ROBOTICS

Product manual

CRB 1100

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Workspace 23C version a17
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Product manual

CRB 1100-4/0.475
CRB 1100-4/0.58

OmniCore

Document ID: 3HAC078007-001

Revision: K

Keep for future reference.

Additional copies of this manual may be obtained from ABB.

Original instructions.

Table of contents

Overview of this manual

About this manual

This manual contains instructions for:

- mechanical and electrical installation of the CRB 1100
- maintenance of the CRB 1100
- mechanical and electrical repair of the CRB 1100

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

- *Standard*

Usage

This manual should be used during:

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

Note

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

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

Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

Prerequisites

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

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

Product manual scope

The manual covers all variants and designs of the CRB 1100. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

Continues on next page

References

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

Document name	Document ID
Product manual, spare parts - CRB 1100	*3HAC078009-001*
Product specification - CRB 1100	*3HAC082108-001*
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*
Product manual - OmniCore C30	*3HAC060860-001*
Operating manual - OmniCore	*3HAC065036-001*
Application manual - Controller software OmniCore	*3HAC066554-001*
Application manual - CalibWare Field	*3HAC030421-001*
Technical reference manual - Event logs for RobotWare 7	*3HAC066553-001*
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*
Technical reference manual - System parameters	*3HAC065041-001*
Application manual - PROFINET Controller/Device	*3HAC066558-001*
Application manual - Functional safety and SafeMove	*3HAC066559-001*
Operating manual - RobotStudio	*3HAC032104-001*
Circuit diagram - CRB 1100	*3HAC076518-003*

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

Revisions

Revision	Description
A	First edition.
B	Published in release 21B. The following updates are done in this revision: • Text regarding fastener quality is updated, see *Fastener quality on page 70*. • Text regarding diameter of air hoses is updated, see *Customer connections on page 91*. • Added delivery information about the attachment screws, see *Attachment screws on page 56*. • Added maintenance activities of running the *Brake Check* and *Cyclic Brake Check* routines. See *Maintenance schedule on page 167*. • Removed maintenance activity of inspecting oil seepage and updated troubleshooting description about oil and grease stains on motors and gearboxes. • Added a caution about cleaning the lamp unit cover. See *Cleaning methods on page 170*. • Updated the tightening torque for fitting the lamp unit cover from 0.15 Nm to 0.1 Nm. • Added a note to remind users that mechanical stop locations cannot be adjusted. See *Adjusting the working range on page 86*.

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Revision	Description
C	Published in release 21C. The following updates are done in this revision: • Added a note to the procedure of enabling the lead-through device. • Added spare part parallel pin on extender unit and updated related refitting procedure of extender unit. • Corrected the description of connection point on cabinet. • Updated the naming of timing belt tension adjustment tools, from acoustic tensiometer and tensiometer to sonic tension meter and dynamometer, respectively.
D	Published in release 22A. The following updates are done in this revision: • Added information about length of thread engagement for attachment screws. • Added cautions in procedures of removing timing belts, motors and gearboxes. • Updated dimension figures to include dimension for bottom connector interface option. • Added troubleshooting for high motor temperature, see *Motor temperature too high on page 690*. • Updated information about Gleitmo treated screws, see *Screw joints on page 708*. • Updated information of lead-through device and laser scanner connection and configuration due to new introduction of Collaborative Speed Control add-in and new laser scanner options. See *Installation of lead-through device on page 71*, *Installation of laser scanner on page 78* and *Configuring the software on page 95*. • Removed caution about not to use cleaning detergents containing ethanol, organic solvent or similar to clean the lamp cover.
E	Published in release 22B. The following updates are done in this revision • Updated the optional port from LAN port to MGMT port, which is used to connect the cable from robot to controller for lead-through functionality. • Added installation and configuration of the two-button-type lead-through device. • Added a list of general software configuration procedure. • Added a note about the requirement for connecting lamp unit cabling.
F	Published in release 22C. The following updates are done in this revision • Updated robot power cable information, see *Robot cables on page 88*. • Updated spare part numbers for axes 1-6 motors. • Added expected life of gearboxes. • Updated cable connection figures for safetyIO-based scanner(s). • Added the lamp unit cabling when the controller is configured with safety I/O device DSQC1042. • Added a caution about carefully using of the lead-through device on the robot. • Updated information label figure. • 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.
G	Published in release 22D. The following updates are done in this revision: • Added information about Wrist Optimization in calibration chapter. • Added notes about installation and configuration of additional scalable I/O device.

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Revision	Description
H	Published in release 23A. The following updates are done in this revision: • Added the direct connection between the laser scanner and OmniCore controller.
J	Published in release 23B. The following updates are done in this revision: • Added pin assignment on XG1 connector of SafetyIO-based laser scanner. • Updated the logical expressions for SafeMove configuration using Visual SafeMove, see *Configuring pre logic on page 116*.
K	Published in release 23C. The following updates are done in this revision: • Updated article number of robot signal cable from 3HAC067446-00*X* to 3HAC084767-00*X*. • Added connection information about scalable I/O devices, see *Scalable I/O device connection on page 92*. • Updated the Ethernet floor cable list.

Product documentation

Categories for user documentation from ABB Robotics

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

Tip

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

Product manuals

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

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

Technical reference manuals

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

Application manuals

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

An application manual generally contains information about:

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

Continues on next page

- Examples of how to use the application.

Operating manuals

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

How to read the product manual

Reading the procedures

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

Safety information

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

Read more in the chapter *Safety on page 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.

Network security

Network security

This product is designed to be connected to and to communicate information and data via a network interface. It is your sole responsibility to provide, and continuously ensure, a secure connection between the product and to your network or any other network (as the case may be).

You shall establish and maintain any appropriate measures (such as, but not limited to, the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB Ltd and its entities are not liable for damage and/or loss related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

1 Safety

1.1 Safety information

1.1.1 Limitation of liability

Limitation of liability

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

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

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

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

Spare parts and equipment

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

1.1.2 Requirements on personnel

General

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

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

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

Personal protective equipment

Use personal protective equipment, as stated in the instructions.

1.2 Safety signals and symbols

1.2.1 Safety signals in the manual

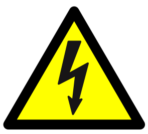
Introduction to safety signals

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

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

Hazard levels

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

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

Continues on next page

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

1.2.2 Safety symbols on manipulator labels

Introduction to symbols

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

Symbols are used in combinations on the labels, describing each specific warning. The descriptions in this section are generic, the labels can contain additional information such as values.

Note

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

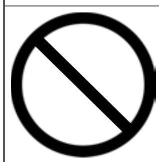
Types of symbols

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

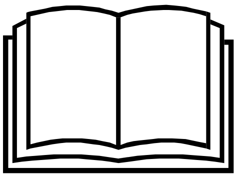
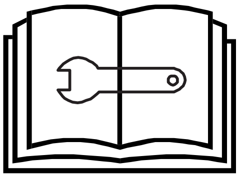
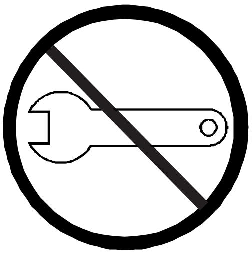
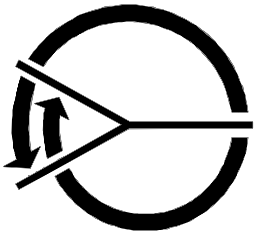
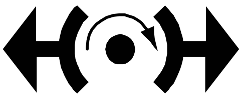
The safety labels are language independent, they only use graphics. See *Symbols on safety labels on page 21*.

The information labels can contain information in text.

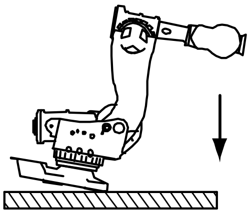
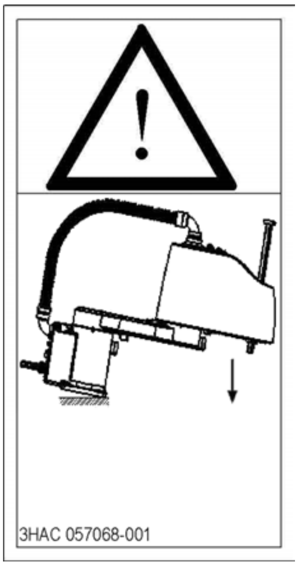
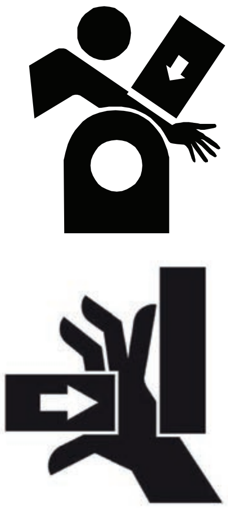
Symbols on safety labels

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

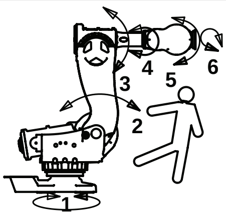
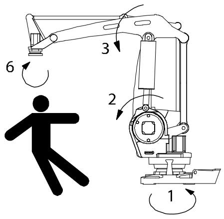
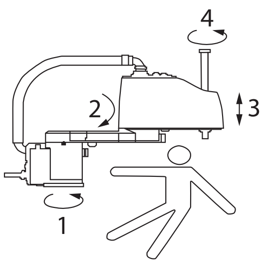
Continues on next page

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

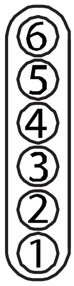
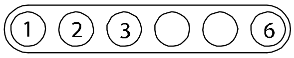
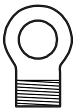
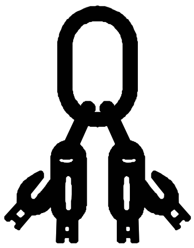
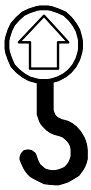
Continues on next page

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

Continues on next page

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

Continues on next page

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

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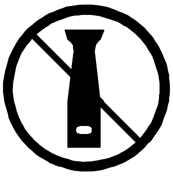
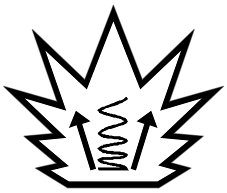
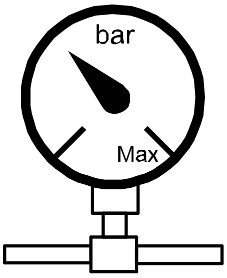
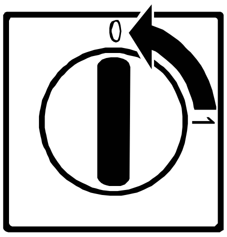
Symbol	Description
 xx1000001144	**No mechanical stop**
 xx0900000825	**Stored energy** Warns that this part contains stored energy. Used in combination with *Do not disassemble* symbol.
 xx0900000826	**Pressure** Warns that this part is pressurized. Usually contains additional text with the pressure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

1.3 Robot stopping functions

Protective stop and emergency stop

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

For more information see:

- *Product manual - OmniCore C30*

1.4 Safety during installation and commissioning

National or regional regulations

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

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

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

Layout

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

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

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

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

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

Allergenic material

See *Environmental information on page 702* for specification of allergenic materials in the product, if any.

Securing the robot to the foundation

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

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

Electrical safety

Incoming mains must be installed to fulfill national regulations.

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

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

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

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

Note

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

Continues on next page

Safety devices

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

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

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

Other hazards

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

- Water
- Compressed air
- Hydraulics

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

Verify the safety functions

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

1.5 Safety during operation

Automatic operation

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

Unexpected movement of robot arm

WARNING

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

1.6 Safety during maintenance and repair

1.6.1 Safety during maintenance and repair

General

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

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

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

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

Hot surfaces

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

Allergic reaction

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

Gearbox lubricants (oil or grease)

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

Note

Take special care when handling hot lubricants.

Warning	Description	Elimination/Action
Hot oil or grease	Changing and draining gearbox oil or grease may require handling hot lubricant heated up to 90 °C.	Make sure that protective gear like goggles and gloves are always worn during this activity.
Allergic reaction	When working with lubricants there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.

Continues on next page

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

Hazards related to batteries

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

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

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

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

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

Related information

See also the safety information related to installation and operation.

1.6.2 Emergency release of the robot axes

Description

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

How to release the brakes is described in the section:

- *Manually releasing the brakes on page 58*.

1.6.3 Brake testing

When to test

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

How to test

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

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

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

Note

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

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

1.7 Safety during troubleshooting

General

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

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

DANGER

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

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

Related information

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

1.8 Safety during decommissioning

General

See section *Decommissioning on page 701*.

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

2 Manipulator description

2.1 About CRB 1100

Introduction

The CRB 1100 is one of ABB Robotics latest generation of 6-axis robot, with a payload of 4 kg, designed based on industrial robot platform. It bridges the gap between industrial robots and robots designed for collaborative applications. Combing ABB SafeMove solution, safety separation technology and speed control with safety laser scanner(s) and lead-through programming with a lead-through device, CRB 1100 enables safe collaborative operations and harmless contacts between robot and the operator. The robot has an open structure that is especially adapted for flexible use, and can communicate extensively with external systems.

2.2 Technical data

Weight, robot

The table shows the weight of the robot.

Robot model	Nominal weight
CRB 1100	21.1 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	Any angle
Wall mounted	Any angle
Suspended	Any angle
Table mounted	Any angle

Note

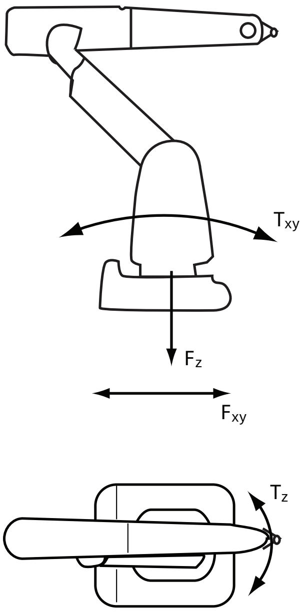
The actual mounting angle must always be configured in the system parameters, otherwise the performance and lifetime is affected. See *Setting the system parameters for an inverted or a tilted robot on page 60*.

