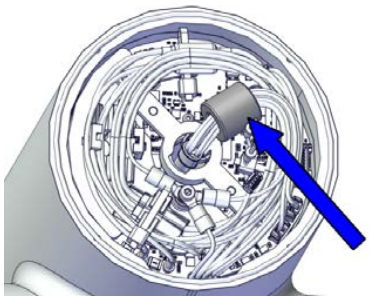
5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Disconnecting the axis-5 joint unit cabling

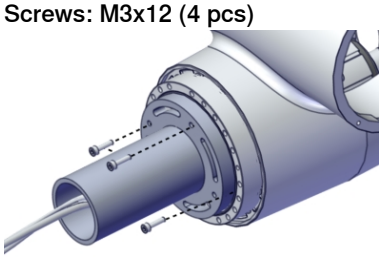
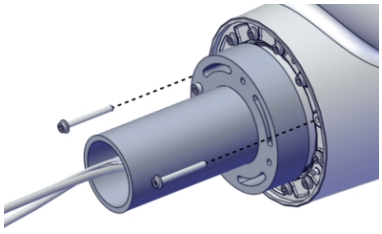
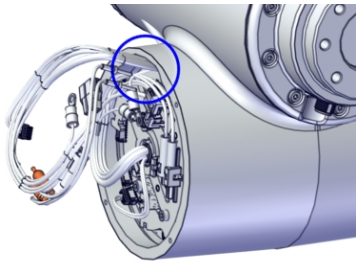
	Action	Note
1	Cut the cable ties.	 xx2000002135
2	Remove the functional and protective earth cables by removing the screw.	 xx2000002136
3	Snap loose and disconnect the connectors: • J5/6.DC+ • J5/6.DC- • J5/6.CS • J5/6.CP	 xx2000002137
4	Disconnect the connectors from the drive board. • D4/5.X1 • D5.DC+ • D5.DC- • D4/5.X4 • D5.X2 • D4/5.X5 **CAUTION** Use tweezers to unlock connectors and pull them off.	Tweezers  xx2000002138

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	Action	Note
5	Remove the ferrite core by pulling the cables D4/5.X4 and D4/5.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

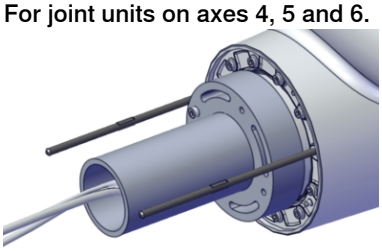
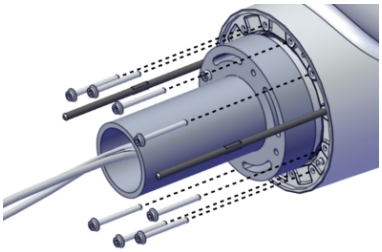
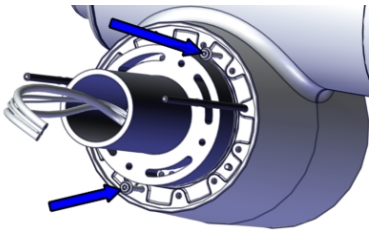
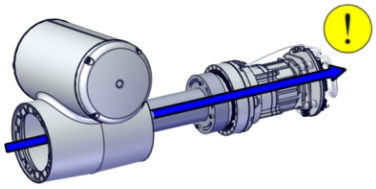
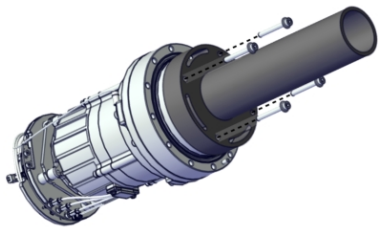
Removing the axis-5 joint unit

	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
2	Remove two attachment screws. Dispose the screws. New screws are included in the spare part delivery of the joint unit.	 xx2000002140
3	Put the cabling at the slot in order not to squeeze it during removal of joint unit.	 xx2100000284

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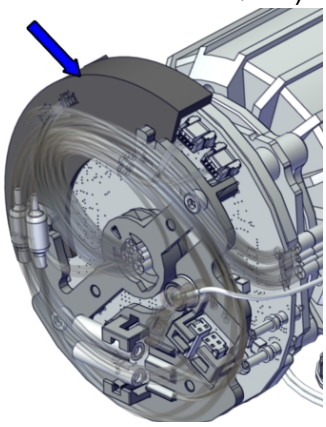
5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

	Action	Note
4	Fit two guide pins to the axis-5 joint unit.	Guide pin, M3x110: 3HAC077787-001 Always use guide pins in pairs. For joint units on axes 4, 5 and 6.  xx2100000332
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.	 xx2100000333
6	Press the joint unit out of position using two of the previous attachment screws as removal tools.	 xx2100000334
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

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Removing the joint cable

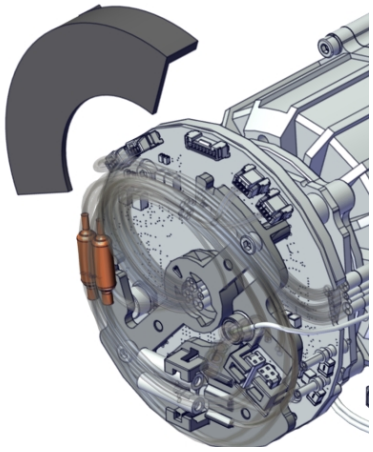
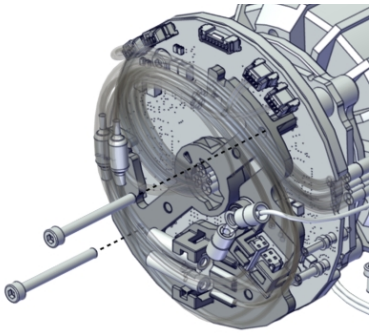
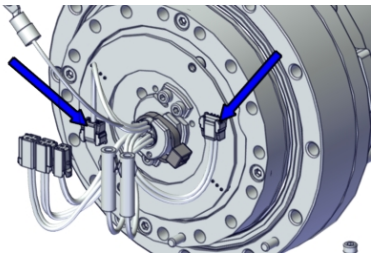
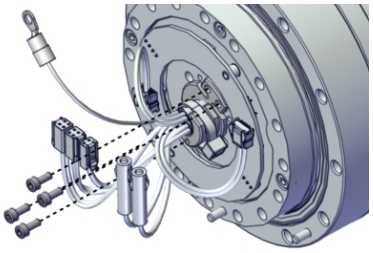
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Fit the protection plate to the drive board unit. **Tip** Using the protection plate is important for protecting the drive board unit. If complete joint unit is to be replaced, the protection plate is not needed.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
3	Cut the cable tie at the drive board.	 xx2000002058

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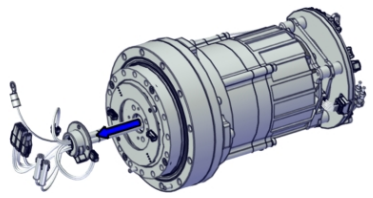
5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

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. • TQ.A • TQ.B	 xx2000002053
7	Remove the cable plate by removing the attachment screws.	 xx2000002049

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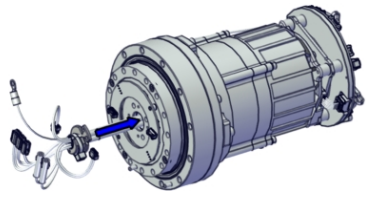
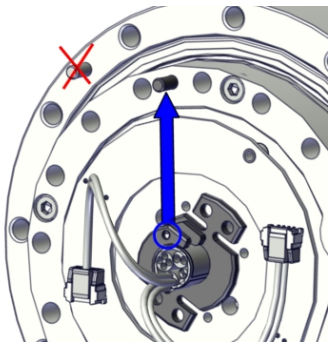
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	Action	Note
8	Remove the joint cable from the hollow shaft from the torque sensor side. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002060

Refitting the joint unit and transition cabling

Use these procedures to refit the joint unit and transition cabling.

Refitting the axis-5 joint unit cable

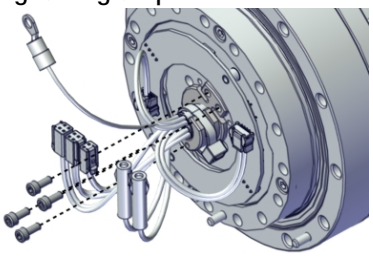
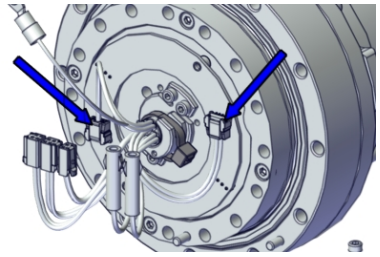
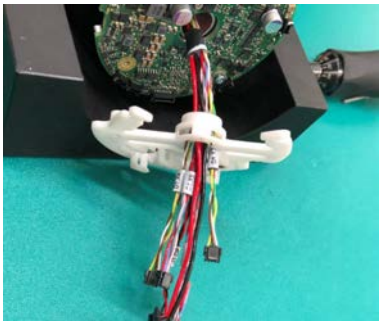
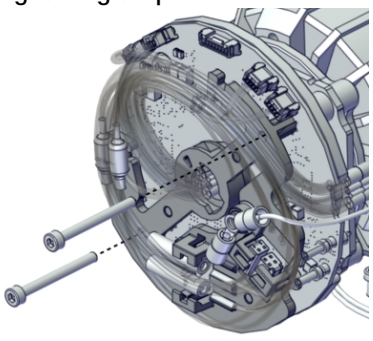
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Place the joint cable through the hollow shaft from the torque sensor side. **CAUTION** The connectors and the joint 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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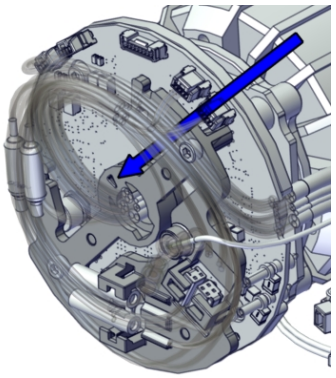
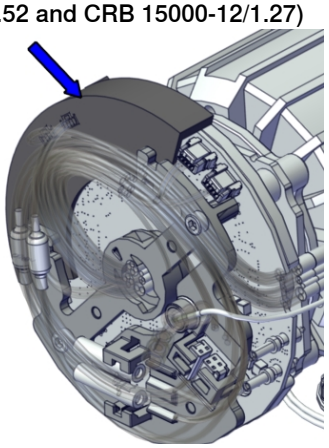
5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	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. • 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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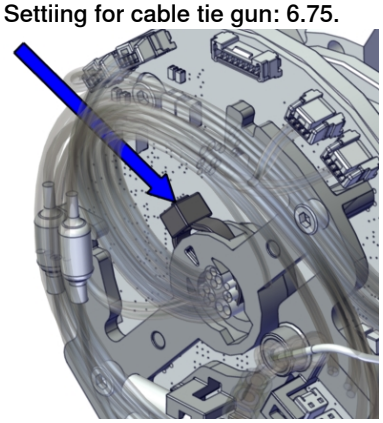
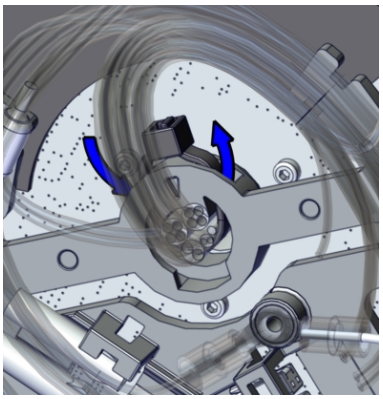
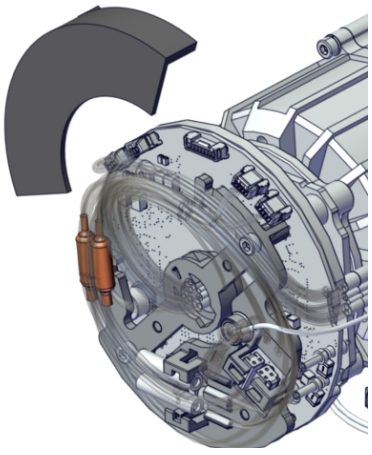
	Action	Note
7	Keep the cabling loose, making sure not to twist or strain it. Use the cable tie to pre-fix the cable by hand.	 xx2100000507
8	Fit the protection plate to the drive board unit.	Protection plate: 3HAC077790-001 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

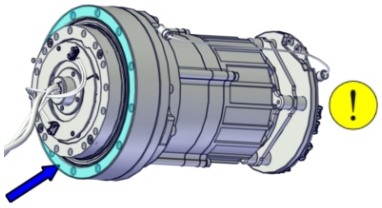
Continued

	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 EVO 7i Settiing for cable tie gun: 6.75.  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 *The unit is sensitive to ESD on page 53*.	
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 (or equivalent)  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 53*.	

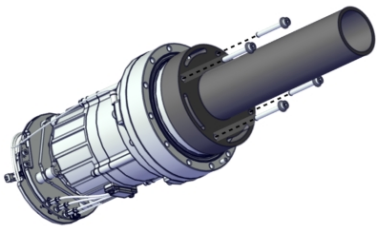
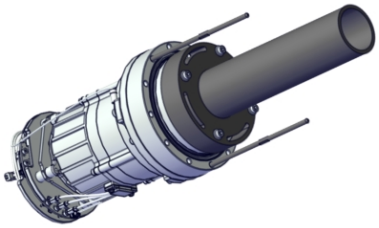
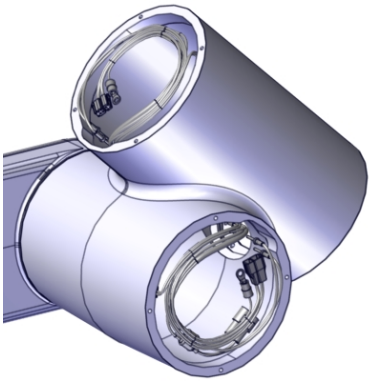
Refitting the axis-5 joint unit and transition cabling

	Action	Note
1	**CAUTION** Axis-5 joint unit used for CRB 15000-5/0.95 has the same appearance as that used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Do not mix the joint units for different manipulator variants. Always check the mark or label on the joint units before refitting.	

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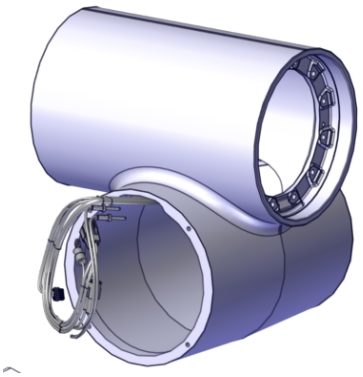
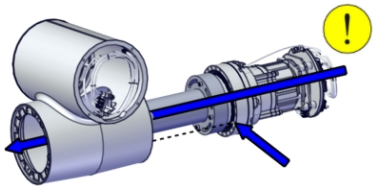
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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

	Action	Note
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: 3HAC079143-001 (for CRB 15000-5/0.95) / 3HAC087546-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
3	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
4	Fit the transition cable between axis-5 and axis-6 joint units into the tilt.	Cable harness, transition joint-5 and joint-6: 3HAC083726-001  xx2100000040

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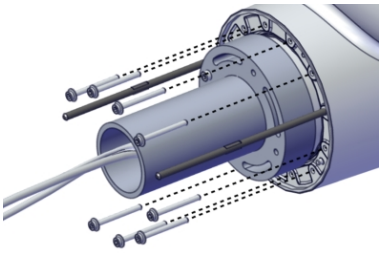
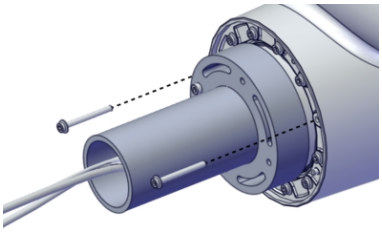
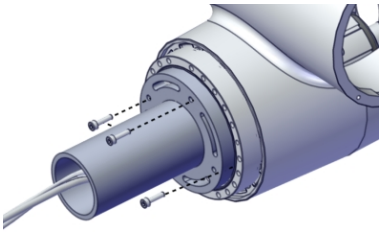
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	Action	Note
5	Place the cabling at the slot before refitting the joint unit.	 xx2100000041  xx2100000285
6	Fit the joint unit to the tilt, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002142

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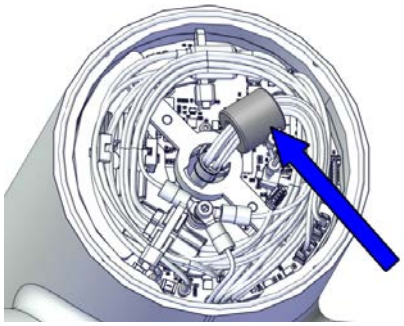
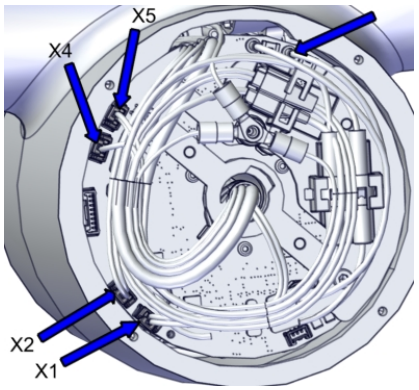
5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

	Action	Note
7	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 Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000333
8	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002140
9	Pre-tighten the screws crosswise.	
10	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm (for CRB 15000-5/0.95) / 1.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)
11	Remove the lifting aid by removing the screws.	 xx2000002139
12	Clean pushed-out flange sealant, if any.	

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Connecting the axis-5 joint unit cabling

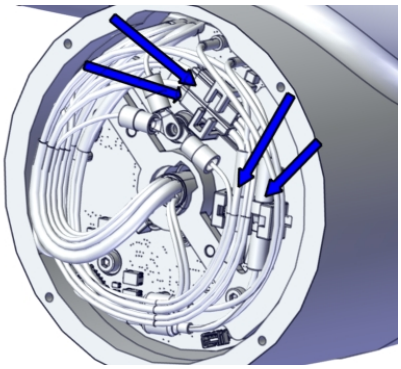
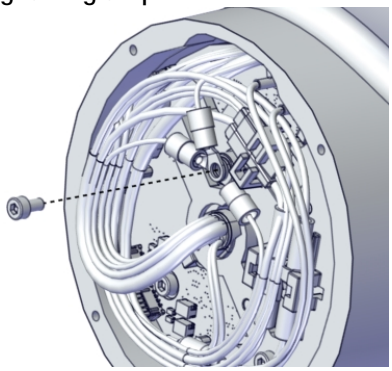
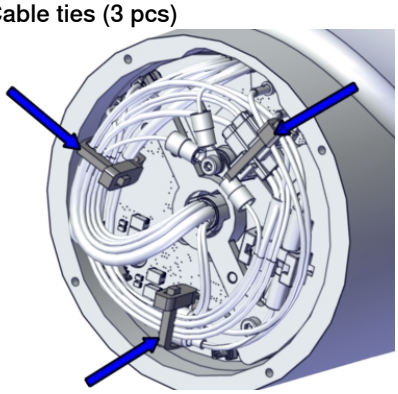
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D4/5.X4 and D4/5.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483
4	Reconnect the connectors to the drive board. • 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

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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

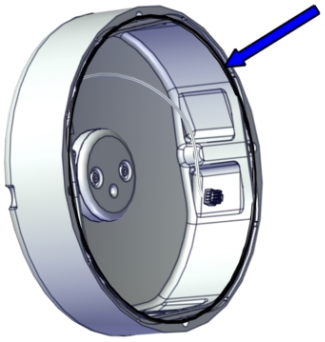
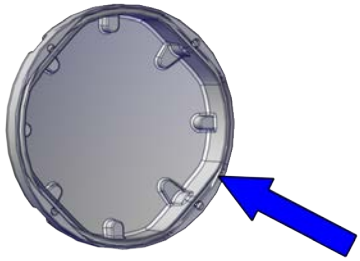
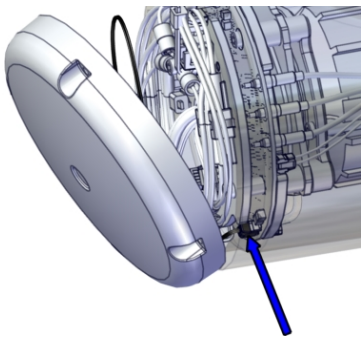
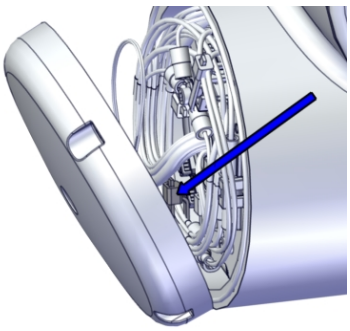
Continued

	Action	Note
5	Connect the connectors to each other and snap them to the cable holders. • 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
6	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
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002135

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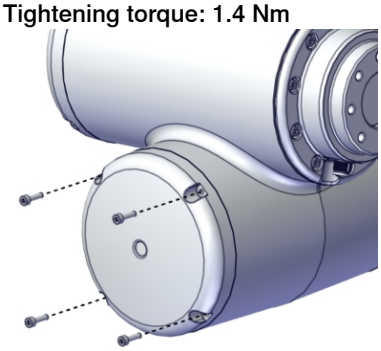
Refitting the axis-5 cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	**Valid for CRB 15000-5/0.95** O-ring: 3HAC061327-051  xx2000001962 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 O-ring: 3HAC061327-051  xx2300000849
2	**For robots with RobotWare earlier than 7.10** Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	 xx2000002134
3	**For robots with RobotWare earlier than 7.10** Secure the brake release cable with a cable tie.	Cable ties  xx2000002133

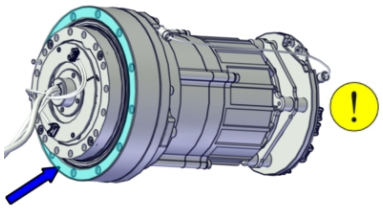
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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

	Action	Note
4	Refit the cover with the four screws.	**Valid for CRB 15000-5/0.95** Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.2 Nm **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 Hex socket head cap screw: M3x12 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.4 Nm  xx2000002132

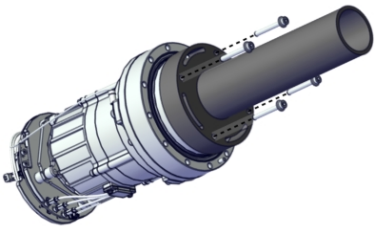
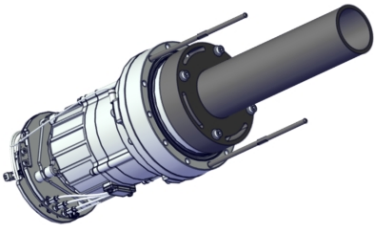
Preparations before fitting the joint unit

	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 53*.	
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 (or equivalent)  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 53*.	

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Refitting the axis-6 joint unit

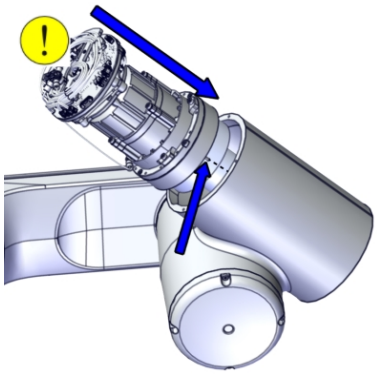
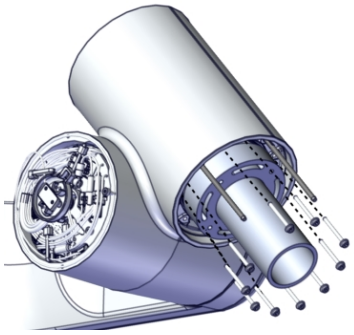
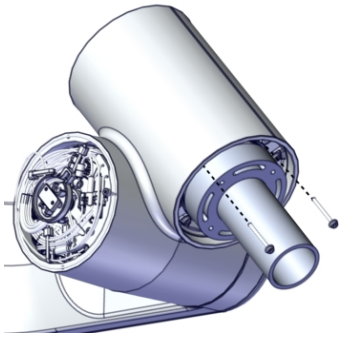
	Action	Note
1	**CAUTION** Axis-6 joint unit used for CRB 15000-5/0.95 has the same appearance as that used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Do not mix the joint units for different manipulator variants. Always check the mark or label on the joint units before refitting.	
2	Fit the lifting 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: 3HAC079143-001 (for CRB 15000-5/0.95) / 3HAC087546-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
3	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
4	Place the cabling at the slot before refitting the joint unit.	 xx2100000041

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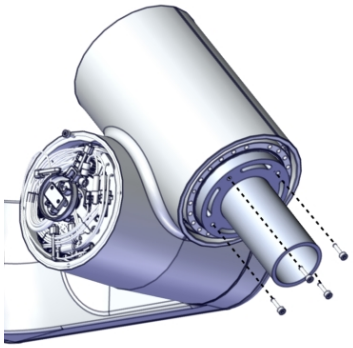
5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

Continued

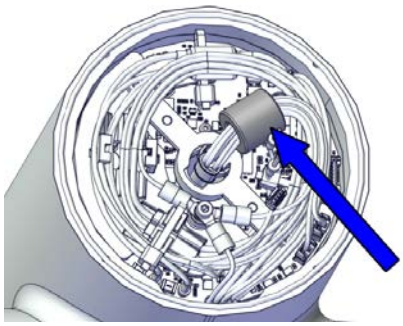
	Action	Note
5	Fit the joint unit to the tilt, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002195
6	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000329
7	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002170
8	Pre-tighten the screws crosswise.	
9	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm (for CRB 15000-5/0.95) / 1.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)

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	Action	Note
10	Remove the lifting aid by removing the screws.	 xx2000002168
11	Clean pushed-out flange sealant, if any.	

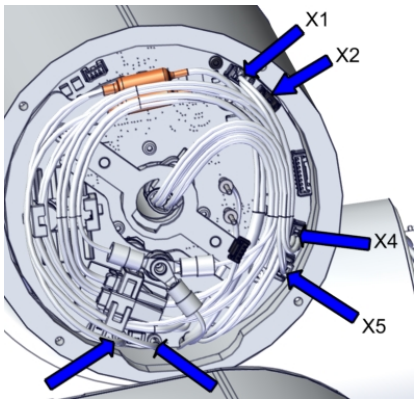
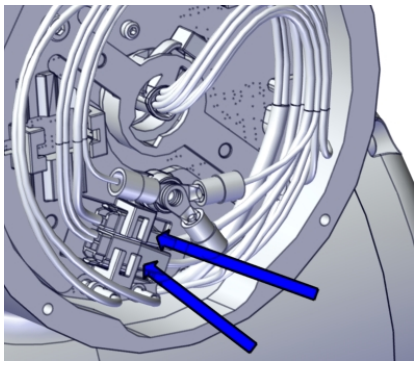
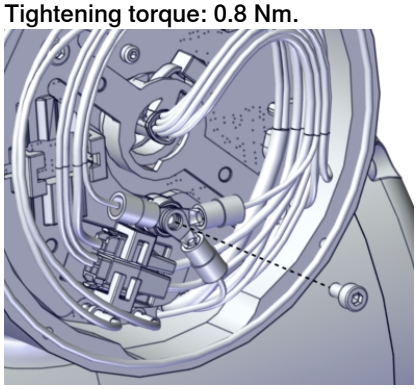
Connecting the axis-6 joint unit cabling

	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 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D6.X4 and D6.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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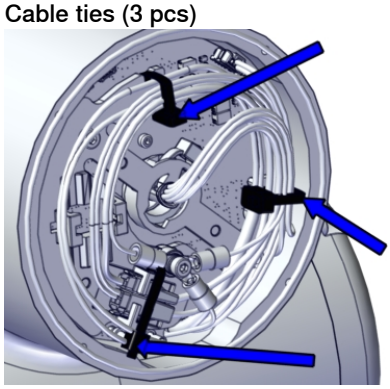
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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