Loads on foundation, robot

The illustration shows the directions of the robots stress forces.

Continues on next page

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



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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	±420 N	±710N
Force z	+210 ±380 N	+210 ±510 N
Torque xy	±180 Nm	±330 Nm
Torque z	±90 Nm	±140 Nm

Continues on next page

Wall mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	+210 ±370 N	+210 ±660 N
Force z	±370 N	±540 Nm
Torque xy	±200 Nm	±370Nm
Torque z	±90 Nm	±140 Nm

Suspended

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	±420 N	±710 N
Force z	-210 ±380 N	-210 ±510 N
Torque xy	±180 Nm	±330 Nm
Torque z	±90 Nm	±140 Nm

Table mounted

Force	Endurance load (in operation)	Maximum load (emergency stop)
Force xy	±420 N	±710N
Force z	+210 ±380 N	+210 ±510 N
Torque xy	±180 Nm	±330 Nm
Torque z	±90 Nm	±140 Nm

Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.1/500 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy.
Minimum resonance frequency	22 Hz **Note** It may affect the manipulator lifetime to have a lower resonance frequency than recommended.	The value is recommended for optimal performance. Due to foundation stiffness, consider robot mass including equipment.[i] For information about compensating for foundation flexibility, see the description of *Motion Process Mode* in the manual that describes the controller software option, see *References on page 10*.

Continues on next page

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	-25°C (-13°F)
Maximum ambient temperature	+55°C (+131°F)
Maximum ambient temperature (less than 24 hrs)	+70°C (+158°F)
Maximum ambient humidity	95% at constant temperature (gaseous only)

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	+5°C[i] (41°F)
Maximum ambient temperature	+45°C (113°F)
Maximum ambient humidity	95% at constant temperature

i At low environmental temperature (below 10° C) a warm-up phase is recommended to be run with the robot. Otherwise there is a risk that the robot stops or runs with lower performance due to temperature dependent oil and grease viscosity.

Protection classes, robot

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

Protection type	Protection class [i]
Manipulator, protection type Standard	IP40

i According to IEC 60529.

Environmental information

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

2.3 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

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.

Safety functions and safety related data

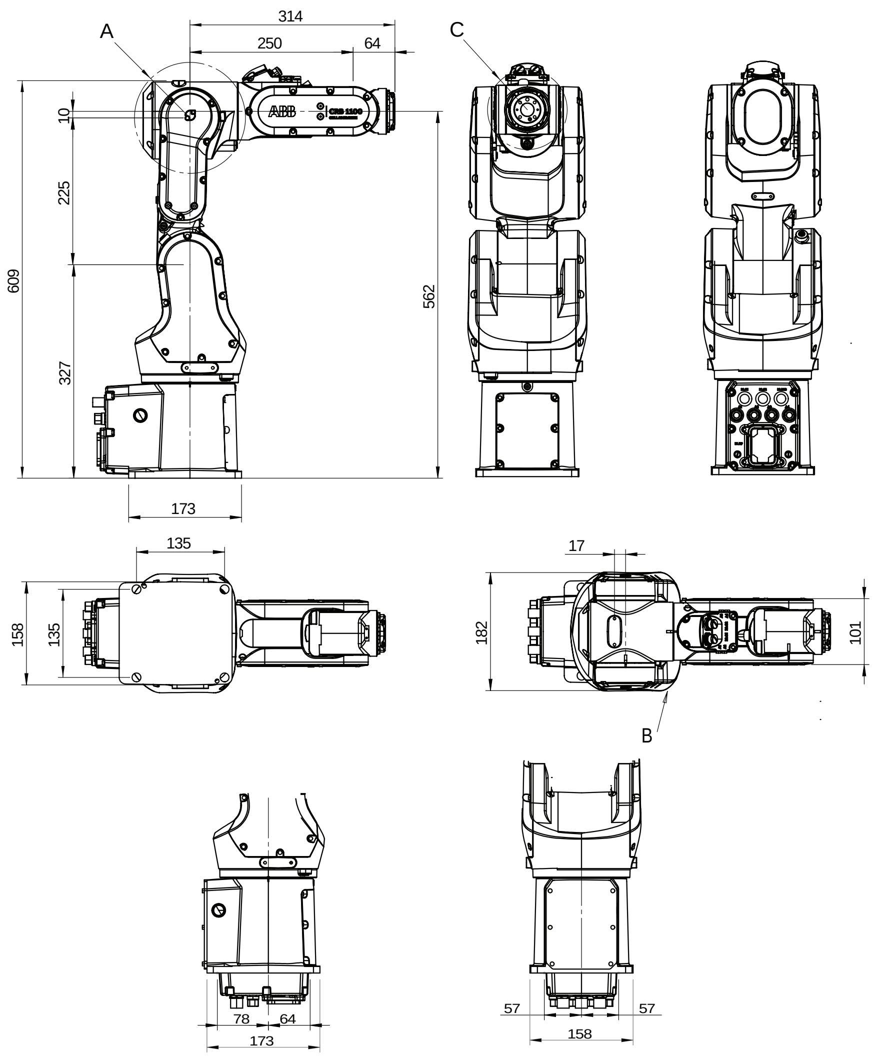
Safety functions and safety related data for CRB 1100 rely on the controller and safety laser scanners.

Safety data for the controller is detailed in the product manual of the robot controller, see *References on page 10*.

Safety data for the safety laser scanners is detailed in the user manual from the vendor, see *Operating instructions microScan3 - PROFINET* and *Operating instructions microScan3 - Pro I/O* that are available on *SICK®* website.

2.4 Dimensions

Main dimensions of CRB 1100-4/0.475



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Pos	Description
A	Turning radius: R85
B	Turning radius: R109
C	Turning radius: R61

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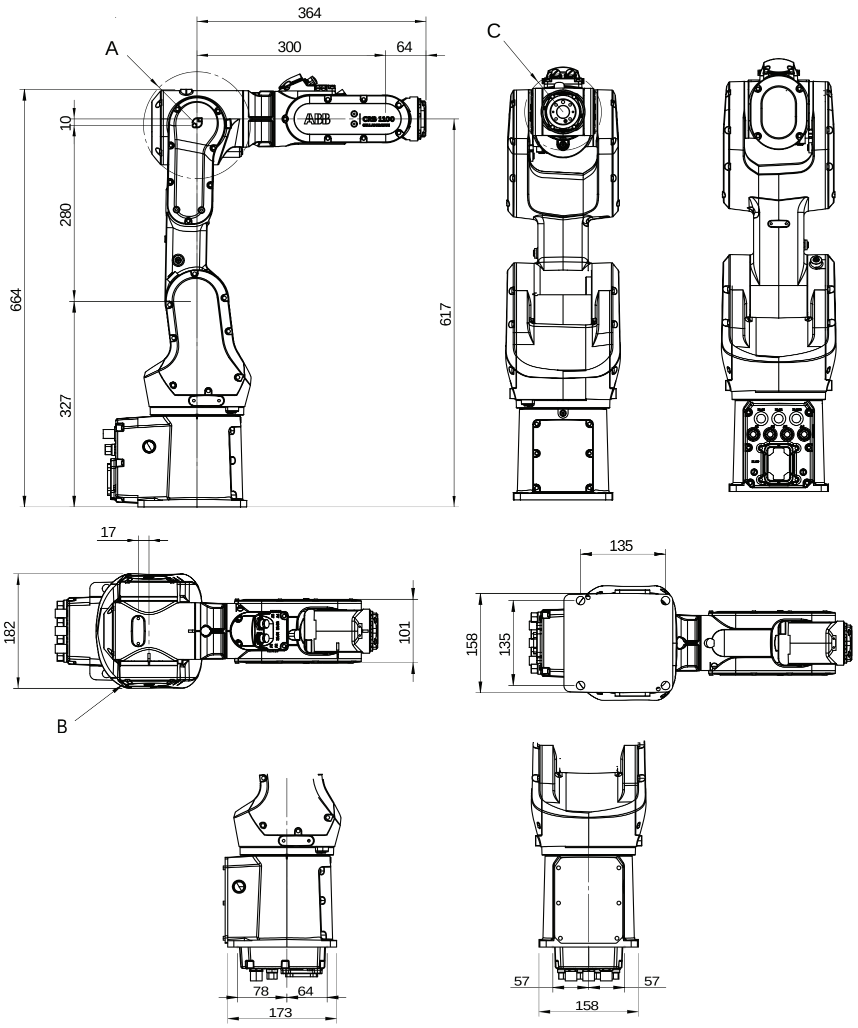
Main dimensions of CRB 1100-4/0.58



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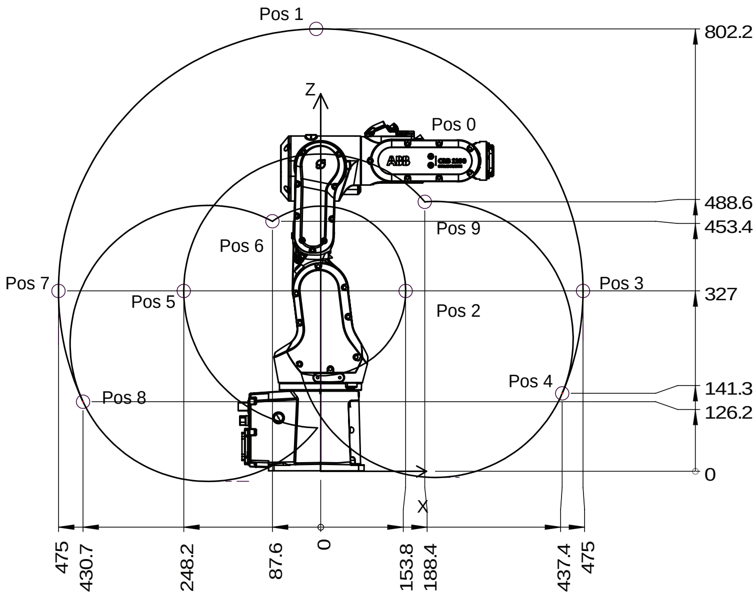
Pos	Description
A	Turning radius: R85
B	Turning radius: R109
C	Turning radius: R61

2.5 Working range

Illustration, working range CRB 1100-4/0.475

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
pos0	314	562	0°	0°
pos1	0	802	0°	-87.7°
pos2	53.8	327	9.7°	55°
pos3	475	327	90°	-87.7°
pos4	437.4	141.3	113°	-87.7°
pos5	-248.2	327	-26.4°	-205°
pos6	-87.6	453.4	-115°	55°
pos7	-475	327	-90°	-87.7°
pos8	-430.7	126.2	-115°	-87.7°
pos9	188.4	488.6	113°	-205°

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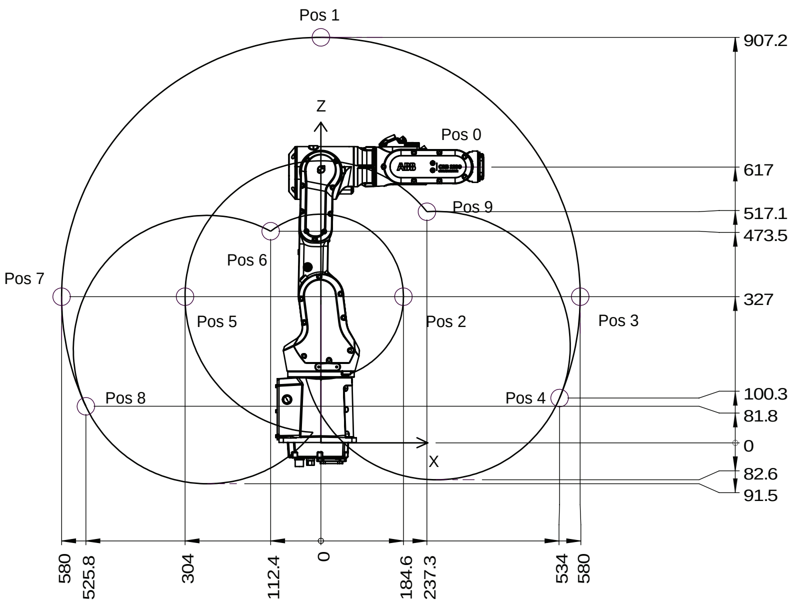
Illustration, working range CRB 1100-4/0.58

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
pos0	364	617	0°	0°
pos1	0	907.2	0°	-88°
pos2	184.6	327	12.5°	55°
pos3	580	327	90°	-88°
pos4	534	100.3	113°	-88°
pos5	-304	327	-28.3°	-205°
pos6	-112.4	473.5	-115°	55°
pos7	-580	327	-90°	-88°
pos8	-525.8	81.8	-115°	-88°
pos9	237.3	517.1	113°	-205°

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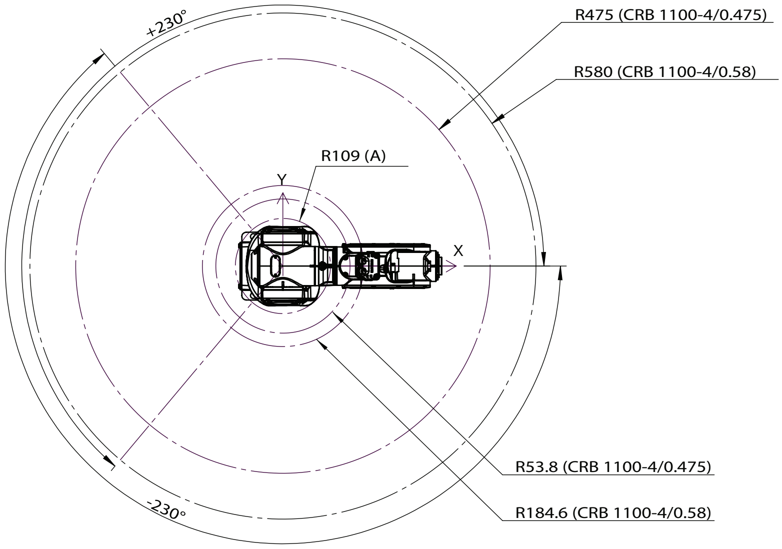
Top view of working range



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Working range

Axis	Working range	Note
Axis 1	±230°	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	-115°/+113°	
Axis 3	-205°/+55°	
Axis 4	±230°	
Axis 5	-125°/+120°	
Axis 6	±400°	Default value.
	±242	Maximum revolution value. The default working range for axis 6 can be extended by changing parameter values in the software.