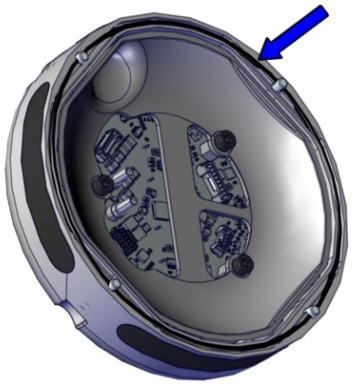
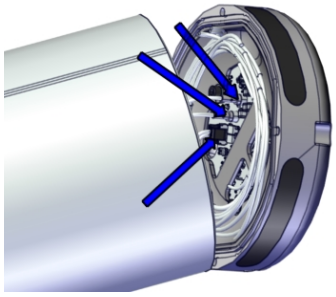
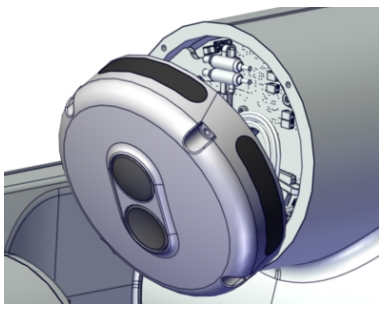
	Action	Note
4	Reconnect the connectors to the drive board. • D6.X1 to X1 • D6.DC+ to +DC • D6.DC- to Ground • D6.X4 to X4 • D6.X2 to X2 • D6.X5 to X5	 xx2000002164
5	Connect the connectors to each other and snap them to the cable holders. • J7.CS to J7.CS • J7.CP to J7.CP	 xx2000002163
6	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002162

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	Action	Note
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002161

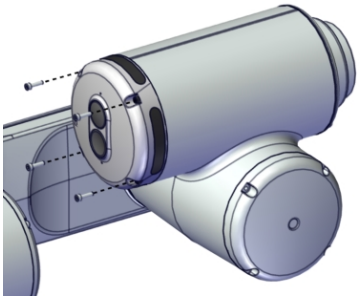
Refitting the arm-side interface

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002551
2	Place the arm-side interface at mounting position and reconnect the connectors. • 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  xx2100000336

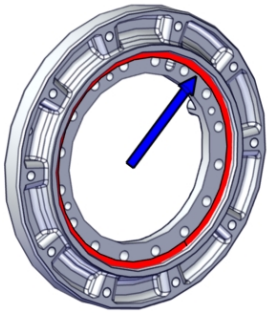
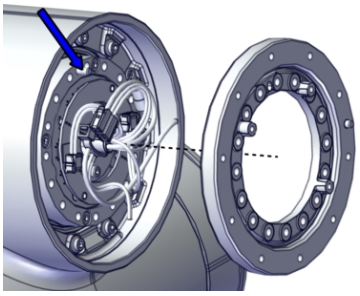
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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

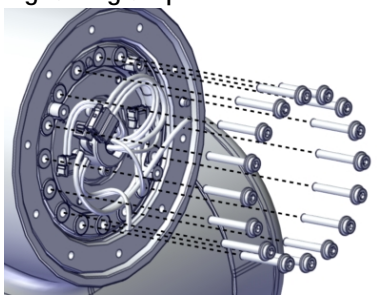
	Action	Note
3	Refit the arm-side interface with four screws.	**Valid for CRB 15000-5/0.95** Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002550

Refitting the tool flange adapter

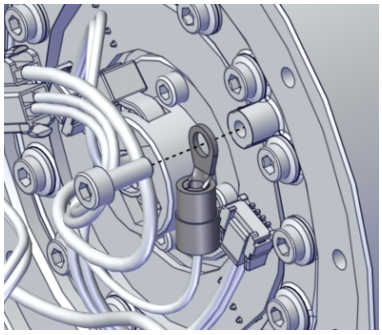
	Action	Note
1	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the adapter mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000002196
2	Refit the tool flange adapter, aligning the pin with the pin hole.	Tool flange adapter: 3HAC073952-001  xx2000002167

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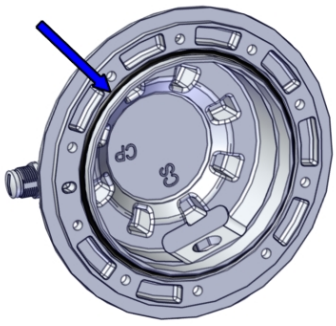
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	Action	Note
3	Secure with screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) Tightening torque: 1.8 Nm.  xx2000002165

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

Refitting the tool flange

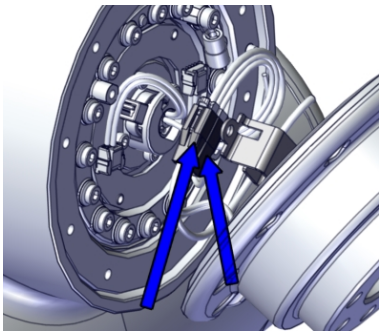
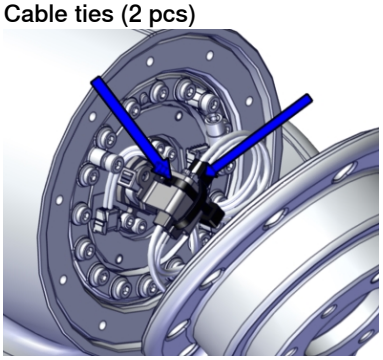
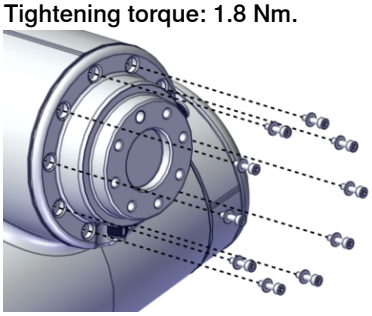
	Action	Note
1	Check the o-ring on the tool flange and lubricate with grease. Replace if damaged.	Axis-6 flange: 3HAC073953-001 O-ring: 3HAB3772-182 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002197

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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling

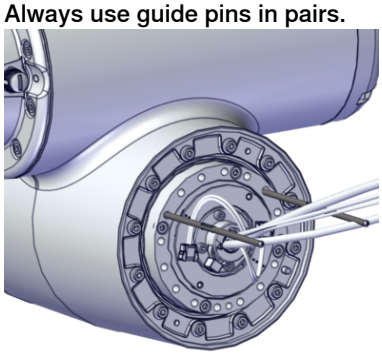
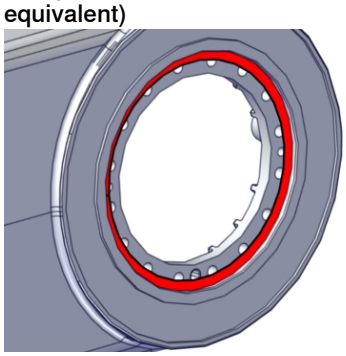
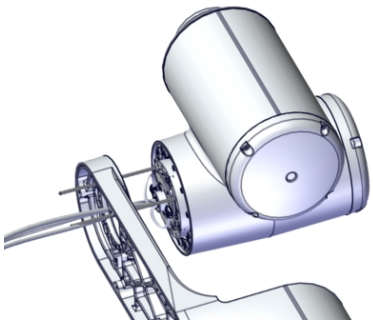
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	Action	Note
2	Place the tool flange at mounting position and reconnect the CP/CS connectors.	 xx2000002158
3	Fit the connectors to the cable bracket and secure the connectors with two cable ties.	Cable ties (2 pcs)  xx2000002157
4	Refit and secure 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

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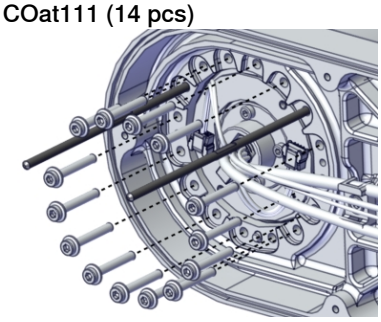
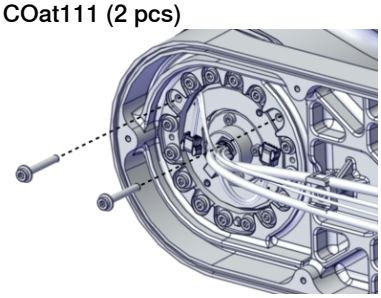
Refitting the tilt

	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 (or equivalent)  xx2000002147
3	Lift the tilt into mounting position while inserting the cabling into the tubular.	 xx2000002131
4	Slide the tilt into place on the guide pins.	

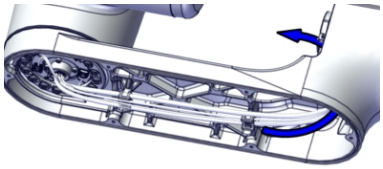
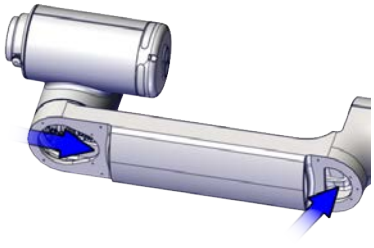
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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
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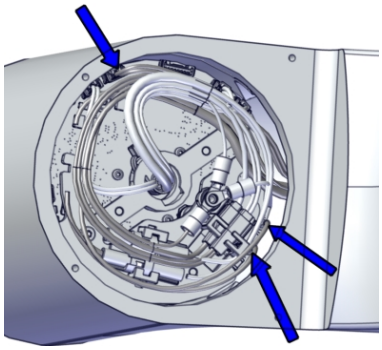
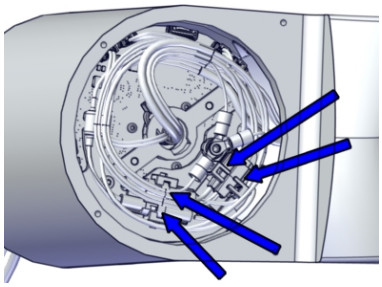
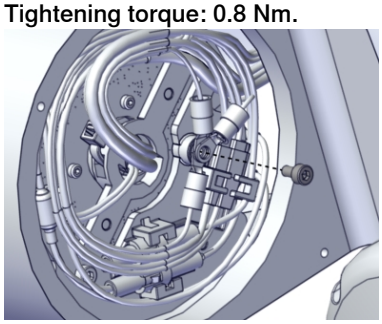
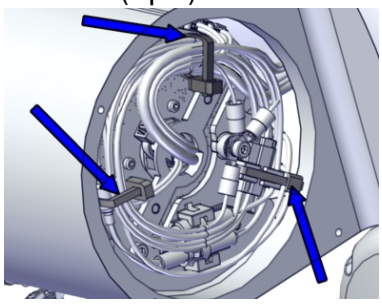
	Action	Note
5	Secure the tilt to the tubular with all attachment screws but two. Pre-tighten the screws crosswise firstly.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (14 pcs)  xx2000002130
6	Remove the guide pins and fasten the remaining two screws.	Flange socket head screw: M3x20 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.	**Valid for CRB 15000-5/0.95**  xx2000002148 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000845

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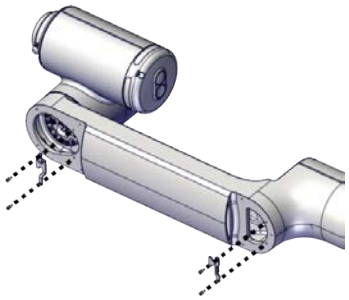
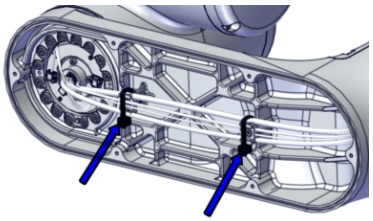
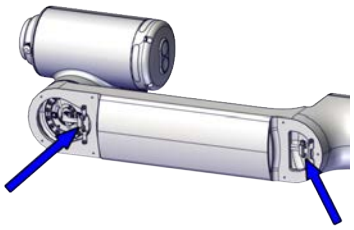
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	Action	Note
2	Reconnect the connectors to the drive board. • D3/4.X2 to X2 • D3/4.DC- to Ground • D3/4.DC+ to +DC	 xx2000002125
3	Connect the connectors to each other and snap them to the cable holders. • J4/5.DC+ to J5/6.DC+ • J4/5.DC- to J5/6.DC- • 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 to joint unit with cable ties.	Cable ties (3 pcs)  xx2000002086

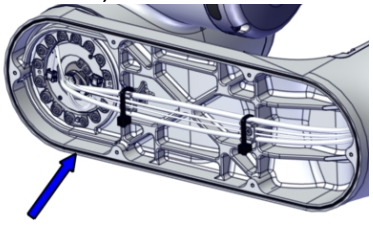
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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

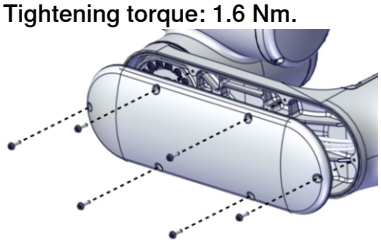
	Action	Note
6	**Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27** Refit the cable brackets.	Hex socket head cap screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs for each). Tightening torque: 0.8 Nm.  xx2300000843
7	Secure the cabling to tubular with cable ties.	Cable ties (2 pcs) **Valid for CRB 15000-5/0.95**  xx2000002124 **Valid for CRB 15000-10/1.52 and CRB 15000-12/1.27**  xx2300000842

Refitting the tubular cover (-5/0.95)

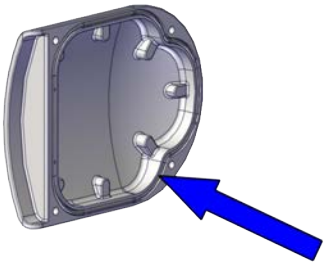
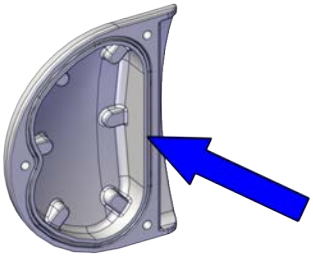
	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-043 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002149

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	Action	Note
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 of CRB 15000-5/0.95. 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

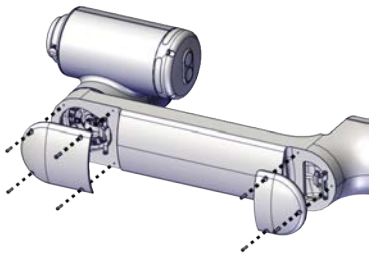
Refitting the tubular cover (-10/1.52 and -12/1.27)

	Action	Note
1	Wipe, lubricate and fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-076 O-ring: 3HAB3772-166 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2300000846  xx2300000847

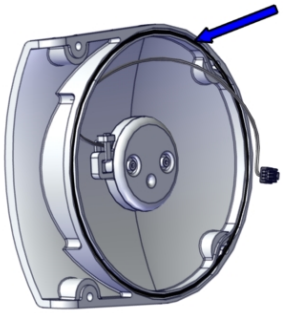
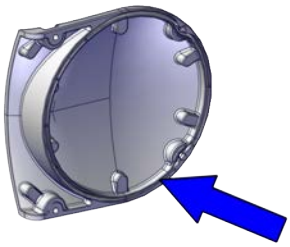
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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

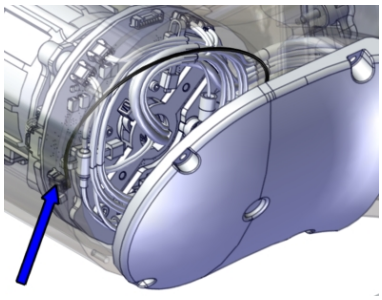
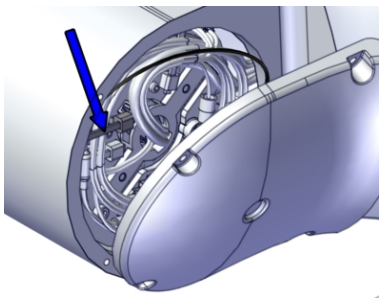
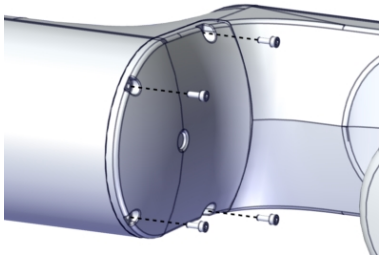
	Action	Note
2	Refit the covers with new attachment screws.	Hex socket head cap screw:M3x12 12.9 Lafre 2C2B/FC6.9 (7 pcs in total) Tightening torque: 1.4 Nm.  xx2300000841

Refitting the axis-4 cover

	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	**Valid for CRB 15000-5/0.95** O-ring: 3HAC061327-051  xx2000002092 **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 O-ring: 3HAC061327-051  xx2300000848

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	Action	Note
2	**For robots with RobotWare earlier than 7.10** Place the cover at mounting position and reconnect the brake release connector DR.X8 to the drive board.	Tweezers  xx2000002085
3	**For robots with RobotWare earlier than 7.10** 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 (for CRB 15000-5/0.95) / 0.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Tightening torque: 0.9 Nm  xx2000002083

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5.6.7 Replacing the axis-5 joint unit and the axis-5 to axis-6 transition cabling
Continued

Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

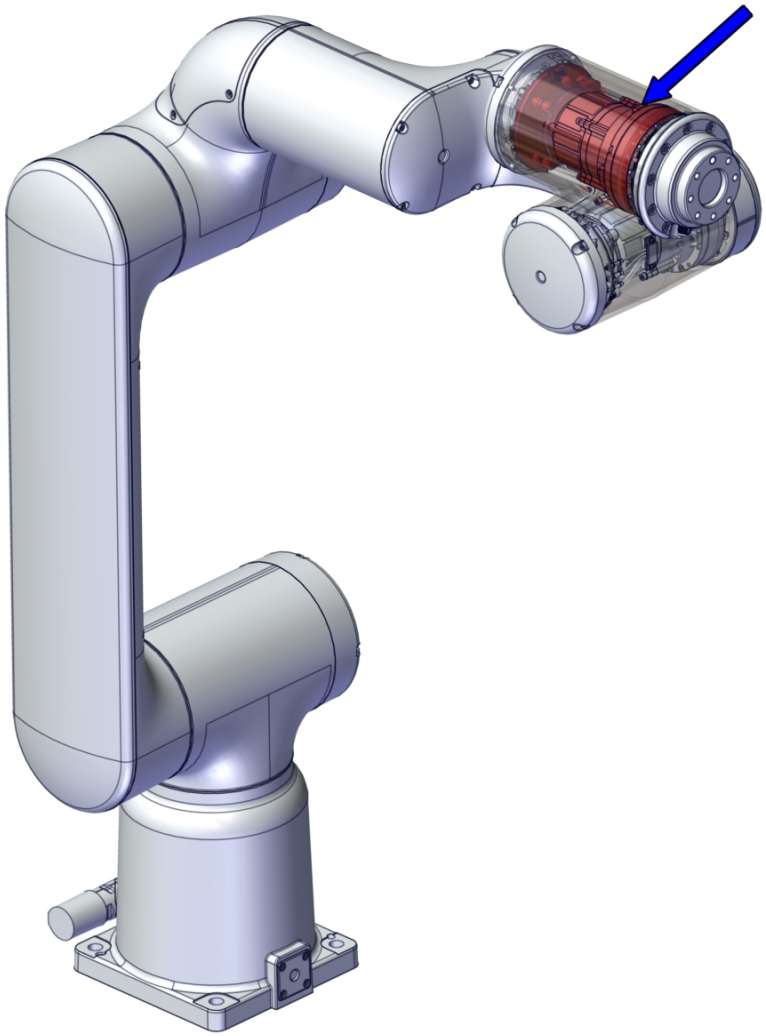
	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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5.6.8 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

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5.6.8 Replacing the axis-6 joint unit
Continued

Required spare parts

> **Note**
>
> The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 15000 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Joint unit	3HAC079143-001	Used for CRB 15000-5/0.95. New attachment screws and cable tie 3HAC075545-001 are included in the delivery.
Joint unit	3HAC087546-001	New attachment screws and cable tie 3HAC075545-001 are included in the delivery.
Ferrite core	3HAC092224-001	

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 units of CRB 15000-5/0.95.
Protection plate	3HAC087789-001	For protection of drive board during cabling installation on joint units of CRB 15000-10/1.52 and CRB 15000-12/1.27.
Cable tie gun EVO 7i	-	HellermannTyton 110-77001 or similar
Tweezers	-	Used to handle drive board connectors.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 1083*.

Required consumables

Consumable	Article number	Note
Cleaning agent	-	Isopropanol
Flange sealant	-	Loctite 574 (or equivalent)
Grease	3HAC042536-001	Shell Gadus S2
O-ring	3HAB3772-182	Tool flange
O-ring	3HAC061327-051	Arm-side interface Replace if damaged.

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Consumable	Article number	Note
Cable ties	-	

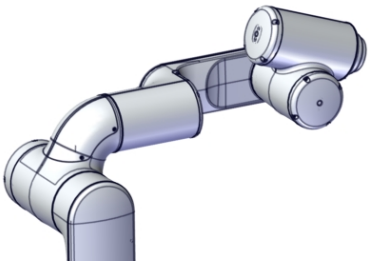
Removing the joint unit

Use these procedures to remove the joint unit.

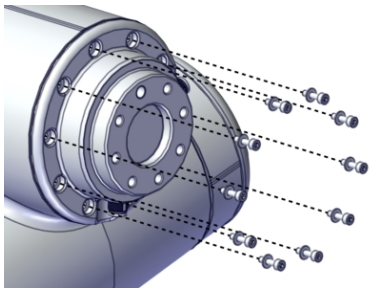
Note

If the RobotWare version is older than 7.10, then create a backup of the system before replacing the joint unit. After the replacement, the software must be upgraded to version 7.10 or later.

Preparations before removing the joint unit

	Action	Note
1	Jog the robot to the specified position: • 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) **CAUTION** 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.	Example of CRB 15000-5/0.95, similar to CRB 15000-10/1.52 and CRB 15000-12/1.27.  xx2100000043
2	**CAUTION** Turn off all supplies for electrical power to the robot, before starting the repair work.	

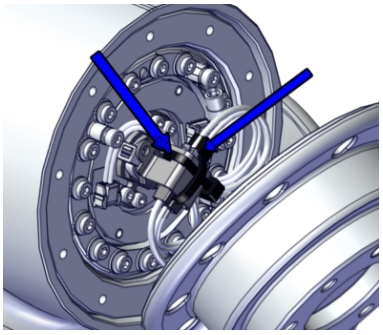
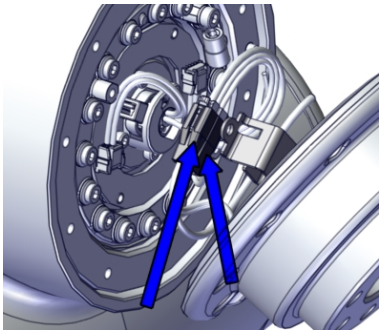
Removing the tool flange

	Action	Note
1	Remove the tool flange screws and washers.	 xx2000002155

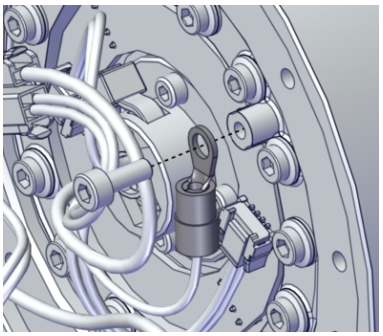
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5.6.8 Replacing the axis-6 joint unit
Continued

	Action	Note
2	**CAUTION** **Valid for CRB 15000-5/0.95** 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	Cut the cable ties.	 xx2000002157
4	Disconnect the CP/CS connectors from the drive board and remove the tool flange.	 xx2000002158

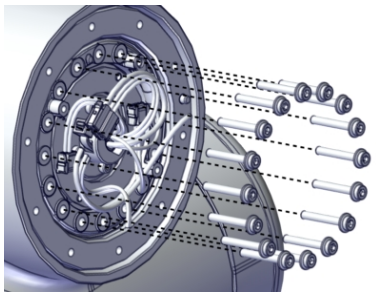
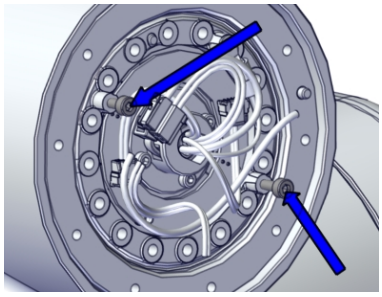
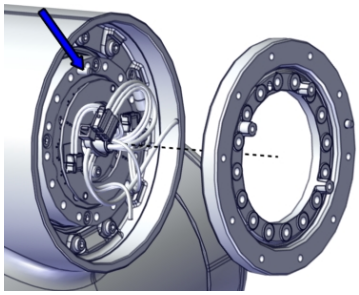
Disconnecting the tool flange functional earth cable

	Action	Note
1	Remove the functional earth cable by removing the screw.	 xx2000002159

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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

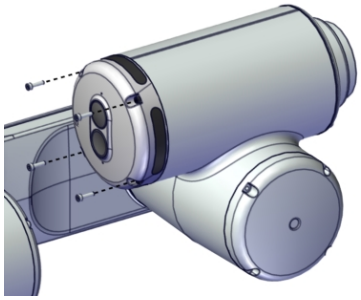
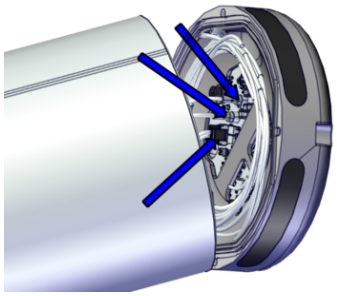
Removing the arm-side interface

	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.	

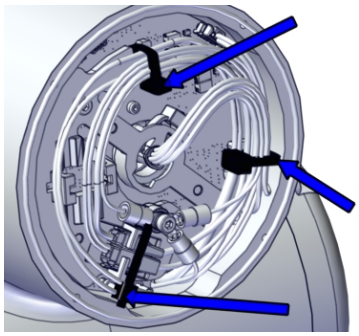
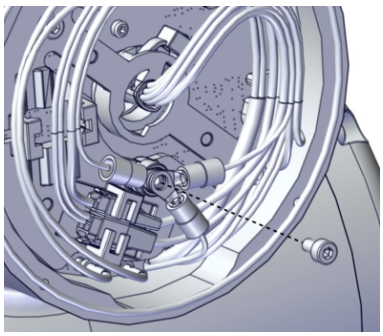
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5.6.8 Replacing the axis-6 joint unit
Continued

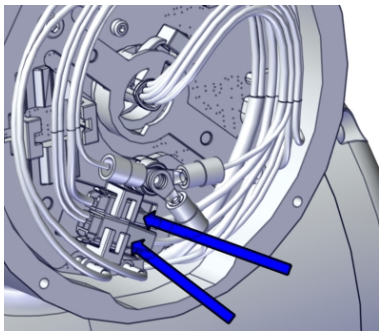
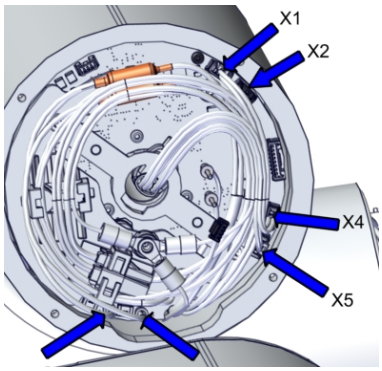
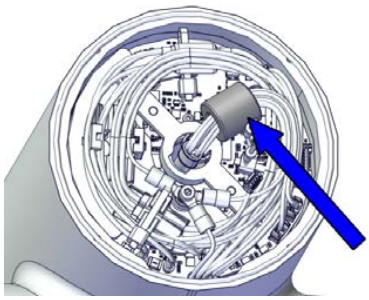
	Action	Note
3	Remove the attachment screws.	 xx2000002550
4	Loosen the arm-side interface carefully and disconnect the connectors from it. • ASI.DC+ • ASI.DC- • ASI.X1	 xx2100000335

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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	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 **CAUTION** Use tweezers to unlock connectors and pull them off.	Tweezers 
 xx2000002164
5	Remove the ferrite core by pulling the cables D6.X4 and D6.X5 out of it carefully. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