2.6 The unit is sensitive to ESD

Description

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

Safe handling

Use one of the following alternatives:

- Use a wrist strap.

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

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

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

3 Installation and commissioning

3.1 Introduction to installation and commissioning

General

This chapter contains assembly instructions and information for installing the CRB 1100 at the working site.

See also the product manual for the robot controller.

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

The technical data is detailed in section *Technical data on page 38*.

Safety information

Before any installation work is commenced, all safety information must be observed.

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

Note

Always connect the CRB 1100 and the robot to protective earth and residual current device (RCD) before connecting to power and starting any installation work.

For more information see:

- *Product manual - OmniCore C30*

3.2 Unpacking

3.2.1 Pre-installation procedure

Introduction

This section is intended for use when unpacking and installing the robot for the first time. It also contains information useful during later re-installation of the robot.

Prerequisites for installation personnel

Installation personnel working with an ABB product must:

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

Checking the pre-requisites for installation

	Action
1	Make a visual inspection of the packaging and make sure that nothing is damaged.
2	Remove the packaging.
3	Check for any visible transport damage. **Note** Stop unpacking and contact ABB if transport damages are found.
4	Clean the unit with a lint-free cloth, if necessary.
5	Make sure that the lifting accessory used (if required) is suitable to handle the weight of the robot as specified in: *Weight, robot on page 38*
6	If the robot is not installed directly, it must be stored as described in: *Storage conditions, robot on page 41*
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: *Operating conditions, robot on page 41*
8	Before taking the robot to its installation site, make sure that the site conforms to: • *Loads on foundation, robot on page 38* • *Protection classes, robot on page 41* • *Requirements, foundation on page 40*
9	Before moving the robot, please observe the stability of the robot: *Risk of tipping/stability on page 51*
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: *On-site installation on page 53*
11	Install required equipment, if any. • *Installation of lead-through device on page 71* • *Installation of laser scanner on page 78*

3.2.2 Risk of tipping/stability

Risk of tipping

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

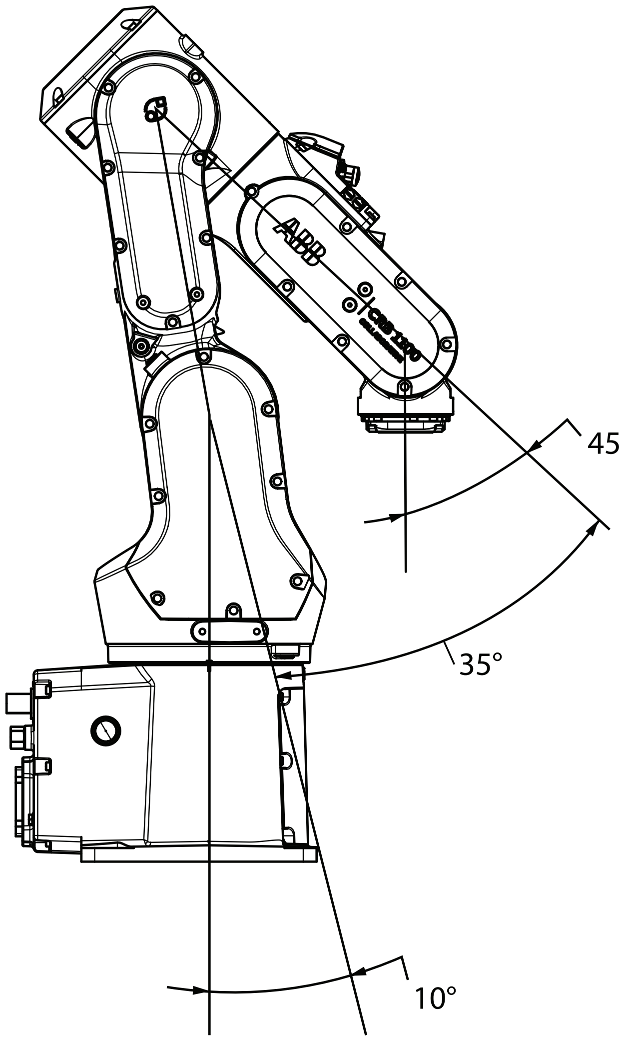
The transportation position is the most stable position.

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

Transportation position

This figure shows the robot in its transportation position.

CRB 1100-4/0.475



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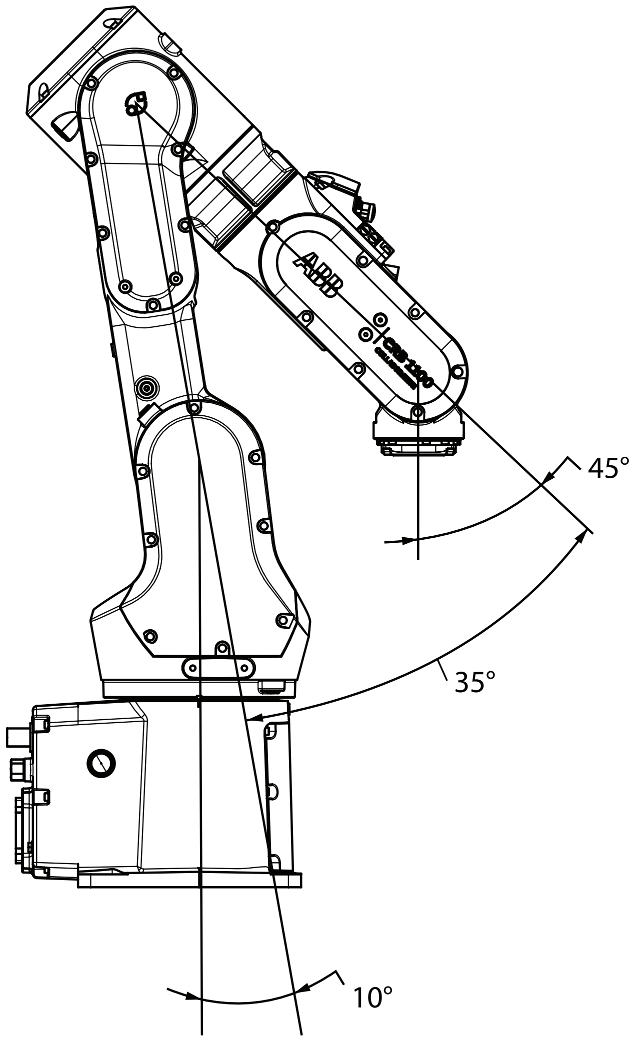
CRB 1100-4/0.58



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Note

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

WARNING

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

3.3 On-site installation

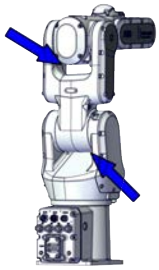
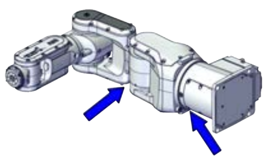
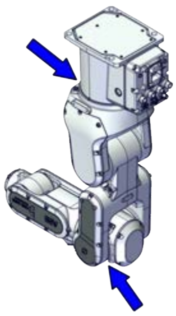
3.3.1 Lifting the robot

3.3.1.1 Lifting the robot by one person

General

This section describes how to lift the robot and move it by one person.

Grasping location

Position	Grasping location	Note
Stand on foot	 xx2100000155	When the robot stands on its foot, grasp the robot with one hand holding the lower arm and the other hand holding the swing.
By side	 xx2100000156	When the robot lies by side, grasp the robot with one hand holding the lower arm and the other hand supporting at the base. It is recommended to hold the robot between your arm and body.
Invented	 xx2100000157	When the robot is inverted, grasp the robot with one hand supporting at the housing and the other hand holding the base.

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Lifting and transporting the robot

	Action
1	**CAUTION** The CRB 1100 weighs, 21.1 kg and can be lifted by one person.
2	Grasp the robot as instructed in *Grasping location on page 53*.
3	Lift the robot.
4	Move the robot to desired position. **CAUTION** Be careful so that the robot does not bump into something while lifting and transporting. It could damage the robot.
5	Secure the robot on a workbench according to section *Orienting and securing the robot on page 56*.

3.3.1.2 Lifting and rotating a suspended mounted robot

Introduction

How to lift and turn the robot to a **suspended** position: Contact ABB for more information.

How to lift and turn the robot into position for **wall** position: Contact ABB for more information.

3.3.2 Orienting and securing the robot

General

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

Attachment screws

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

All hardware is enclosed in the robot delivery.

Suitable screws	M12x25 (robot installation directly on foundation)
Quantity	4 pcs
Quality	8.8
Suitable washer	4 pcs, 24 x 13 x 2.5
Guide pins	2 pcs, article number 3HNP00449-1
Tightening torque	50 Nm±5 Nm
Length of thread engagement	Minimum 12.5 mm for ground with material yield strength 150 MPa
Level surface requirements	0.1/500 mm [i]

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

Securing a floor mounted robot

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

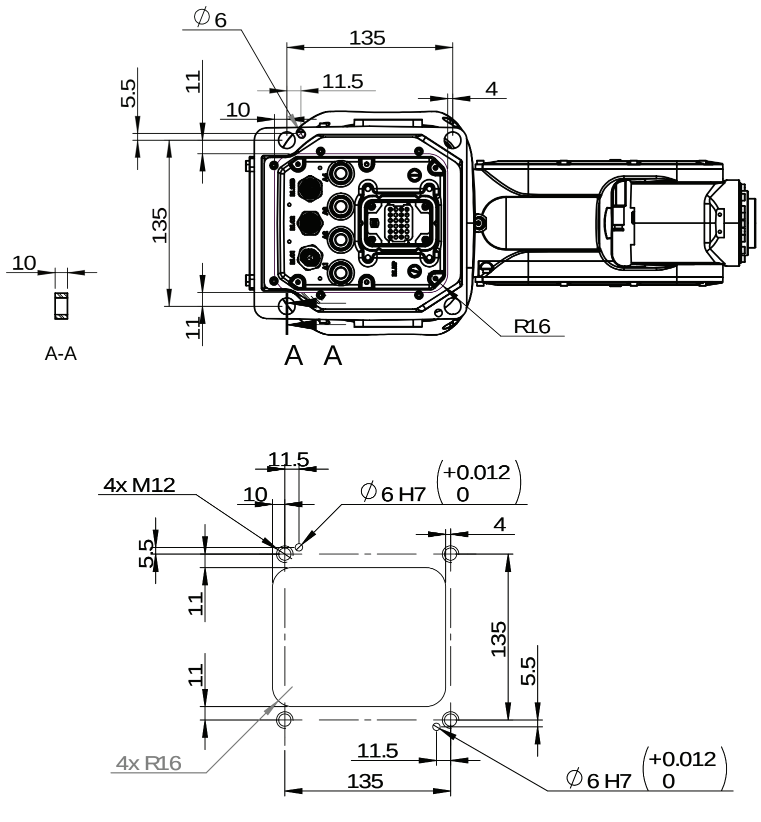
	Action	Note
1	Make sure the installation site for the robot conforms to the specifications in section *Technical data on page 38*.	
2	Prepare the installation site with attachment holes. The foundation surface must be clean and unpainted.	The hole configuration of the base is shown in the figure in *Hole configuration, base on page 57*.
3	**CAUTION** The weight of the CRB 1100 robot is 21.1 kg All lifting accessories used must be sized accordingly.	
4	**CAUTION** When the robot is put down after being lifted or transported, there is a risk of it tipping, if not properly secured.	
5	Lift the robot.	See *Lifting the robot on page 53*.
6	Fit two pins to the holes in the base.	2 pcs, article number 3HNP00449-1

Continues on next page

	Action	Note
7	Guide the robot gently, using the attachment screws while lowering it into its mounting position.	Make sure the robot base is correctly fitted onto the pins.
8	Fit the securing screws and washers in the attachment holes of the base.	Screws: M12x25 (robot installation directly on foundation), 4 pcs, quality 8.8 Washers: 4 pcs, 24 x 13 x 2.5
9	Tighten the bolts in a crosswise pattern to ensure that the base is not distorted.	Tightening torque: 50 Nm±5 Nm

Hole configuration, base

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



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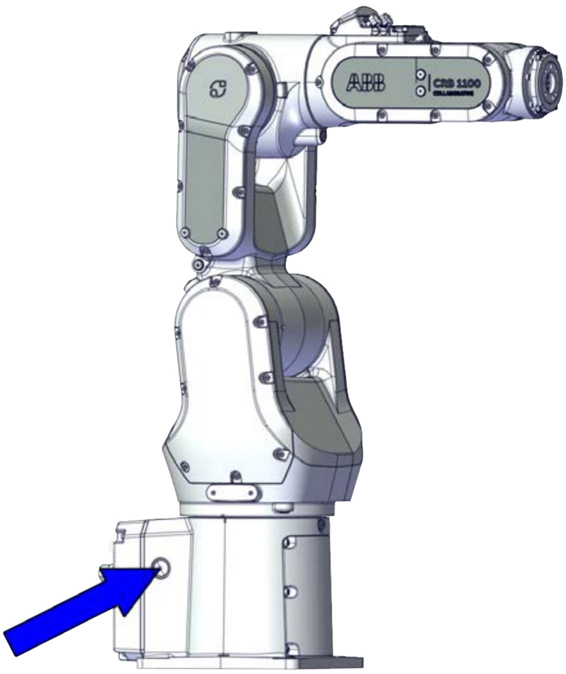
3.3.3 Manually releasing the brakes

Introduction to manually releasing the brakes

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

Location of the brake release unit

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



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Releasing the brakes

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

	Action	Note
1	**Note** If the robot is not connected to the controller, power must be supplied to the connector R1.MP according to the section *Supplying power to connector R1.MP on page 59*.	
2	**DANGER** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways. Make sure no personnel is near or beneath the robot.	