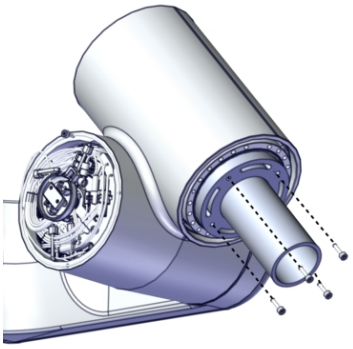
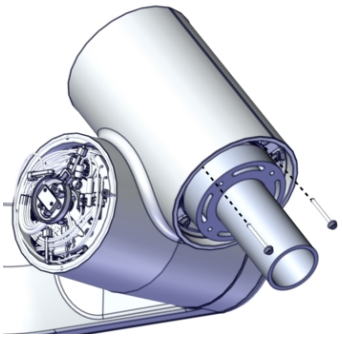
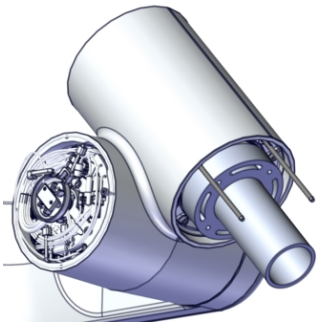
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5.6.8 Replacing the axis-6 joint unit

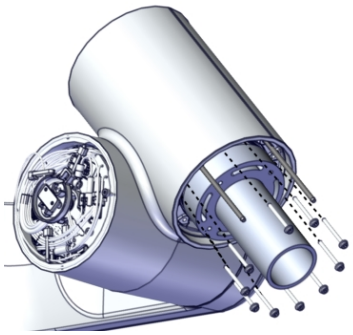
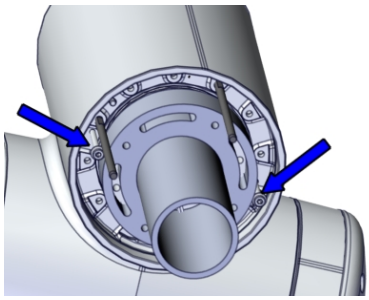
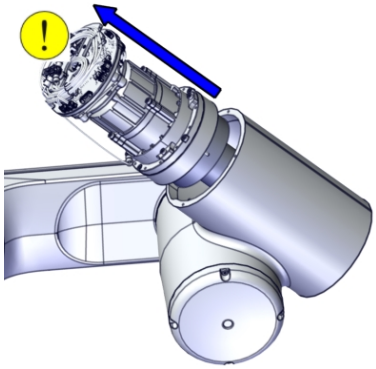
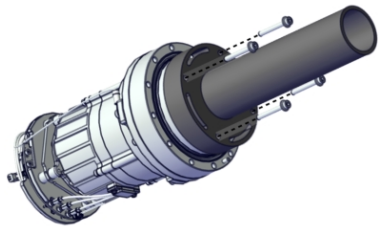
Continued

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.
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

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	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.	 xx2100000329
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

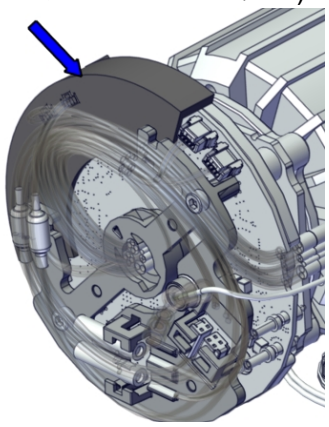
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5.6.8 Replacing the axis-6 joint unit

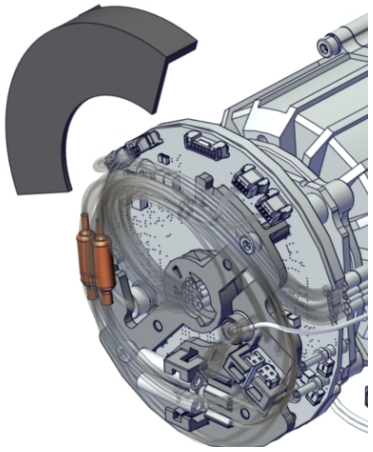
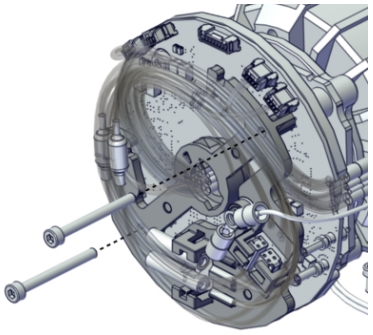
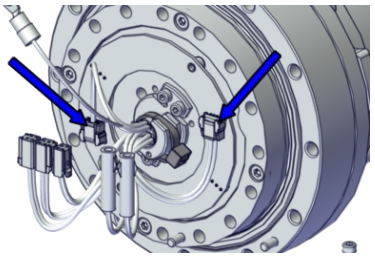
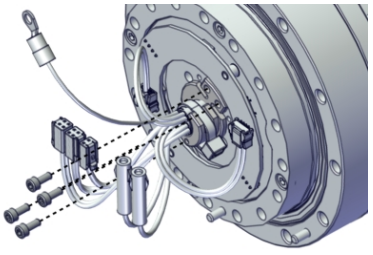
Continued

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 53*.	
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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057
3	Cut the cable tie at the drive board.	 xx2000002058

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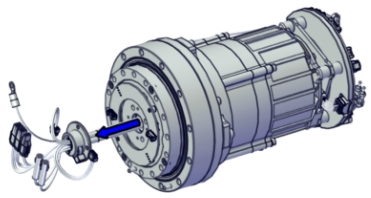
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	Action	Note
4	Remove the protection plate.	 xx2100000301
5	Remove the cable support from the drive board by removing the attachment screws.	 xx2000002055
6	Disconnect the two connectors from the torque sensor board. • TQ.A • TQ.B	 xx2000002053
7	Remove the cable plate by removing the attachment screws.	 xx2000002049

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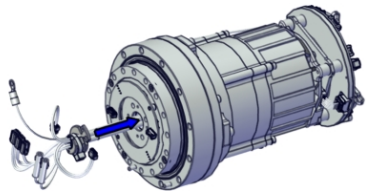
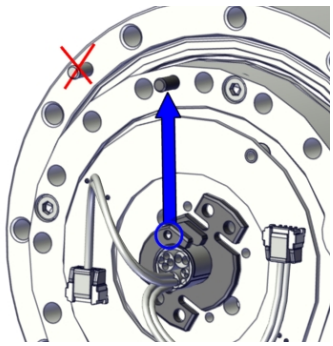
5.6.8 Replacing the axis-6 joint unit
Continued

	Action	Note
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

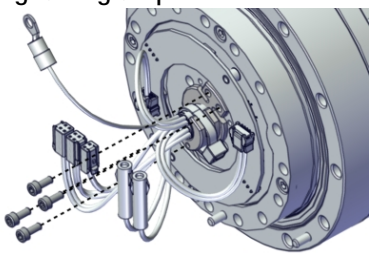
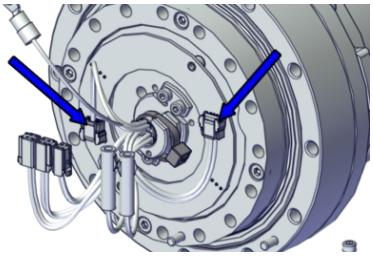
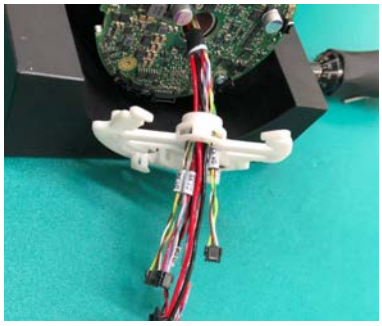
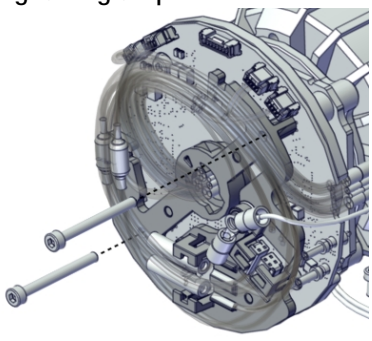
Use these procedures to refit the joint unit.

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 53*.	
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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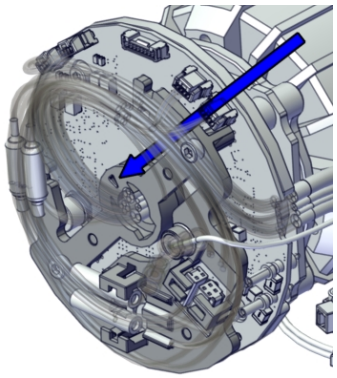
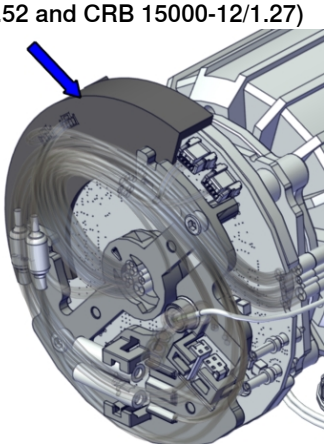
	Action	Note
4	Secure the cable plate to the joint unit with the attachment screws.	Hex socket head cap screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm.  xx2000002049
5	Connect the two connectors to the torque sensor board. • TQ.A to CH1/A • TQ.B to CH2/B	 xx2000002053
6	Insert 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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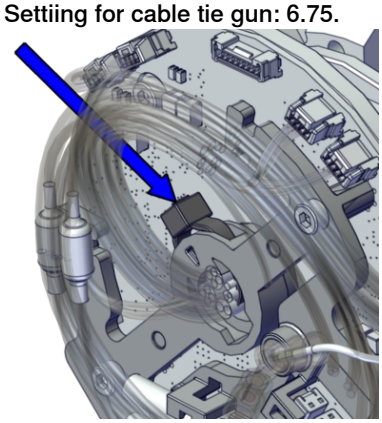
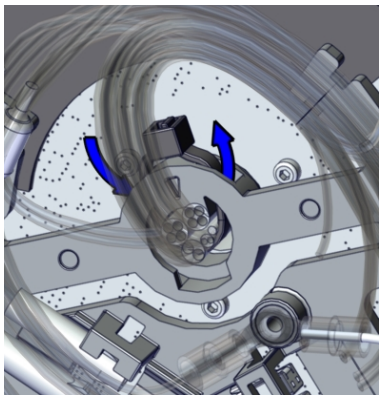
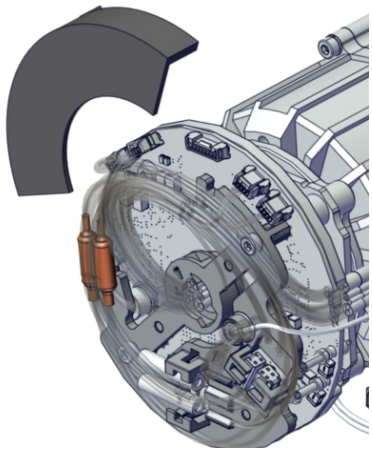
5.6.8 Replacing the axis-6 joint unit

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 (for CRB 15000-5/0.95) / 3HAC087789-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27)  xx2000002057

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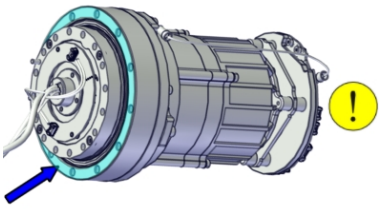
	Action	Note
9	Secure the cables to the cable support with a cable tie, using a cable tie gun. Assembly direction for the cable tie is shown in the figure.	Cable tie: 3HAC075545-001. For securing joint unit cable. Cable tie gun EVO 7i Settiing for cable tie gun: 6.75.  xx2000002058  xx2000002059
10	Remove the protection plate.	 xx2100000301

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5.6.8 Replacing the axis-6 joint unit
Continued

Preparations before fitting the joint unit

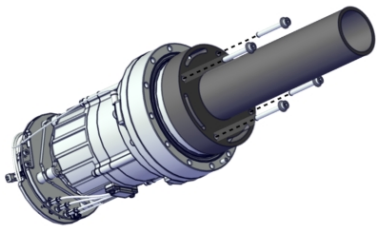
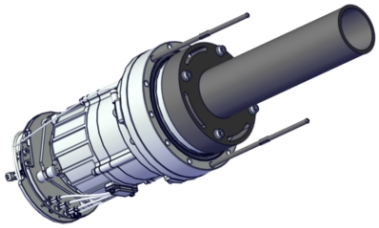
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Clean the mounting surface of the joint unit and the mating surface on the casting with isopropanol. Joint unit mounting surface is pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  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 53*.	

Refitting the axis-6 joint unit

	Action	Note
1	**CAUTION** Axis-6 joint unit used for CRB 15000-5/0.95 has the same appearance as that used for CRB 15000-10/1.52 and CRB 15000-12/1.27. Do not mix the joint units for different manipulator variants. Always check the mark or label on the joint units before refitting.	