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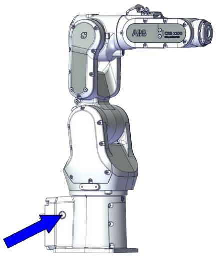
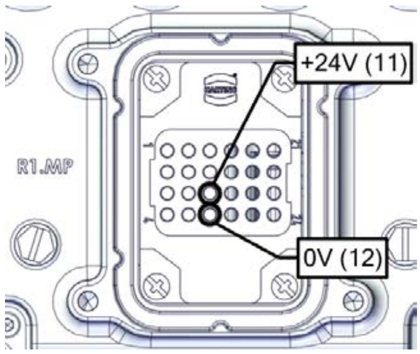
	Action	Note
3	Release the holding brake of all axes by pressing the brake release button. The brake will be enable as soon as the button is released. **WARNING** Pressing the brake release button will release the holding brakes on all axes simultaneously.	 xx2100000158

Supplying power to connector R1.MP

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

	Action	Note
1	**DANGER** Incorrect connections, such as supplying power to the wrong pin, may cause all brakes to be released simultaneously and instantly!	
2	Supply • 0V on pin 12. • 24V on pin 11. **Note** Do not interchange the 24V and 0V pins. If they are mixed up, damage can be caused to internal electrical components.	 xx1800002443
3	Use the brake releasing button as described in *Releasing the brakes on page 58*.	

3.3.4 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 38*, and the requirements on the foundation are described in *Requirements, foundation on page 40*.

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).

Continues on next page

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

Note

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

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

Note

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

Gamma Rotation

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

Mounting angles and values

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

`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

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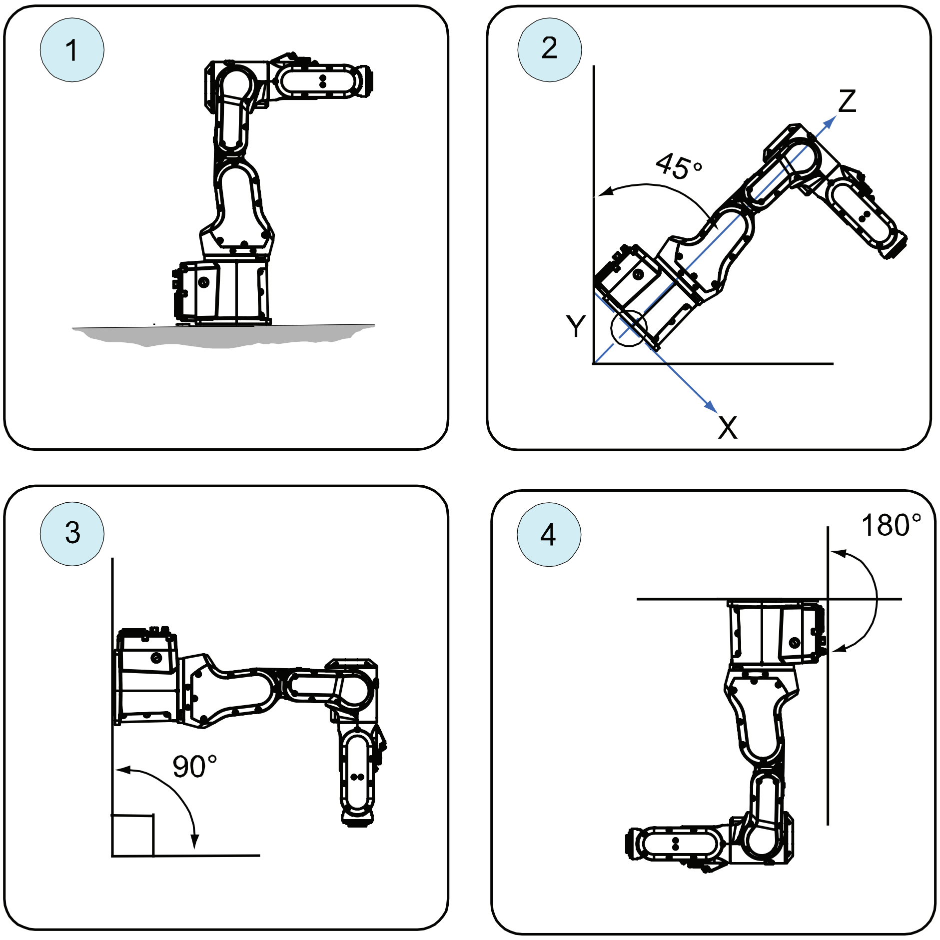
Examples of mounting angles tilted around the Y axis (*Gravity Beta*)



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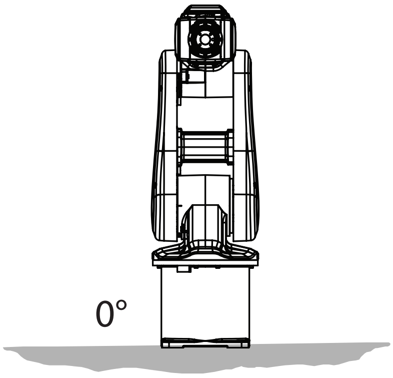
Pos 1	Floor mounted
Pos 2	Mounting angle 45° (Tilted)
Pos 3	Mounting angle 90° (Wall)
Pos 4	Mounting angle 180° (Suspended)

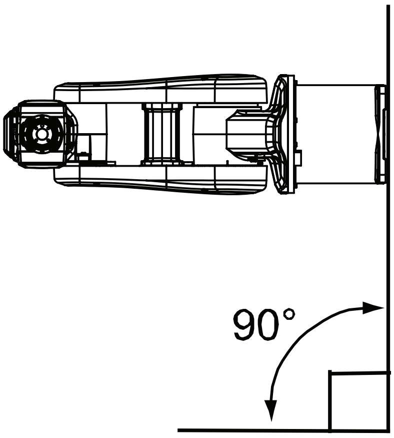
Continues on next page

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

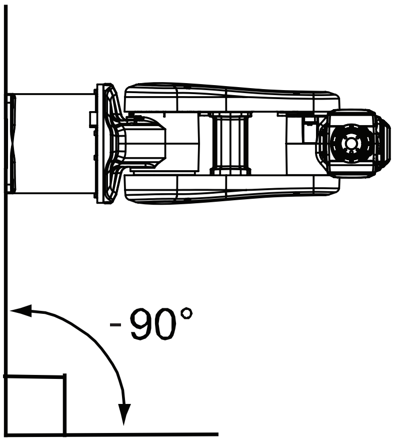
The following illustration shows the IRB 120, but the same principle applies for all robots.



xx2100000297



xx2100000299



xx2100000300

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 47*.

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*.

Continues on next page

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

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

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

Define loads carefully

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

CAUTION

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

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

Stopping time and braking distances

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

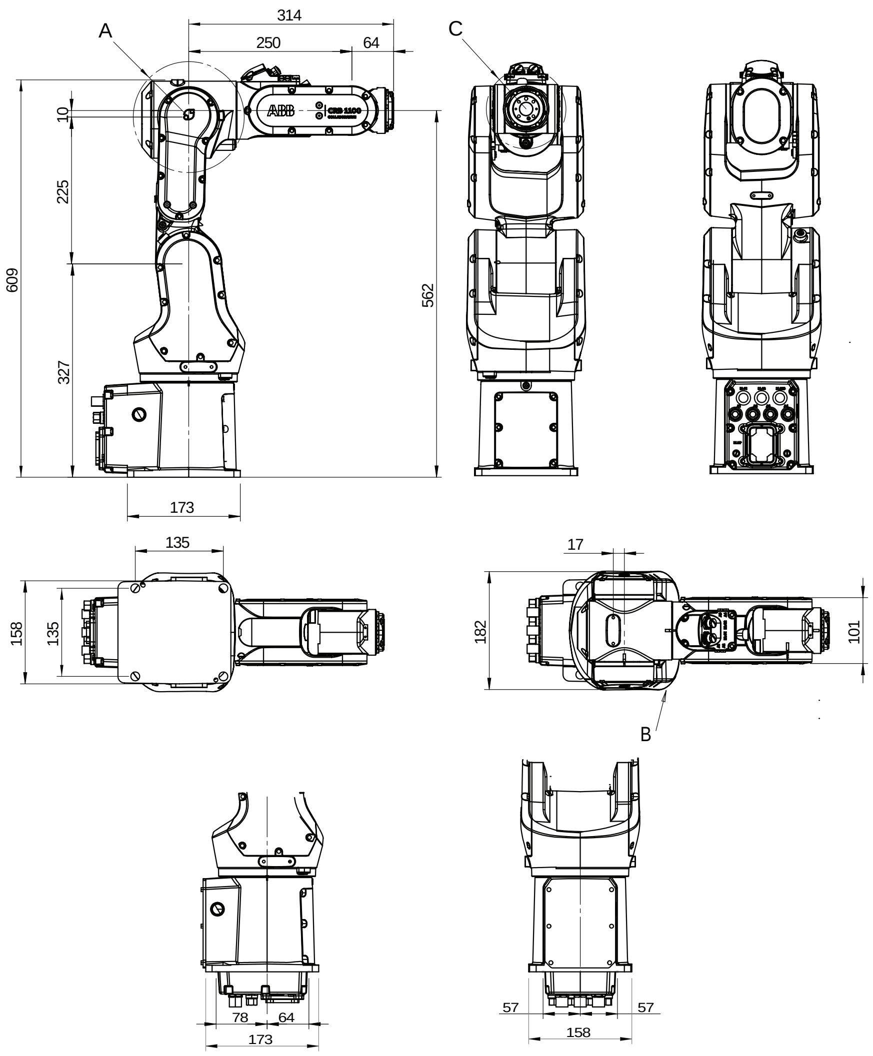
See the product specification for the robot, listed in *References on page 10*.

3.3.6 Fitting equipment on the robot (robot dimensions)

Robot dimensions

Dimensions CRB 1100-4/0.475

The figure shows the dimension of the CRB 1100-4/0.475.



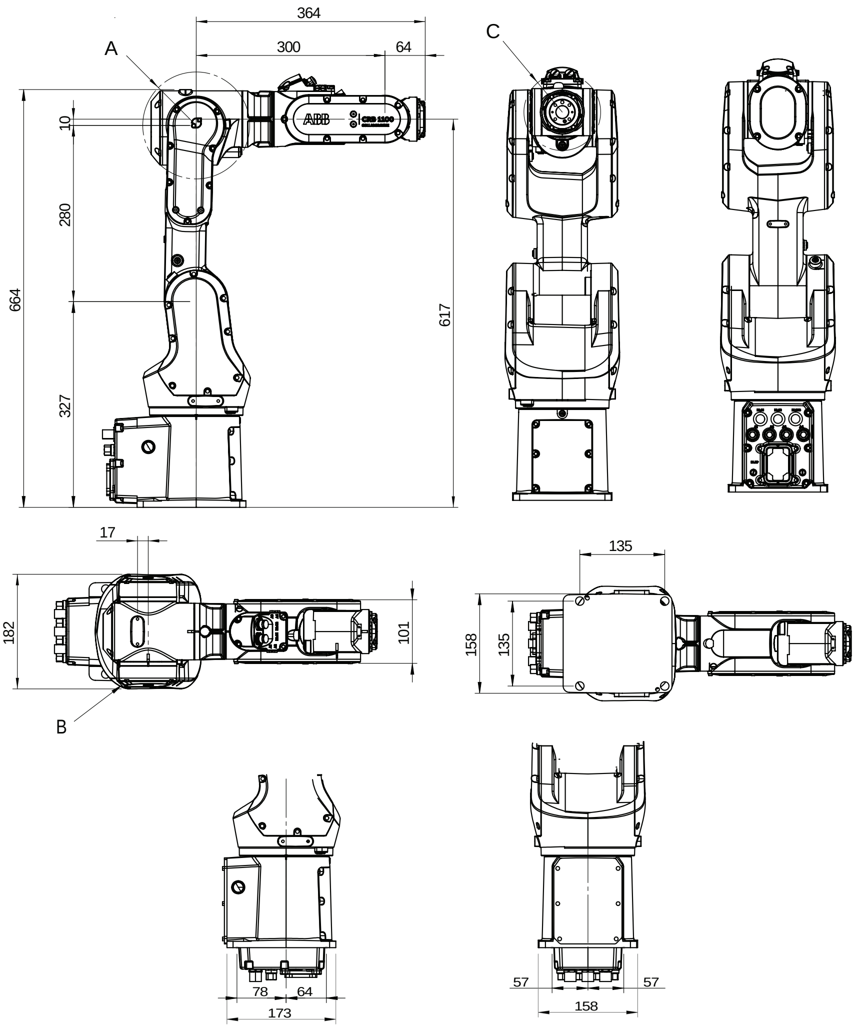
xx2000002545

Pos	Description
A	Turning radius: R85
B	Turning radius: R109
C	Turning radius: R61

Continues on next page

Dimensions CRB 1100-4/0.58

The figure shows the dimension of the CRB 1100-4/0.58.



xx2000002546

Pos	Description
A	Turning radius: R85
B	Turning radius: R109
C	Turning radius: R61

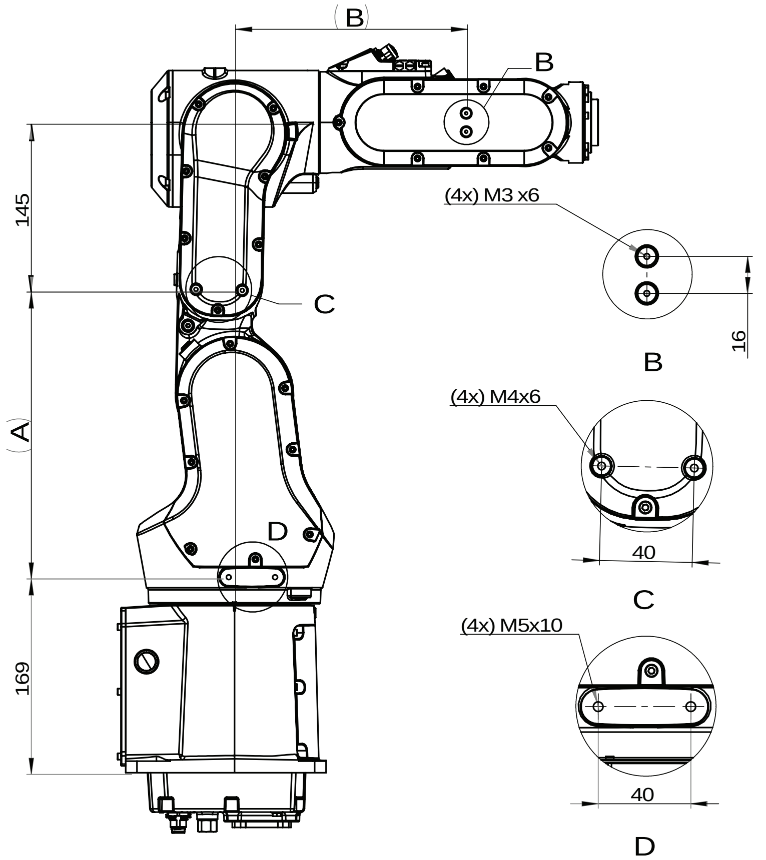
Attachment holes and dimensions

Extra loads can be mounted on robot. Definitions of dimensions and masses are shown in the following figures. The robot is supplied with holes for fitting extra equipment.

Continues on next page

Maximum allowed arm load depends on center of gravity of arm load and robot payload.

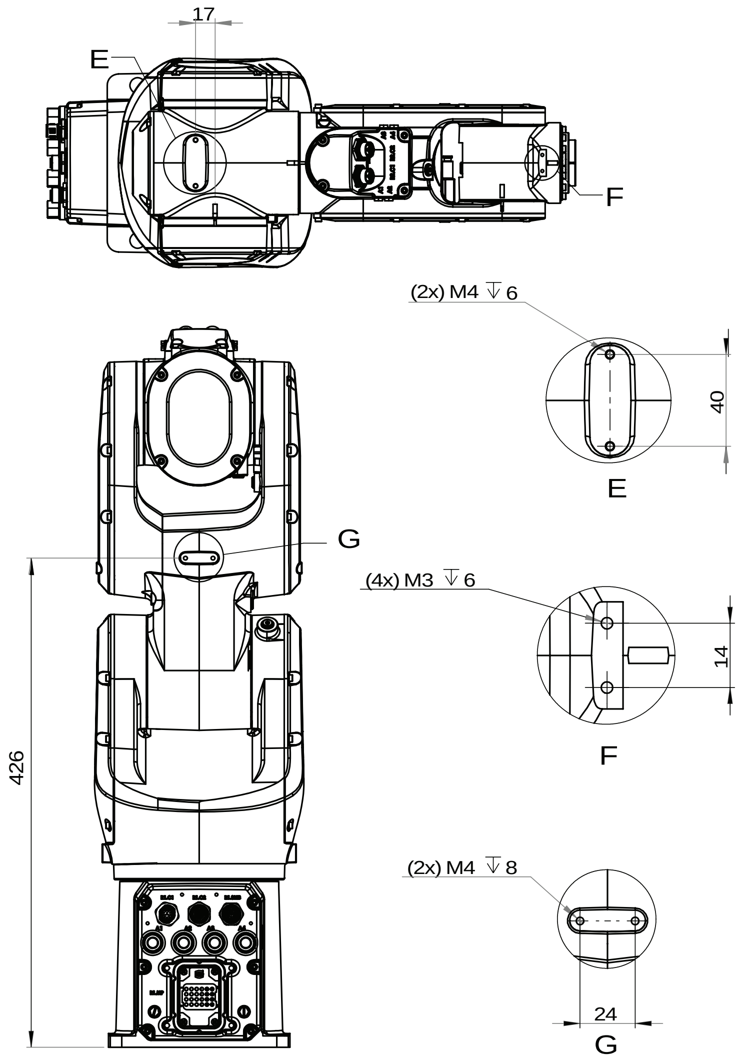
Holes for fitting extra equipment



xx1800002449

Pos	CRB 1100-4/0.475	CRB 1100-4/0.58
A	248	303
B	200	250

Continues on next page



xx1800002450

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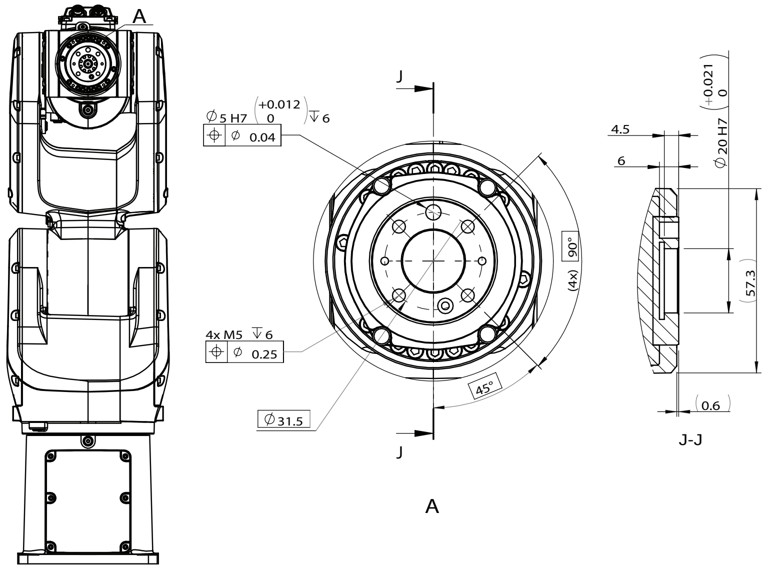
Tool flange standard



xx1800002451

> **CAUTION**
>
> To calibrate the axis 6, the notch on the wrist must be aligned with the marked pin hole on the tool flange. Before installing a tool on the tool flange, make sure a visible mark has been made to the tool at the corresponding position.
>
> For details about the synchronization mark, see *Synchronization marks and synchronization position for axes on page 659*.

Fastener quality

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

3.3.7 Installation of lead-through device

Introduction

The lead-through functionality is available for the CRB 1100 by mounting a lead-through device on axis 6. With the lead-though functionality enabled, you can hold the handler of the lead-through device and move the robot arm manually to the desired position, as an alternative to jogging.

To use lead-through, make sure the system is running in manual mode; otherwise, the functionality cannot be enabled. If running the system in auto mode, always remove the lead-through device from the robot first to prevent any unexpected damages.

CAUTION

Be careful not to stretch or squeeze the device cabling when moving the robot with the lead-through device, especially to extreme positions. Otherwise, it will cause cabling damages.

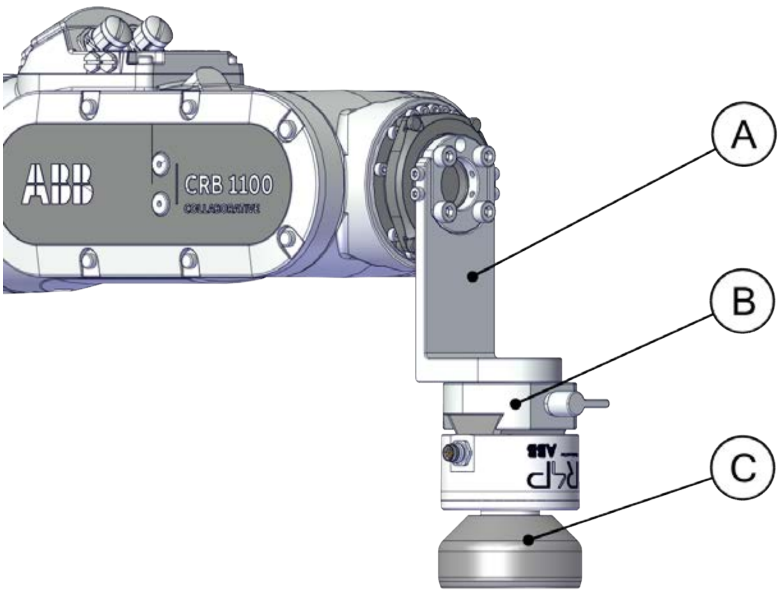
Note

Two types are available to the lead-through device used with the CRB 1100, no-button-type and two-button-type. The actual delivered device type varies according to the order time. Unless otherwise stated, the instructions of installing and configuring the device are applicable to both no-button-type device and two-button-type device. Always read the instructions carefully to install and configure your device based on the actual device type.

Continues on next page

Location of lead-through device

The lead-though device is located as shown in the figure.



xx2100000159

A	Adapter
B	Lead-through device base **Note:** base for no-button-type lead-through device is shown as an example.
C	Lead-through device **Note:** no-button-type lead-through device is shown as an example.

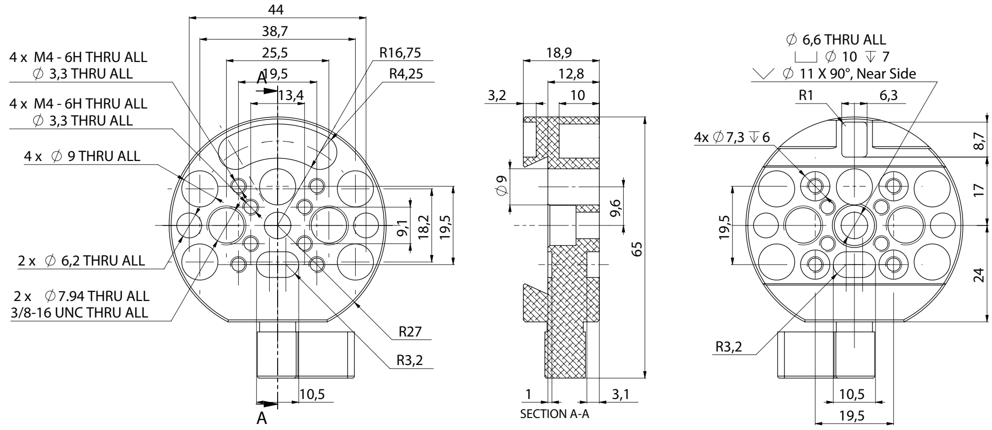
Preparing the adapter

The lead-through device is mounted to the device base and then to the robot tool flange through an adapter. Customers can use an L-shape adapter offered by ABB (option 3314-1) or design adapters according to actual requirements. During adapter design, hole dimensions on the device base and robot tool flange shall be considered.

Continues on next page

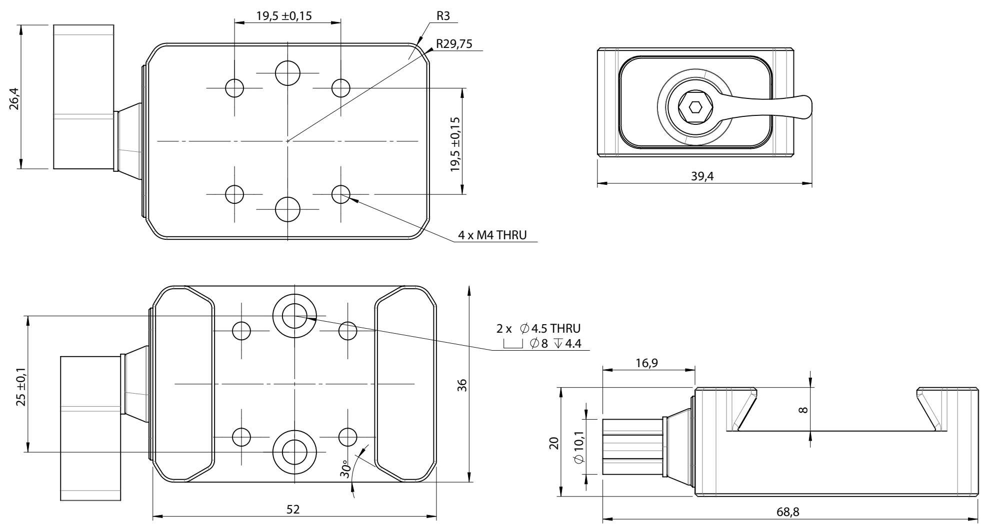
The following figure illustrates the hole dimensions on lead-through device base.

For no-button type



xx2100000164

For two-button type



xx2200000767

For the hole dimensions on robot tool flange, see *Tool flange standard on page 70*.

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 1100 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Lead-through device	3HAC075974-001	

Continues on next page

Spare part	Article number	Note
Lead-through device base (for no-button type)	3HAC075975-001	
Lead-through device with buttons	3HAC082590-001	
Lead-through device base (for two-button type)	3HAC082591-001	
Cabling M8-M12, 500 mm (for lead-through device)	3HAC077018-001	
Ethernet cable M12- RJ45, 7m (for lead-through device)	3HAC077020-001	

Installing the lead-through device

Use the following procedure to install the lead-through device.