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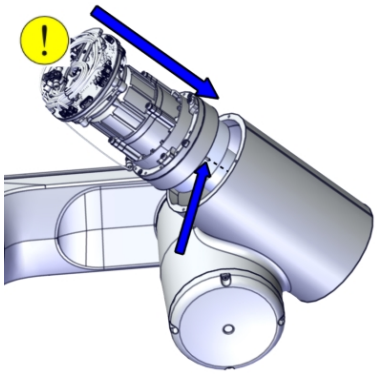
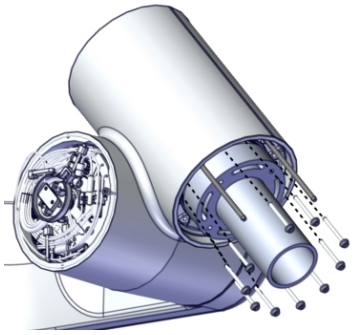
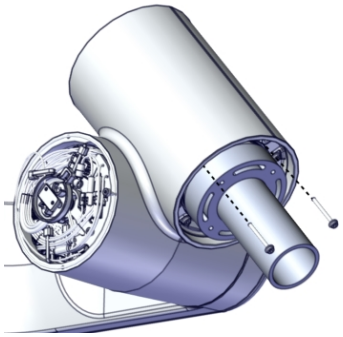
	Action	Note
2	Fit the lifting aid to the joint unit. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	Joint unit: 3HAC079143-001 (for CRB 15000-5/0.95) / 3HAC087546-001 (for CRB 15000-10/1.52 and CRB 15000-12/1.27) Lifting aid: 3HAC077789-001 Screws: M3x12 (4 pcs)  xx2000001957
3	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
4	Place the cabling at the slot before refitting the joint unit.	 xx2100000041

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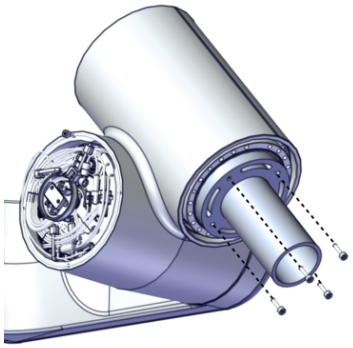
5.6.8 Replacing the axis-6 joint unit

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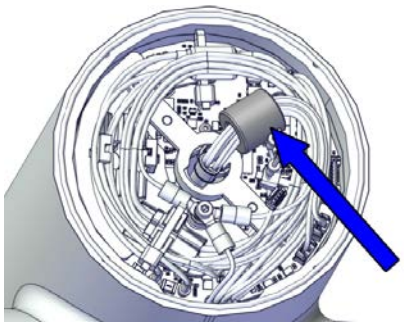
	Action	Note
5	Fit the joint unit to the tilt, aligning the pin with the pin hole. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2000002195
6	Secure the joint unit with new attachment screws.	Flange socket head screw with glue: 3HAB3413-330 M3x30 12.9 Lafre 2C2B/FC6.9+PrO-COat111, with NYPLAS glue , 12 pcs Used for joint unit of CRB 15000-5/0.95. Always use new screws when refitting a joint unit. If ordering a new joint unit spare part, new screws are included.  xx2100000329
7	Remove the guide pins and secure the remaining two attachment screws.	 xx2000002170
8	Pre-tighten the screws crosswise.	
9	Torque tighten all screws crosswise.	Tightening torque: 1.4 Nm (for CRB 15000-5/0.95) / 1.9 Nm (for CRB 15000-10/1.52 and CRB 15000-12/1.27)

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	Action	Note
10	Remove the lifting aid by removing the screws.	 xx2000002168
11	Clean pushed-out flange sealant, if any.	

Connecting the axis-6 joint unit cabling

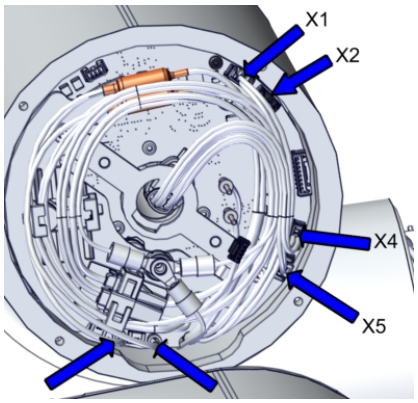
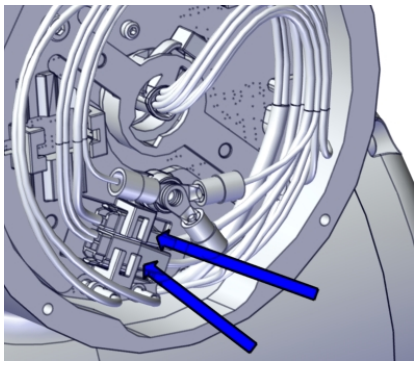
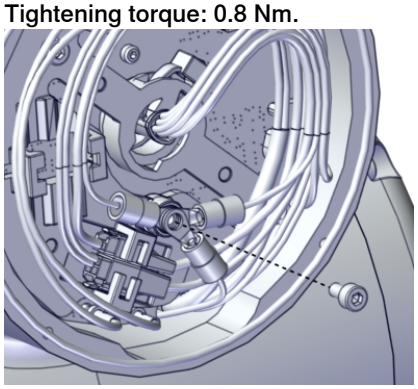
	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 53*.	
2	Check the ferrite core. Replace if damaged.	Ferrite core: 3HAC092224-001  xx2400001484
3	Thread the cables D6.X4 and D6.X5 through the ferrite core in sequence. **CAUTION** The connectors and the joint unit cables are sensitive to mechanical damage. Handle the assembly with care.	 xx2400001483

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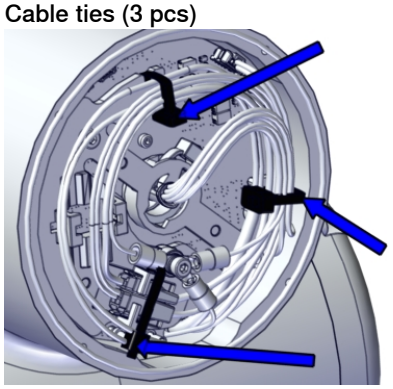
5.6.8 Replacing the axis-6 joint unit

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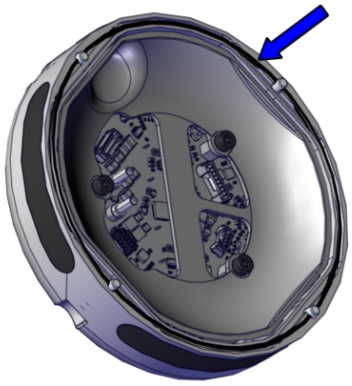
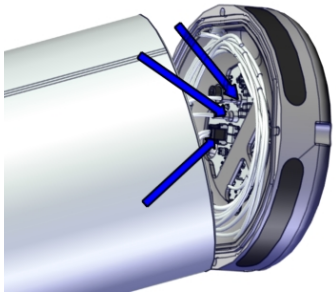
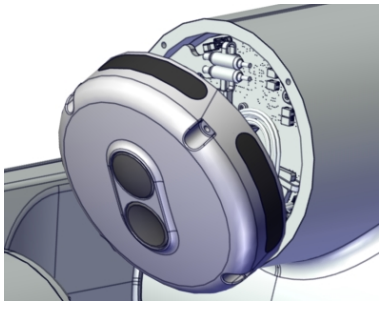
	Action	Note
4	Reconnect the connectors to the drive board. • D6.X1 to X1 • D6.DC+ to +DC • D6.DC- to Ground • D6.X4 to X4 • D6.X2 to X2 • D6.X5 to X5	 xx2000002164
5	Connect the connectors to each other and snap them to the cable holders. • J7.CS to J7.CS • J7.CP to J7.CP	 xx2000002163
6	Secure the cables for functional earth and protective earth with a screw.	Hex socket head cap screw: M3x6 (1 pcs). Tightening torque: 0.8 Nm.  xx2000002162

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	Action	Note
7	Secure the cabling with cable ties.	Cable ties (3 pcs)  xx2000002161

Refitting the arm-side interface

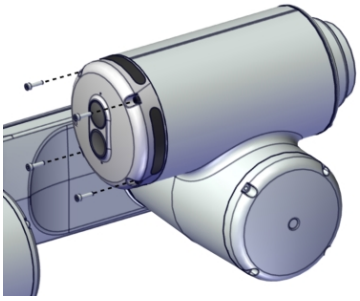
	Action	Note
1	Fit the o-ring to its groove. Replace if damaged.	O-ring: 3HAC061327-051  xx2000002551
2	Place the arm-side interface at mounting position and reconnect the connectors. • ASI.DC+ • ASI.DC- • ASI.X1 The correct orientation of the arm-side interface is with the convex button in upper position. **Note** Do not leave the arm-side interface in location without being secured with the attachment screws.	 xx2100000335  xx2100000336

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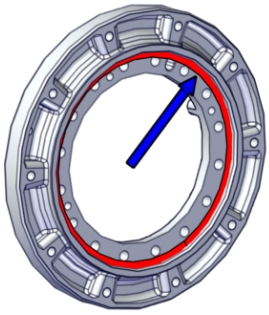
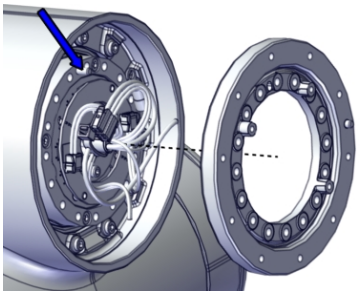
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5.6.8 Replacing the axis-6 joint unit

Continued

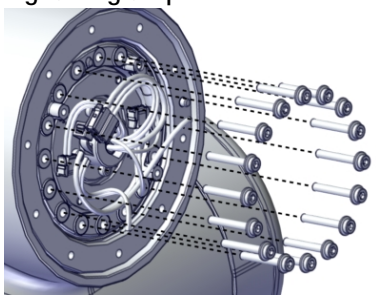
	Action	Note
3	Refit the arm-side interface with four screws.	**Valid for CRB 15000-5/0.95** Hex socket head cap screw: M3x30 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm **Valid for CRB 15000-10/1.52** and CRB 15000-12/1.27 Hex socket head cap screw: M3x20 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.45 Nm  xx2000002550

Refitting the tool flange adapter

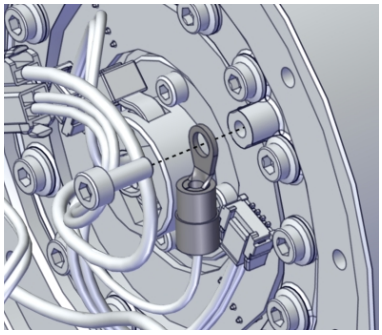
	Action	Note
1	Clean the mounting surface with isopropanol. Apply flange sealant to the corner of the adapter mounting surface, as pointed out in the figure.	Cleaning agent: Isopropanol Flange sealant: Loctite 574 (or equivalent)  xx2000002196
2	Refit the tool flange adapter, aligning the pin with the pin hole.	Tool flange adapter: 3HAC073952-001  xx2000002167

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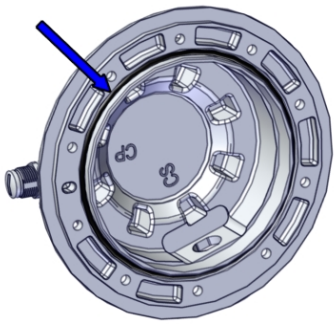
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	Action	Note
3	Secure with screws.	Flange socket head screw: M3x20 12.9 Lafre 2C2B/FC6.9+PrO-COat111 (16 pcs) Tightening torque: 1.8 Nm.  xx2000002165

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

Refitting the tool flange

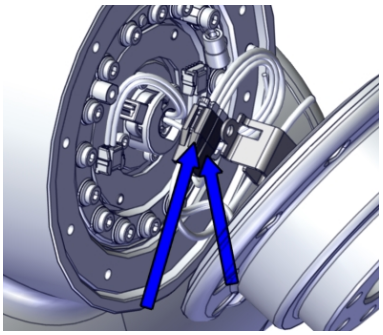
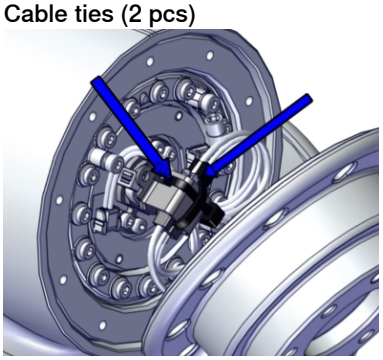
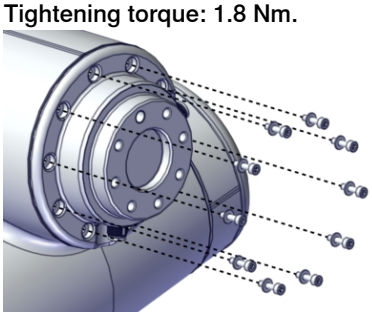
	Action	Note
1	Check the o-ring on the tool flange and lubricate with grease. Replace if damaged.	Axis-6 flange: 3HAC073953-001 O-ring: 3HAB3772-182 Grease: 3HAC042536-001 (Shell Gadus S2)  xx2000002197

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5.6.8 Replacing the axis-6 joint unit

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 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

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Concluding procedure

After replacing a joint unit, the routine **Joint Unit Replacement** must be run before the robot can go to motors on state.

	Action	Note
1	Calibrate the joint unit torque sensor. 1 On the FlexPendant, go to the **Code** app and call the calibration procedure using **PP to Routine**, not by using **Call Routine**. 2 Select the **Joint Unit Replacement** feature and then select the axis to calibrate. 3 The controller is now restarted. Once the home screen of the FlexPendant is shown, press the Play button to continue the calibration routine. 4 The robot moves to a position or positions where measurements are performed. 5 The results of the measurements are presented together with the current values in the controller. Choose whether to save the calibration data or not. 6 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. 7 Finally the robot is moved back to the original position. 8 Test the brake release (movement without drive power) functionality, see *Testing the brake release functionality on page 153*.	See *Calibration on page 1047* The routine must be run in motors off state.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 89*.	

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6 Calibration

6.1 Calibration methods

Overview

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

Types of calibration

Type of calibration	Description	Calibration method
Absolute accuracy calibration (optional)	Based on standard calibration, and besides positioning the robot at synchronization position, the Absolute accuracy calibration also compensates for: • Mechanical tolerances in the robot structure • Deflection due to load Absolute accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot. Absolute accuracy calibration data is found on the serial measurement board (SMB) or other robot memory. A robot calibrated with Absolute accuracy has the option information printed on its name plate (OmniCore). To regain 100% Absolute accuracy performance, the robot must be recalibrated for absolute accuracy after repair or maintenance that affects the mechanical structure.	CalibWare
Ultra accuracy calibration (optional)	Based on standard calibration, and besides positioning the robot at synchronization position, the Ultra accuracy calibration also compensates for: • Mechanical tolerances in the robot structure • Deflection due to load Ultra accuracy option is available to the CRB 15000. The purpose is to improve precision with path accuracy and absolute position accuracy even further. A robot calibrated with Ultra accuracy has the option information printed on its name plate (OmniCore). To regain 100% Ultra accuracy performance, the robot must be recalibrated for ultra accuracy after repair or maintenance that affects the mechanical structure.	CalibWare
Torque sensor calibration	The CRB 15000 torque sensors are calibrated with the service routine *TorqueSensorCal*. 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.	Torque sensor calibration

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Type of calibration	Description	Calibration method
Optimization	Optimization of TCP reorientation performance. The purpose is to improve reorientation accuracy for continuous processes like welding and gluing. Wrist optimization will update standard calibration data for axes 4 and 5. **Note** For advanced users, it is also possible to use the do the wrist optimization using the RAPID instruction `WristOpt`, see *Technical reference manual - RAPID Instructions, Functions and Data types*. This instruction is only available for OmniCore robots.	Wrist Optimization

Brief description of calibration methods

Torque sensor calibration

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.
- After heavy collisions or uncontrolled stops. This does not apply to collisions or stops which may routinely be experienced as part of a power and force limiting application.