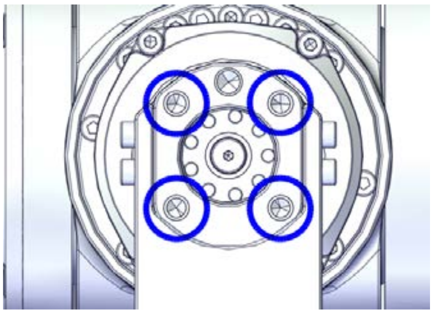
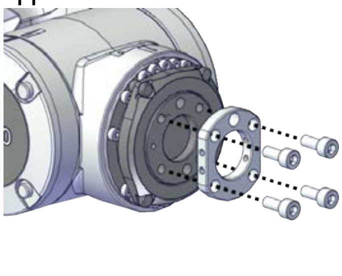
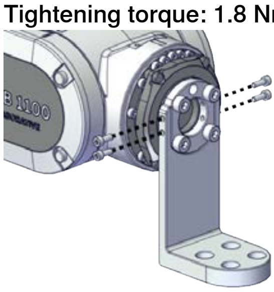
Note

The lead-through device can be installed in any position according to actual applications. Figures in the following procedures only illustrate an example position.

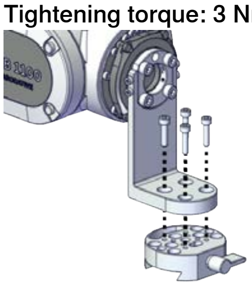
Preparations before installing the lead-through device

	Action	Note
1	Remove all tools from the mounting flange.	
2	Jog the robot to the synchronization position.	Calibration is detailed in section *Calibration on page 655*.
3	Prepare the lead-through device adapter. **CAUTION** To calibrate the axis 6, the notch on the wrist must be aligned with the marked pin hole on the tool flange. Before installing the adapter on the tool flange, make sure a visible mark has been made to the adapter at the corresponding position. For details about the synchronization mark, see *Synchronization marks and synchronization position for axes on page 659*.	Refer to *Preparing the adapter on page 72*.

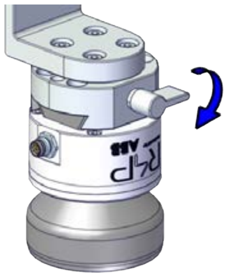
Continues on next page

	Action	Note
4	Install the adapter to mounting flange. **Note** Secure the adapter to the tool flange using the screw holes circled in the following figure if there are no other tools to be fitted. Otherwise, the tools should use these holes as via holes to be fitted to the robot.  xx2100000167	Following figures illustrate installation of the offered L-shape adapter (option 3314-1). Specification and tightening torque of screws fixing the adapter to the tool flange vary according to actual applications.  xx2100000281 Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.8 Nm  xx2000002222

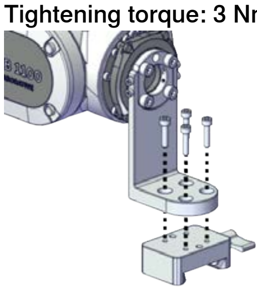
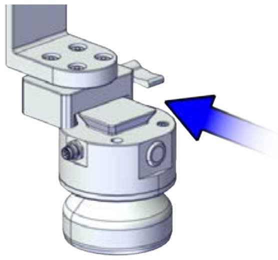
Installing the lead-through device (no-button type)

	Action	Note
1	Install the device base to the adaptor.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 3 Nm  xx2000002223

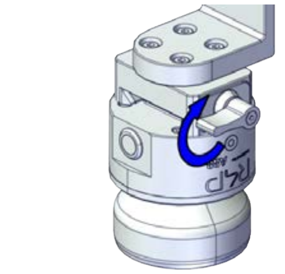
Continues on next page

	Action	Note
2	Insert the lead-through device to the base.	 xx2000002224
3	Turn the adjusting knob to lock the lead-through device. **Note** Do not use excessive force! The arrow in the figure indicates the direction of locking the lead-through device.	 xx2000002225

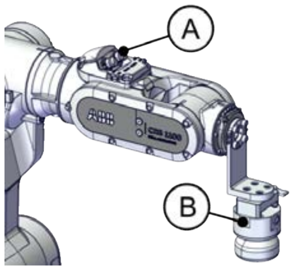
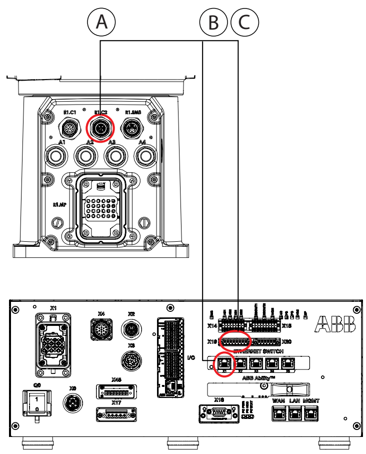
Installing the lead-through device (two-button type)

	Action	Note
1	Install the device base to the adaptor.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 3 Nm  xx2200000763
2	Insert the lead-through device to the base.	 xx2200000764

Continues on next page

	Action	Note
3	Turn the adjusting knob to lock the lead-through device. **Note** Do not use excessive force! The arrow in the figure indicates the direction of locking the lead-through device.	 xx2200000765

Connecting the cables

	Action	Note
1	Connect the cabling between the lead-through device and robot. • R2.C2 connector on process hub of robot (A) • Lead through device connector (B)	 xx2200000766
2	Connect the cable between robot and controller. • R1.C2 connector on robot base (A) • Ethernet switch port on controller (B) • X19 connector on controller (C) **Note** Ethernet switch port is available for use only when the **5 Port Ethernet switch** option is selected. Otherwise, connect the cable to the MGMT port. **Note** Pins 3 and 4 of X19 connector are used for the lead-through device connection while pins 1 and 2 are occupied by the CP/CS cable for lamp unit.	 xx2100000292

Configuring the lead-through functionality

The lead-through functionality is predefined for robots that are delivered with the option 3313-1 Lead-through Device ordered.

If the lead-through option is newly ordered for an existing robot and the robot system is operating in RobotWare 7.6 or later, the Collaborative Speed Control add-in must be installed to the system to activate the lead-through functionality.

For details about how to install the add-in and configure the lead-through functionality, see *Lead-through on page 98*.

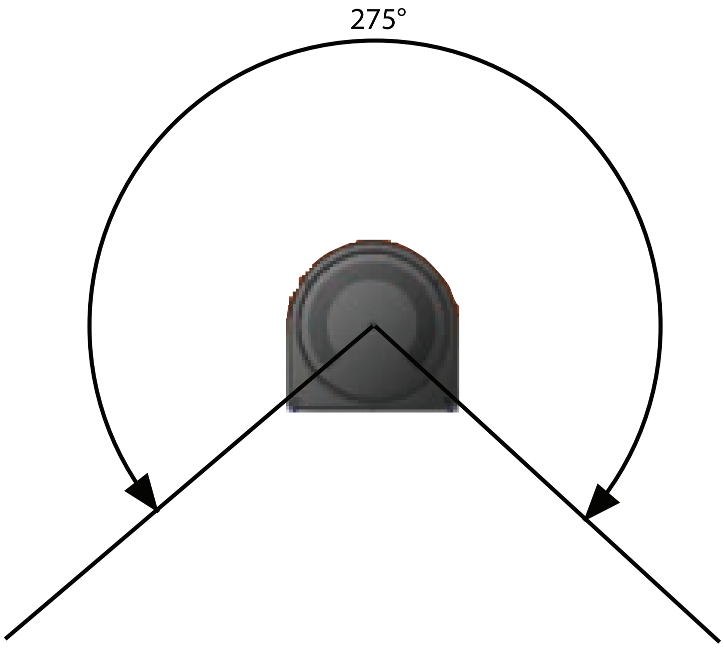
3.3.8 Installation of laser scanner

Overview

The safety separation technology and speed control for CRB 1100 is based on the connection and communication of one or two safety laser scanners in the robot. Laser scanner(s) provides a timely and continuous monitor on the activities within its scanning area and forms a protective field. One laser scanner can provide a scanning range of approximately 275°. The system integrator shall investigate the site environment and place the laser scanner to a suitable location according to the actual requirements.

CAUTION

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



xx2100000168

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)

Continues on next page

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 WAN 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.

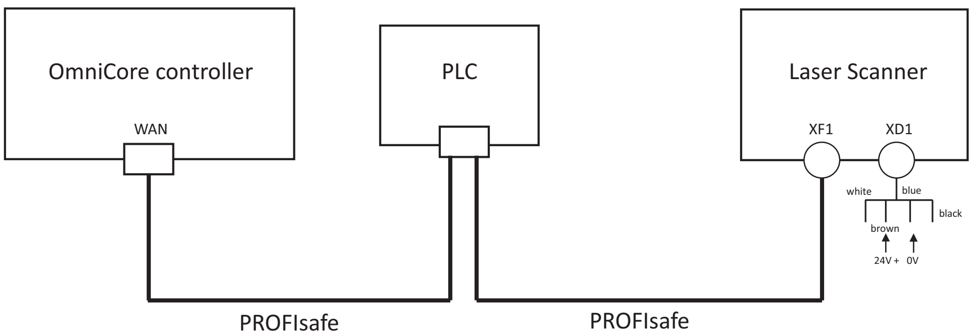
Connecting the laser scanner(s)

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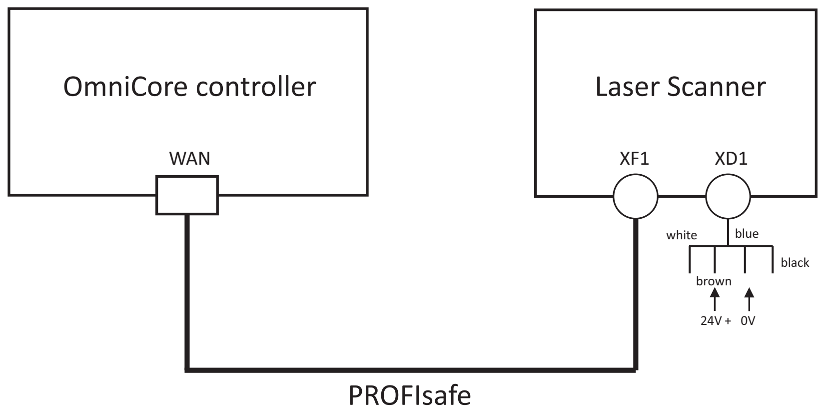
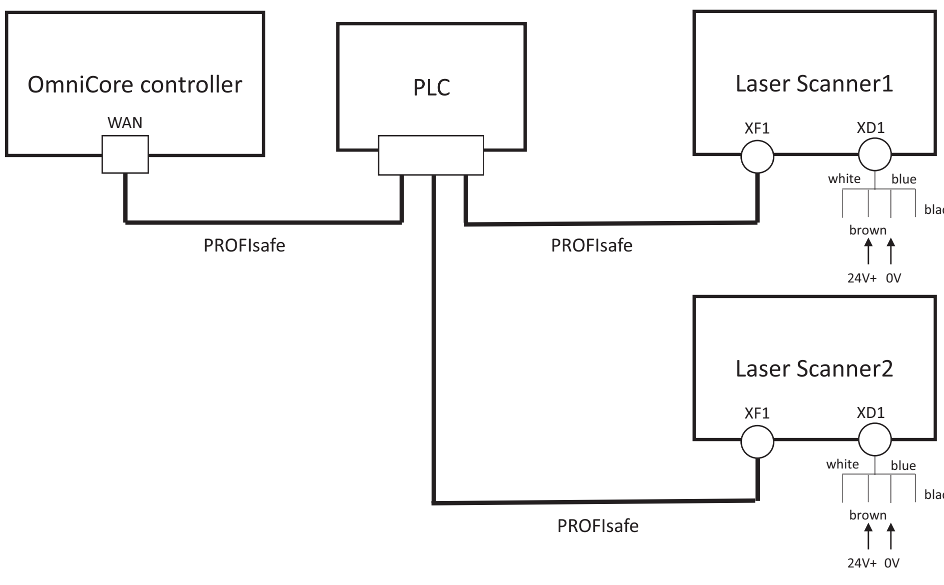
1 PROFIsafe-based laser scanner (option 3051-1), without PLC connected



xx2300000226

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



xx2200000298

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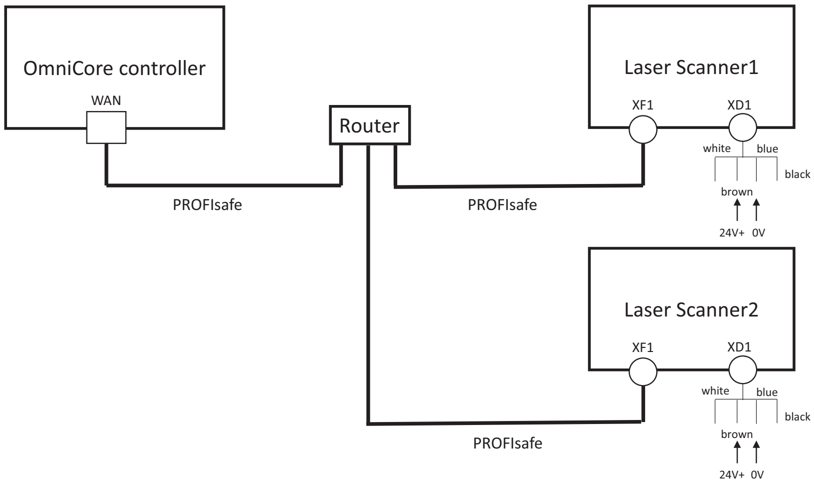
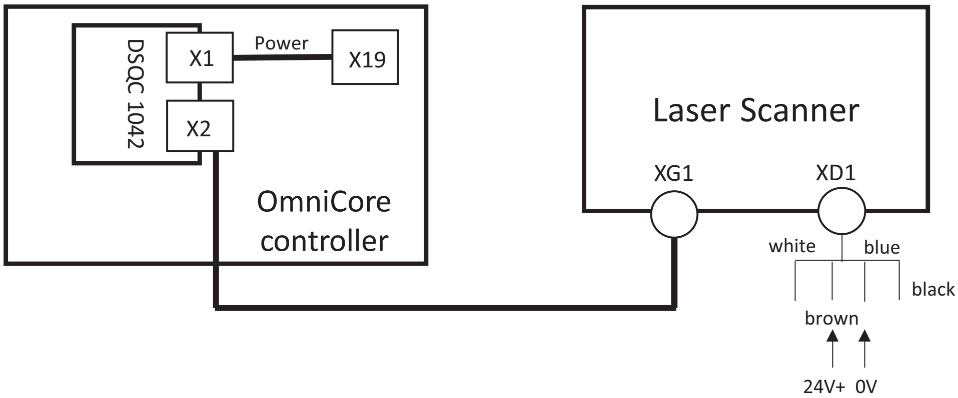
2 PROFIsafe-based laser scanners (option 3051-3), without PLC connected



xx2300000227

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



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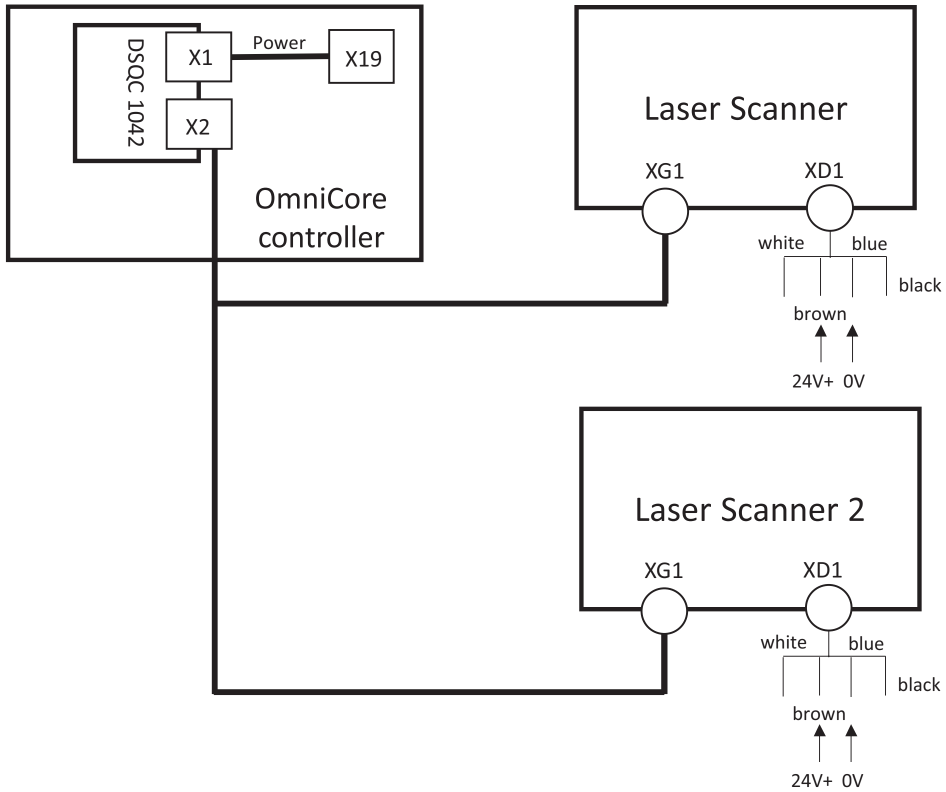
2 SafetyIO-based laser scanners (option 3051-4)



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Note

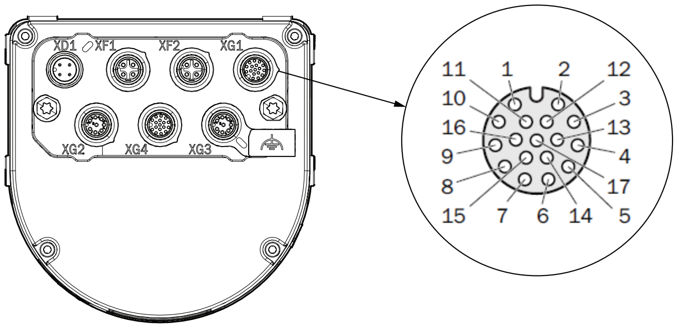
If there are additional scalable I/O devices available, install and configure the additional devices by following the detailed procedures in *Application manual - Scalable I/O*.

Continues on next page

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.



xx2300000750

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

Continues on next page

Configuring the laser scanner(s)

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

Scanner type	Works with...			Number of connected scanners	RobotWare version	Require...	Refer to...
	PLC	Scalable I/O deviceDSQC1042	OmniCore controller with SafeMove			Collaborative Speed Control add-in	
PROFIsafe-based	Y	N	Y	1	RobotWare 7.5 or earlier	N	*Configuration of one PROFINET-base laser scanner (RobotWare 7.5 or earlier) on page 121*
	Y	N	Y	1	RobotWare 7.6 or later	Y	*Configuration of one PROFIsafe-based laser scanner (RobotWare 7.6 or later and PLC acting as Master) on page 127*
	Y	N	Y	2	RobotWare 7.6 or later	Y	*Configuration of two PROFIsafe-based laser scanners (RobotWare 7.6 or later and PLC acting as Master) on page 131*
	N	N	Y	1	RobotWare 7.10 or later	Y	*Configuration of one PROFIsafe-based laser scanner (RobotWare 7.10 or later and OmniCore acting as Master) on page 135*
	N	N	Y	2	RobotWare 7.10 or later	Y	*Configuration of two PROFIsafe-based laser scanners (RobotWare 7.10 or later and OmniCore acting as Master) on page 139*
SafetyIO-based	N	Y	Y	1	RobotWare 7.6 or later	Y	*Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later) on page 143*
	N	Y	Y	2	RobotWare 7.6 or later	Y	*Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later) on page 148*

Continues on next page

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

Scenario	Actions
RobotWare 7.5 or an earlier version upgraded to RobotWare 7.6 or a later version	**Note** Applicable only when using PROFIsafe-based laser scanners 1. Install the Collaborative Speed Control add-in. See *Information about Collaborative Speed Control add-in on page 97*. 2. Reconfigure the PLC and laser scanner. See *Configuration of one PROFIsafe-based laser scanner (RobotWare 7.6 or later and PLC acting as Master) on page 127*.
RobotWare 7.6 or a later version rolled back to RobotWare 7.5 or an earlier version	**Note** Applicable only when using PROFIsafe-based laser scanners Reconfigure the PLC and laser scanner. See *Configuration of one PROFINET-base laser scanner (RobotWare 7.5 or earlier) on page 121*.
Adding a new laser scanner	1. Connect the new laser scanner in the same type as the one existing in the system. See *Connecting the laser scanner(s) on page 79*. 2. Configure the new laser scanner. See *Configuration of two PROFIsafe-based laser scanners (RobotWare 7.6 or later and PLC acting as Master) on page 131* or *Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later) on page 148*.
Connection via a PLC changed to direct connection with the OmniCore Controller	**Note** Applicable only when using PROFIsafe-based laser scanners 1. Upgrade the robot system to RobotWare 7.10 or later, and install the options [3020-1] PROFINET Controller and [3023-1] PROFIsafe Controller to the system. 2. Reconfigure the laser scanners. See *Configuration of one PROFIsafe-based laser scanner (RobotWare 7.10 or later and OmniCore acting as Master) on page 135* or *Configuration of two PROFIsafe-based laser scanners (RobotWare 7.10 or later and OmniCore acting as Master) on page 139*.

3.4 Restricting the working range

3.4.1 Adjusting the working range

Reasons for adjusting the manipulator working range

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

Working range configurations

The parameter values for the axes working range can be altered within the allowed working range and according to available options for the robot, either to limit or to extend a default working range. Allowed working ranges and available options for each manipulator axis are specified in *Working range on page 47*.

Mechanical stops on the manipulator

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

Note

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

Axis	Fixed mechanical stop [i]	Movable mechanical stop [ii]
Axis 1	yes	no
Axis 2	yes	no
Axis 3	yes	no
Axis 4	no	no
Axis 5	yes	no
Axis 6	no	no

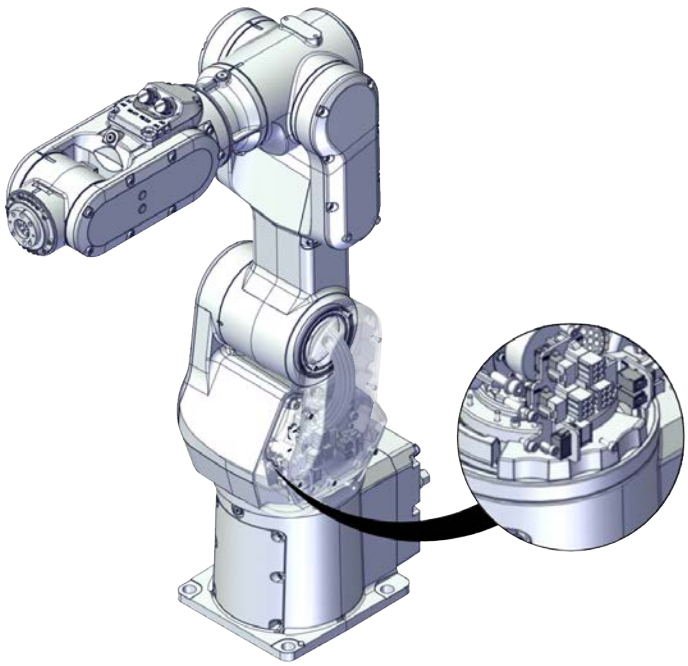
i Part of the casting or fixed on the casting and can not /should not be removed.

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

3.4.2 Mechanically restricting the working range

Location of the mechanical stops

Only axis 1 has a replacable mechanical stop.



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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 1100 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Mechanical stop, axis 1	3HAC061947-001	Replace if damaged.

Replacement of the axis-1 mechanical stop

The axis-1 mechanical stop is accessible after removing the base, see *Replacing the base on page 280*.

3.5 Electrical connection

3.5.1 Robot cabling and connection points

Introduction

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

DANGER

Turn off the main power before connecting any cables.

CAUTION

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

Main cable categories

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

Cable category	Description
Robot cables	Handles power supply to and control of the robot's motors as well as feedback from the serial measurement board. Specified in the table *Robot cables on page 88*.
Customer cables	Handles communication with equipment fitted on the robot by the customer, low voltage signals and high voltage power supply + protective ground. The customer cables also handle databus communication. The customer cables also include the air hose. See the product manual for the controller, see document number in *References on page 10*.
Air hoses	The hose for compressed air is integrated with the manipulator cable harness.

Robot cables

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

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

Continues on next page

Robot cable, power

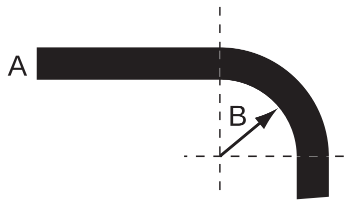
Power cable length	Article number
Power cable, straight connector, 3 m	3HAC077245-001
Power cable, straight connector, 7 m	3HAC077245-002
Power cable, straight connector, 15 m	3HAC077245-003
Power cable, angled connector, 3 m	3HAC077247-001
Power cable, angled connector, 7 m	3HAC077247-002
Power cable,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

Robot cable, signals

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

Bending radius for static floor cables

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



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A	Diameter
B	Diameter x10

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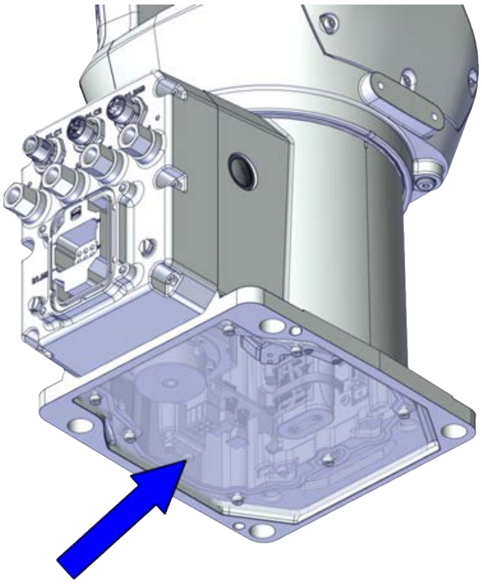
Grounding and bonding point on manipulator

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



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Customer cables - CP/CS cable

CP/CS cable length[i]	Article number
3 m, with lamp unit cabling	3HAC078069-001
7 m, with lamp unit cabling	3HAC078069-002
15 m, with lamp unit cabling	3HAC078069-003

i CP/CS cable for CRB 1100 also includes lamp unit cabling used for communication with the lamp unit on the process hub. The cable is also designed with free ends for more I/O connections and shall always be used properly in applications. It is recommended to shield the free ends not in use.

Do not use other types of CP/CS cables or use in an improper way; otherwise, the lamp unit will not work and other unknown faulty may be raised.

Customer cables - Ethernet floor cable

Ethernet floor cable length	Article number
7 m	3HAC067447-002
15 m	3HAC067447-003
7 m, with lead-through device cabling[i]	3HAC077020-001

i Ethernet floor cable with lead-through device cabling is used for communication with the lead-through device when installed. Another Ethernet cable of 500 mm is used between the lead-through device and R2.C2 connector on robot wrist.