No calibration is needed at site at robot installation.

The torque sensor service routine only works on floor mounted robots.

Tip

When designing the robot cell, run the torque sensor service routine in RobotStudio to verify that the path and pose are obtainable in the planned design.

Wrist Optimization method

Wrist Optimization is a method for improving reorientation accuracy for continuous processes like welding and gluing.

The actual instructions of how to perform the wrist optimization procedure is given on the FlexPendant.

After Wrist Optimization is done, the safety controller must be updated from Visual SafeMove. See *The SafeMove configurator app on FlexPendant on page 117* or *Application manual - Functional safety and SafeMove*.

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CalibWare - Absolute Accuracy calibration / Ultra Accuracy calibration

The CalibWare tool guides through the calibration process and calculates new compensation parameters. This is further detailed in the *Application manual - CalibWare Field*.

If a service operation is done to a robot with the option Absolute Accuracy or Ultra Accuracy, a new absolute accuracy calibration / ultra accuracy calibration is required in order to establish full performance. For most cases after replacements that do not include taking apart the robot structure, standard calibration is sufficient.

The Absolute Accuracy / Ultra Accuracy option varies according to the robot mounting position. This is printed on the robot name plate for each robot. The robot must be in the correct mounting position when it is recalibrated for absolute accuracy / ultra accuracy.

References

Article numbers for the calibration tools are listed in the section *Special tools on page 1084*.

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6.2 Calibrating the torque sensors

Torque sensor calibration routine

The CRB 15000 torque sensors are calibrated with the service routine TorqueSensorCal. No external calibration tools are required.

Features in the service routine

The service routine for torque sensor calibration includes the following features. Some functionality is accessible only with the user grant **Safety Services**.

Feature	Description
Calibrate torque sensor[i]	This feature calibrates torque sensors for one axis when a sensor drift has occurred. 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.
Joint Unit Replacement[ii]	This feature calibrates torque sensors when a joint unit has been exchanged, or when a joint has been removed as part of replacing another part.
Calibrate all torque sensors[i]	This features calibrates torque sensors for all axes when a sensor drift has occurred. 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.

i Without the user grant **Safety Services**, it is only possible to run the **Torque sensor Check**. It compares the current torque sensor offsets with measured offsets. This is useful for a quick test of the calibration.
With user grant **Safety Services**, the new values can also be written to the controller.

ii This feature is only available when user authorization (UAS) is set with user grant Safety Services.

Preparations before calibration

The torque sensor calibration routine must be run in manual operating mode.

Running the calibration routine is possible only if the logged in user has the grant **Safety Services**. However, a torque sensor check can be done to do a quick test of the calibration without the grant **Safety Services**.

Running the service 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.

CAUTION

Keep a distance from the robot while the routine is running, until the calibration data has been reviewed, accepted as reasonable, and stored.

1. On the FlexPendant, go to the **Code** app and call the calibration procedure **Torque Sensor Calib**, using **Call Routine**. Tap **Go to**, then press **Play**.
2. Select which feature to run.
   The features are described in *Features in the service routine on page 1050*.
3. All features require a password. The password is 14775 (cannot be changed).
   However, the **Torque sensor Check** can be done without the password.

Continues on next page

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4 For the **Joint Unit Replacement** feature, select axis. The controller will then restart. Once the home screen of the FlexPendant is shown, press **Play** to continue the calibration routine. Once the calibration routine is finalized, run the **Calibrate torque sensor** on the replaced axis.

5 For the **Calibrate torque sensor** feature, select calibration position 1 and then calibration position 2 by jogging the robot. The positions must be reachable by moving only one axis. The robot will move from position 1 to position 2 and then back. The results of the measurements are presented together with the current values from the controller. Choose whether to save the calibration data or not. If the calibration data is saved, the new sensor offsets are saved in the file *AxisN.txt*, where *N* represents the axis. The file is store in a directory starting with *Calib_x* in the HOME directory, where *x* is the serial number of the robot.

6 For the **Calibrate all torque sensors** feature, the robot will move through most of its working space. For each axis, the results of the measurements are presented together with the current values from the controller. Choose whether to save the calibration data or not. If the calibration data is saved, the new sensor offsets are saved in the file *AxisN.txt*, where *N* represents the axis. The file is store in a directory starting with *Calib_x* in the HOME directory, where *x* is the serial number of the robot.

7 If the robot is unable move through the entire working space, or if having a tool mounted, it is possible to use adapted movement instead of the full space movement. In the adapted movement it is possible to modify each position that the robot moves to from a user interface. If changing the positions, there is a check that the positions are valid, and that the movements are within the specifications. The updated positions are saved in the file *OffsetCalibrationData.sysx* in directory *HOME:\TorqueSensorCal*

   It is also possible to manually update the positions in the file *OffsetCalibrationData.sysx* directly from RobotStudio. This is however not possible while running the service routine.

   The positions in the RAPID module *OffsetCalibrationData.sysx* are always used for the adapted movements, and the default movements are used when running full space movements.

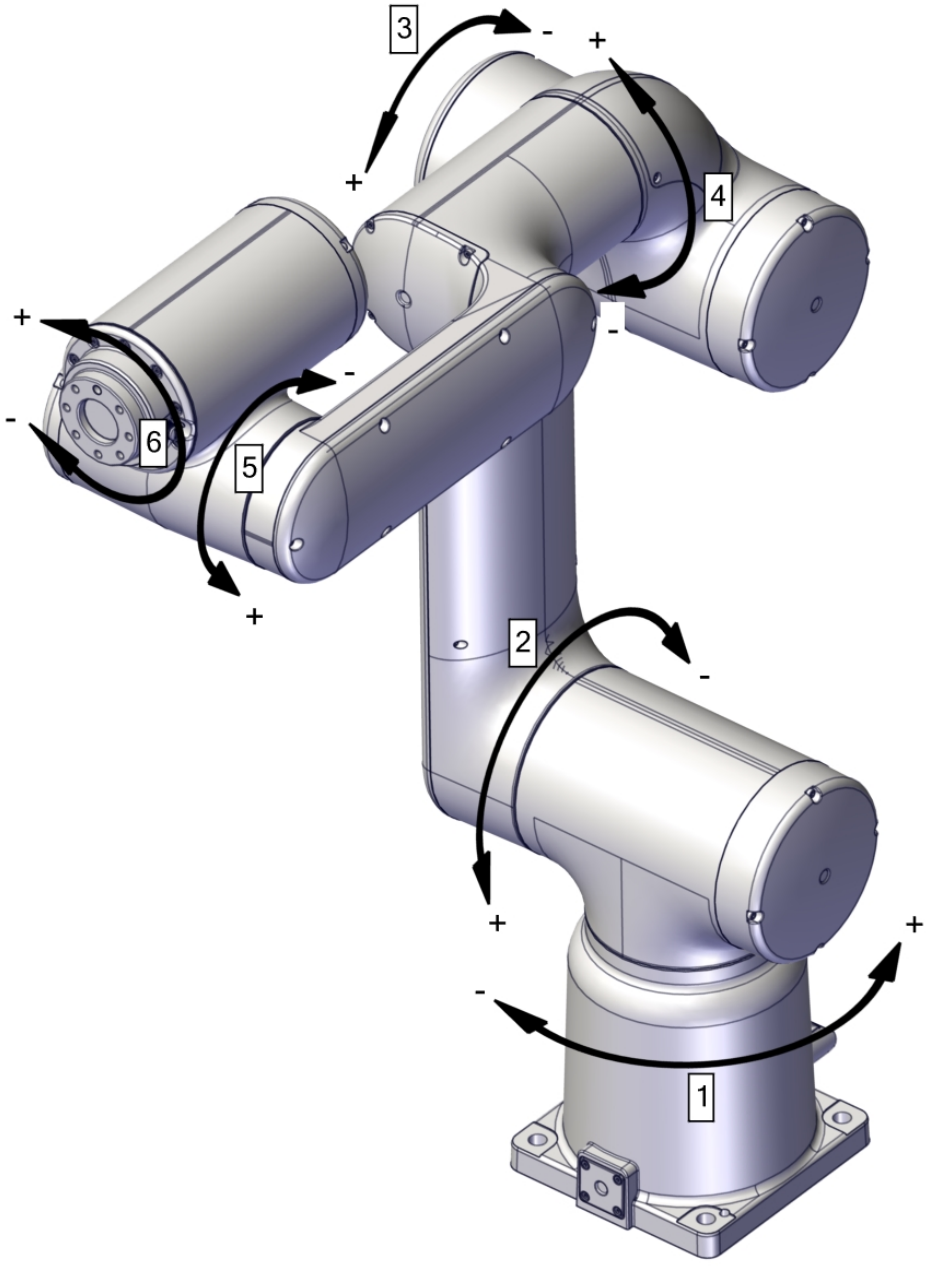
> **Note**
>
> The *OffsetCalibrationData.sysx* is copied to the directory *TorqueSensorCal* the first time that the service routine *TorqueSensorCal* is executed.

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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.



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6.4 Calibrating with Wrist Optimization method

When to run Wrist Optimization

Wrist Optimization routine is run to improve TCP reorientation performance.

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

Overview of the calibration procedure on the FlexPendant

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

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

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

1 Choose calibration routine Wrist Optimization.

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

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

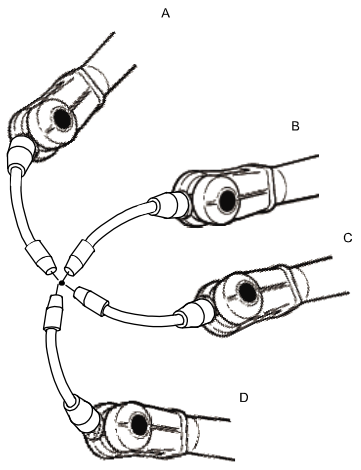
a Jog the robot to an appropriate position, A, for the first approach point.

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

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

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

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



en0400000906

3 Improved calibration data to the wrist axes is identified and presented.

4 Optimized positions for the wrist axes are presented.

5 The controller must be restarted. Tap **Restart**.

6 After the controller is restarted, an event message appears, 50296 **Robot memory data difference**. Update the robot memory, as described in *Operating manual - Integrator's guide OmniCore*.

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7 Wrist optimization is finished.
8 Redefine / verify TCP for all tools.

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7 Troubleshooting

7.1 Introduction to troubleshooting

Introduction

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

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

Make sure to read through the section *Safety on page 17* before starting.

Troubleshooting strategies

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

Work systematically

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

Keep a track of history

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

Basic scenarios

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

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

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7.1 Introduction to troubleshooting

Continued

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

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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.	

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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.

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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:

- The RobotWare version is 7.10 or higher. Then the brakes are released using the FlexPendant, see *Manually releasing the brakes on page 69*.
- 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 **Note** The spare parts related to the brake release function using the external tool are discontinued from Q2 2023.
2	Verify that the brake release tool is used correctly.	See *Manually releasing the brakes with the external tool on page 71*.
3	Check the brake power supply to the motor during the Motors OFF state.	See the circuit diagram. Check for any recorded fault status.

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7.4 Brake release tool does not work
Continued

	Action	Information
4	Reset the brake release software as follows: 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. Software is reset. Any error code is removed from the FlexPendant. 4 Test the brake release function using the brake release tool against the brake release point on the joint. If the brake still does not release, repeat the reset cycle steps 3 and 4. 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.	

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7.5 Drive system communication link and DC link are both down during robot running

Description

During robot running, the robot system enters system failure state with 34402 "DC link voltage too low" and 39351 "The drive system communication link is down" reported.

Consequence

No operation will be possible until the fault is corrected.

Possible causes

- The system power is derating when the robot system is running with incoming mains lower than 180 VAC.
- The incoming mains voltage to the rectifier unit is out of specification.
- Cable between manipulator and controller is disconnected.

Recommended actions

1. Run warm-up cycles.
2. Reduce acceleration or speed.
3. Change to 230 VAC incoming mains, or add an external transformer to upgrade the incoming mains to 230 VAC.
4. Check incoming mains voltage. Change the mains tolerance min so that the mains voltage is inside the specified interval.
5. Check the cable connection between manipulator and controller.
6. Check for other hardware event log messages regarding connection problem.

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7.6 Communication failure between PROFIsafe-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 PROFIsafe-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**.

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7.7 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 PROFIsafe-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.

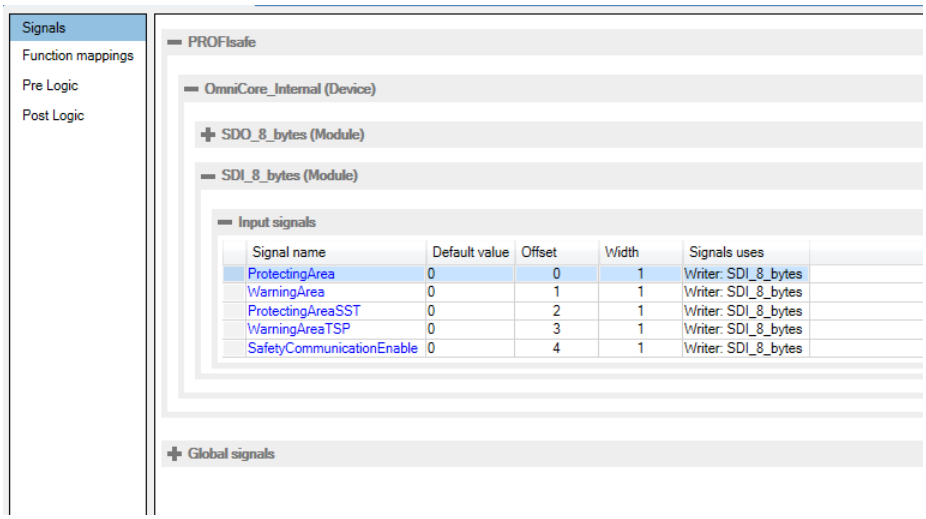
Recommended actions

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.

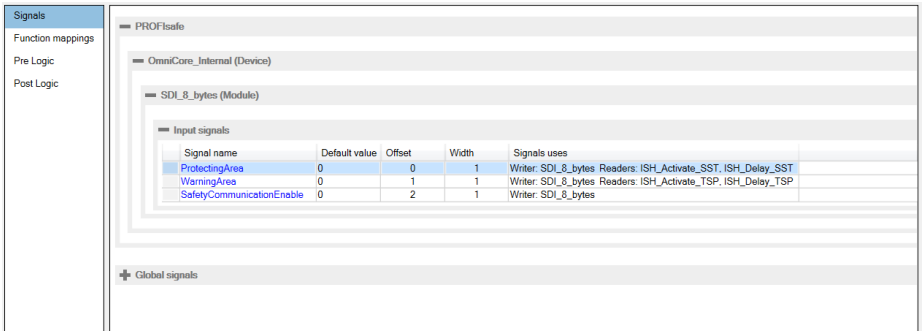


xx2100000511

For robots running RobotWare 7.6 or later, the following signals can be observed.

Continues on next page

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xx2200000304

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.

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7.8 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.

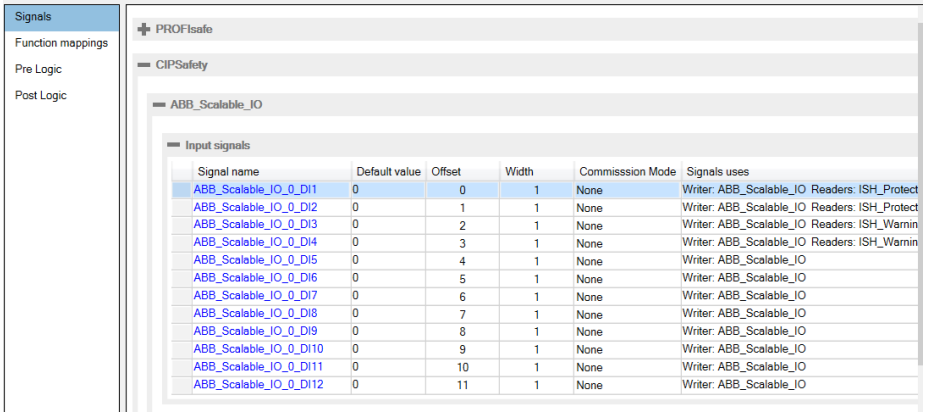
Recommended actions

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.



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.

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7.9 System failure when changing PROFINET-based laser scanner to SafetyIO-based laser scanner

Description

The robot configured with PROFINET-based laser scanner(s) needs to replace with SafetyIO-based laser scanner. During system update using the **Modify Installation** function, system failure occurs after removing the profisafe package option(s) and selecting required IO package option(s).

Consequence

The system cannot be successfully set up.

Possible causes

Option *3020-2 PROFINET Device* and option *3023-2 PROFIsafe Device* are removed together with the profisafe package option(s), and the safety configurations become invalid.

Recommended actions

1. On the home page of the FlexPendant, tap **Settings**.
2. Tap **Backup & Recovery**.
3. Tap **Reset user data**.
4. Select **Reset safety settings**.
5. Tap **Reset**.
6. Restart the controller.

If the problem persists, reinstall the system.

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7.10 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 in 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.

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.

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7.11 Unable to remove or reselect installed options in Collaborative Speed Control add-in

Description

The installed lead-through or laser scanner options fail to be removed or reselected in the Collaborative Speed Control add-in using the **Modify Installation** function.

Consequence

- Modules of the SpeedHandling function remain in task T_ROB1 after the installed options are removed.
- Existing template SafeMove configuration file is not removed after the installed options are removed or not synchronized with new configuration file for the new option after the installed options are reselected.

Recommended actions

1. Reset the template SafeMove configuration file to factory settings and apply it to the controller.
2. For scenarios to remove options, de-select the checkboxes of the options that require to be removed in the Collaborative Speed Control add-in and apply it to the controller.
3. For scenarios to reselect options, de-select the checkboxes of the options not required first and then select the required options in the Collaborative Speed Control add-in and apply it to the controller.
4. Reset the RAPID programs and parameters in RobotStudio and restart the controller.
5. Load the template SafeMove configuration file using the SafeMove configurator app on FlexPendant.

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7.12 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_IntemitCollab 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.

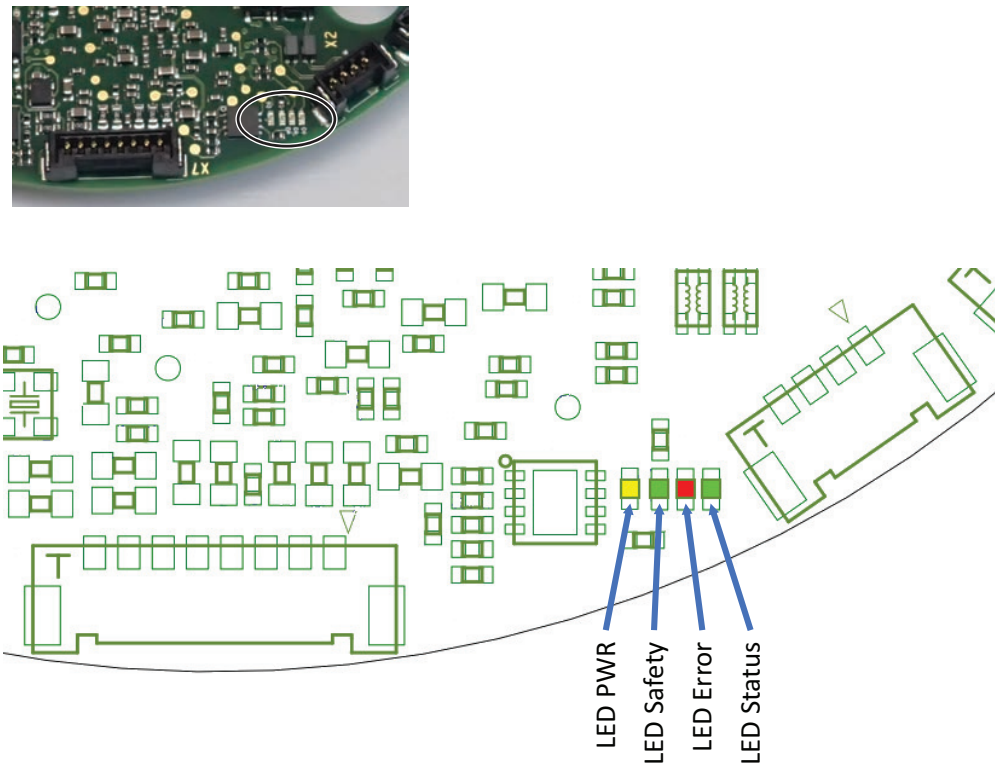
Recommended actions

Reset the template SafeMove configuration file to factory setting and then load the configuration file provided with the Collaborative Speed Control add-in.

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7.13 Diagnostic LEDs on joint unit drive board

Location of LEDs on the drive board



xx2200000706

LED PWR	LED Power
LED Safety	Safety LED (green)
LED Error	Functional error LED (red)
LED Status	Functional status LED (green)

Diagnostic codes

LED PWR

Diagnostic code	Description
Remain ON	Power is on

LED Safety (green): Safety LED

Diagnostic code	Description
Blinking fast (less than 1s blinking)	FSoE[i] connection is active
Blinking slow (2s on, 4s off)	No FSoE[i] connection
Not blinking within 10s from reboot and stopped	Safety software is in fatal state

i Safety over EtherCAT

Continues on next page

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LED Error (red): Functional LED

Diagnostic code	Description
Flash 4 times then pause	EtherCAT cable is not connected
	Problem in communication along EtherCAT physical input to current EtherCAT node. Check connectivity between current and previous EtherCAT nodes.
Flash 1 time then pause	Drive status word[i] fault

[i] DS402

LED Status (green): Functional LED

Diagnostic code	Description
Remain ON	Drive status word[i]: Internal limitation is active
Flash 3 times then pause	Drive status word[i]: Operation is enabled
Flash 2 times then pause	Drive status word[i]: Ready to switch on / Motor on
Flash 1 time then pause	Other state than what mentioned above

[i] DS402

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7.14 Program execution stops because no safety configuration template loaded

Description

The robots installed with the Collaborative Speed Control add-in that provides safety configuration templates for easy use. However, the templates are not loaded after selecting **Enable Edit Mode** and **Use template configuration** in the SafeMove configurator app on FlexPendant.

When executing the program, a message box is displayed, prompting users to load templates from the controller file system.

Consequence

Program execution cannot proceed until a safety configuration template is loaded.

Possible causes

If the robot operating in RW 7.12 with a Collaborative Speed Control add-in earlier than 1.2.1, the safety configuration templates are unavailable in the controller file system for loading.

Recommended actions

1. Check the Collaborative Speed Control add-in version and make sure the version 1.2.1 is installed.
2. Log in the FlexPendant as a user with safety user grants.
3. Open the SafeMove app.
4. Tap **Enable Edit Mode**.
5. Tap **Load Configuration From File** from the **Context** menu (...).
6. Browse templates in the controller file folder: "*PRODUCTS/CollaborativeSpeedControl/SafeMove/<your robot type>/Templates*" and select the template for your option.
7. Tap **OK** and then **Yes** to load the template.
8. Tap **Write to controller**.
9. Select **Apply to controller** to proceed.

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8 Decommissioning

8.1 Introduction to decommissioning

Introduction

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

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

> **Note**
>
> The decommissioning process shall be preceded by a risk assessment.

Disposal of materials used in the robot

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

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

See also *Environmental information on page 1074*.

Transportation

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

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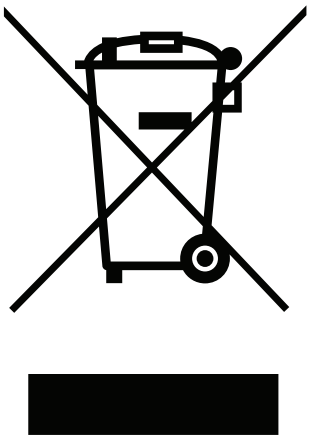
8.2 Environmental information

Introduction

ABB robots contain components in different materials. During decommissioning, all materials shall 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.

Disposal symbol

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



xx1800000058

Materials used in the product

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

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

Material	Example application
Aluminium	Base, 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

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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.

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8.3 Scrapping of robot

Note

The decommissioning process shall be preceded by a risk assessment.

Important when scrapping the robot

DANGER

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

- Always remove all oil/grease in gearboxes. If exposed to heat, for example from a blow torch, the oil/grease will catch fire.
- When motors are removed from the robot, the robot will collapse if it is not properly supported before the motor is removed.
- A used robot does not have the same performance as on delivery. Springs, brakes, bearings, and other parts might be worn or broken.

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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.

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9.2 Applicable standards

General

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

Robot standards

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

Other standards used in design

Standard	Description
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements, normative reference from ISO 10218-1
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments
IEC 61000-6-4	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
ISO 13849-1:2006	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design, normative reference from ISO 10218-1
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.
UL 1740 (option) CSA Z434 (option)	Standards For Safety - Robots and Robotic Equipment Industrial robots and robot Systems - General safety requirements Valid for USA and Canada.

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Deviations

Deviations from ISO 10218-1:2011 for CRB 15000

The CRB 15000 is intended for collaborative operation. The integrator of the robot system is required to perform an assessment of the hazards and risks.

Requirement	Deviation for CRB 15000	Motivation
§5.3.5 Single point of control.	The arm side interface can be overridden in automatic mode.	The CRB 15000 robot is intended for collaborative applications where contact between robot and the operator is harmless.

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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	

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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)	*Gleitmo 603* + *Geomet 500*	3-5 µm
M6-M20 (any length except M20x60)	*Gleitmo 603* + *Geomet 720*	3-5 µm
M20x60	*Gleitmo 603* + *Geomet 500*	8-12 µm
M20x60	*Gleitmo 603* + *Geomet 720*	6-10 µm

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%**!

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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.	

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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	

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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 1083*, 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.

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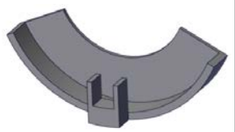
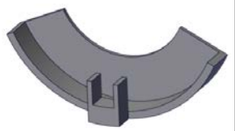
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Tools and equipment with spare part number: (These tools can be ordered from ABB)			Axis-1 cabling	Axis-2 cabling	Axis-3 cabling	Axis-4 cabling	Axis-5 cabling	Axis-6 cabling	Axis-5 to axis-6 transition cabling	Lower arm	Housing	Tubular	Wrist housing	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			
Lifting aid	3HAC077789-001	 xx2100000464							1			1	1						1	1	1
Lifting aid	3HAC087787-001	 xx2300000825	1											1	1	1	1				
Lifting aid	3HAC087788-001	 xx2300000826									1							1			
Guiding tools																					
Guide pin, M4x120	3HAC077786-001	 xx2100000463	2							2	2			2	2	2	2	2			
Guide pin, M3x110	3HAC077787-001	 xx2100000462							2		2	2	2						2	2	2

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9.7 Special tools

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
Guide pin, M5x125	3HAC087786-001	 xx2300000824	2	2						2				2	2	2	2				
Guide pin, M5x75	3HAC087786-002	 xx2300000824	2											2	2	2					
Other tools																					
Cable tie gun EVO 7i	-		1	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	1
Protection plate	3HAC087789-001	 xx2100000461	1	1	1	1	1	1	1				1	1	1	1	1	1	1	1	1

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3HAC077389-001, Rev S, en

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