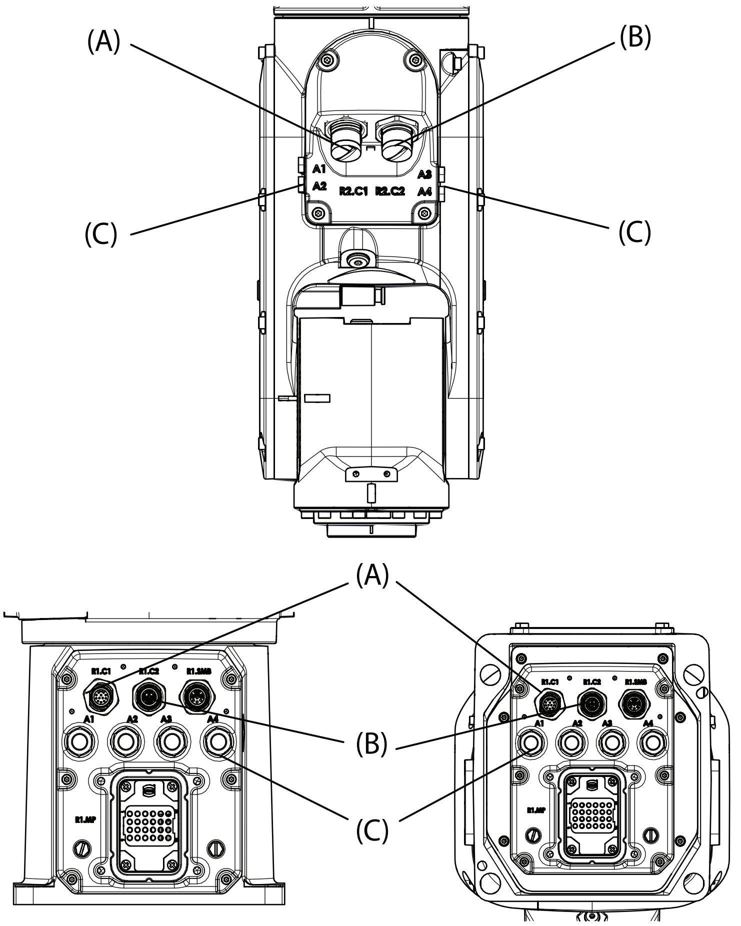
3.5.2 Customer connections

Introduction to customer connections

The cables for customer connection are integrated in the robot and the connectors are placed on the wrist and one at the base. There is one connector R2.C1 at the wrist. Corresponding connector R1.C1 is located at the base.

There is also connections for Ethernet, one connector R2.C2 at the wrist and the corresponding connector R1.C2 located at the base.

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



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Position	Connection	Description	Number	Value
A	(R1)R2.C1	Customer power/signal	4 wires[i]	30 V, 1.5 A
B	(R1)R2.C2	Customer power/signal or Ethernet	8 wires[ii]	30 V, 1 A or 1 Gbits/s
C	Air	Max. 6 bar	4	Outer diameter of air hose: 4 mm

i The connector has 12 pins. Only pins 5 to 8 are available for use. Pins 1 to 4 are used for LED indicator, and pins 9 to 12 are not connected internally.

Continues on next page

ii If the lead-through device is installed, the C2 connector will be used for the lead-through device and 6 wires are occupied.

Connector kits (optional)

Connector kits, wrist

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

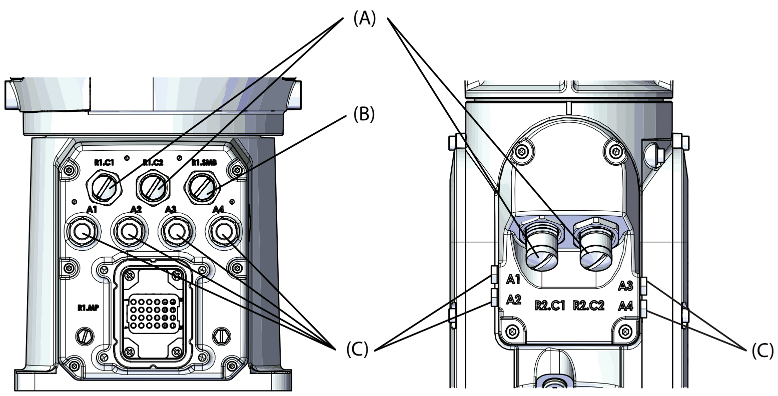
Position	Description		Art. no.
Connector kits	CP/CS	M12 CPCS Male straight connector kits	3HAC066098-001
		M12 CPCS Male angled connector kits	3HAC066099-001
	Ethernet	M12 Ethernet Cat5e Male straight connector kits	3HAC067413-001
		M12 Ethernet Cat5e Male angled connector kits	3HAC067414-001

Protection covers

Protection covers for water and dust proofing

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

Always remember to refit the protection covers after removing them.



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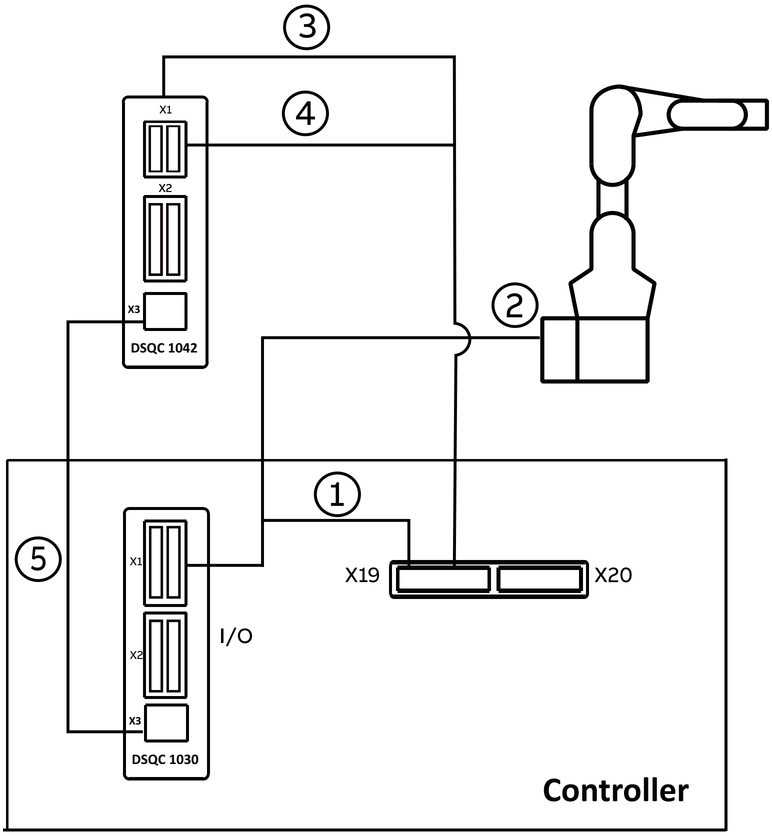
A	CP/CS or Ethernet connector protection covers
B	SMB connector protection cover
C	Air hose connector protection covers

Scalable I/O device connection

For robot working with safetyIO-based laser scanners, a safety I/O device DSQC1042 will be available and required to be connected with the base I/O device DSQC1030 installed on the controller.

Continues on next page

The following figure illustrates the connection among manipulator, controller with base I/O device configured and the safety I/O device.



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1	Ethernet connection	Between X3 connectors on DSQC1030 and on DSQC1042
2	Lamp unit cabling	Using CP/CS cable to connect, • X1 connector on DSQC1030 • X19 connector on controller • R1.C1 connector on manipulator base
3	Power connection	Between X4 connector on DSQC1030 and X19 connector on controller

For details about the I/O module models, see *Application manual - Scalable I/O*.

3.6 Start of robot in cold environments

Introduction

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

Problems with starting the robot

Event message from Motion Supervision

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

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

Robot stopping with other event message

Use this procedure if the robot is not starting.

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

Adjusting the speed and acceleration during warm-up

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

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

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

3.7 Configuring the software

Overview

This section is intended for guiding users to set up robot system and configure necessary software for CRB 1100. It also contains information of some customizable safety configurations.

A general software configuration procedure is listed as below.

	Action	Reference to...
1	Configure RobotWare as required.	• *Information about RobotWare and CRB 1100 on page 96* • *Operating manual - Integrator's guide OmniCore*
2	**For robots operating in RobotWare 7.6 or later** Download the Collaborative Speed Control add-in and install required options.	*Information about Collaborative Speed Control add-in on page 97*
3	Configure the lead-through functions.	*Lead-through on page 98*
4	Configure 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.	• *The SafeMove configurator app on FlexPendant on page 105* • *Application manual - Functional safety and SafeMove*
	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.	• *Configuration of SafeMove using Visual SafeMove in RobotStudio on page 116* • *Application manual - Functional safety and SafeMove*
5	Configure laser scanner(s) and apply speed control strategies.	*Speed control on page 121*
6	Get knowledge of the robot status indications shown by the lamp unit.	*Robot status indication on page 156*
7	If required, modify customizable safety configurations.	*Use cases of safety configurations on page 158*

Continues on next page

3.7.1 Information about RobotWare and CRB 1100

Overview

CRB 1100 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*.

SafeMove

See *Application manual - Functional safety and SafeMove*.

3.7.2 Information about Collaborative Speed Control add-in

Overview

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

The Collaborative Speed Control add-in is integrated in the robot system at delivery if option 3313-1 Lead-through device or any of laser scanner options 3351-X are ordered. It is also available separately in the add-ins section in RobotStudio. To add it to an existing controller or do an update, see the installation procedure to install and add it to the robot.

With the Collaborative Speed Control add-in installed, the configuration of the lamp indicator, lead-through, and speed control are activated for the robot.

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

Installing the Collaborative Speed Control add-in

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

1. Start RobotStudio and open the **Add-Ins** tab. The **Gallery** window is displayed.
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. In the **Controller** tab page, choose **Installation** > **Modify Installation** function in the **Configuration** group.
6. In the **Modify Installation** window, connect to a real controller or select/create a virtual controller.
7. Proceed to the **Options** window and access the **Applications** tab page.
8. In the **Collaborative Features** group, choose the required option checkbox.
9. Click **Next** to go to the **Confirmation** window.
10. Click **Apply** to confirm and save the changes.

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

3.7.3 Lead-through

What is lead-through?

The lead-through functionality is available for robots designed for collaborative applications. Using lead-through, you can move the robot manually to a desired position, as an alternative to jogging.

Using lead-through

> **Note**
>
> For robots newly ordered with option 3313-1 Lead-through Device and operating in RobotWare 7.6 or later, install the Collaborative Speed Control add-in with the option *[3313-1] Lead-through Device* selected first. See *Installing the Collaborative Speed Control add-in on page 97*.

Checking lead-through status

The lead-through device is not configured by default. Users can perform the following procedure to check the configuration status:

1. In the FlexPandant, on the status bar, tap the **QuickSet** button.

   The **QuickSet** window is displayed.
2. Tap **Lead-through**.

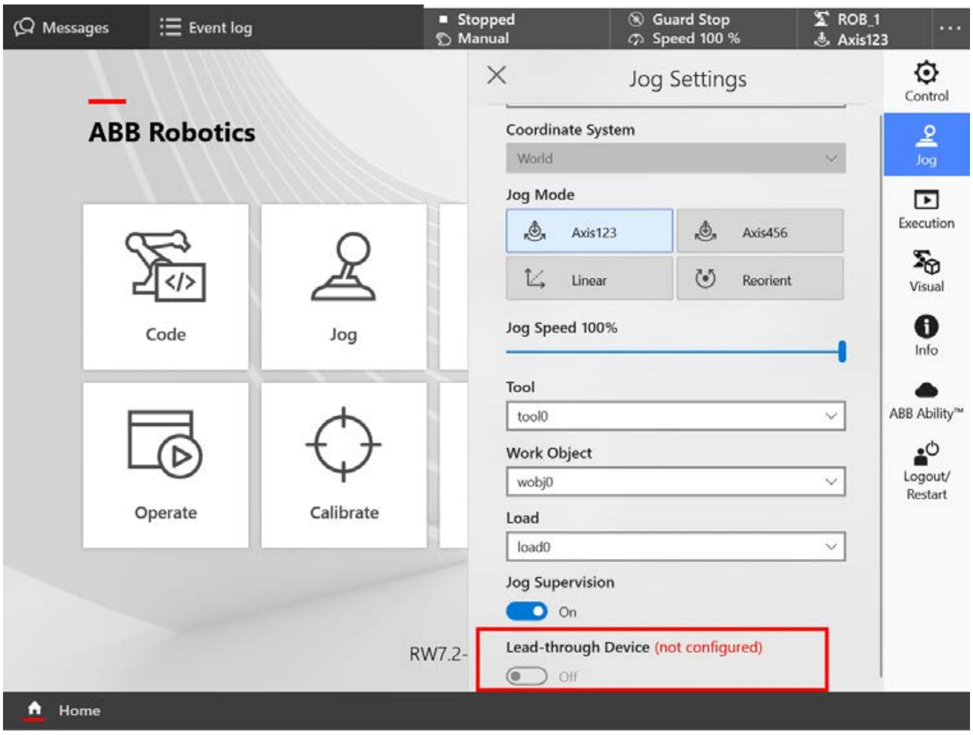
   The **Lead-through Settings** tab page is displayed.
3. Check the lead-through device setting.

   The device is not configured by default and the **Enable Lead-through** switch is unavailable for use.

Continues on next page

Note

For robots operating in RobotWare version earlier than 7.7, check the lead-through status in the **Jog Setting** tab page by tapping **Jog** in the **QuickSet** window.



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Configuring installation information of the lead-through device

Use the following procedure to configure the installation information of the lead-through device and get it ready for use:

1. Tap **Settings** on the home page of the FlexPendant.
2. Tap **Lead-through Device.**
3. For robots installing with the Collaborative Speed Control add-in in version 1.1 or later, choose the lead-through device type from the drop-down list.

   Tip

   You can click **About the versions** and refer to the pictures to figure out your device type.

4. In the **Installation** page of the displayed window, select the installation position of the lead-through device.

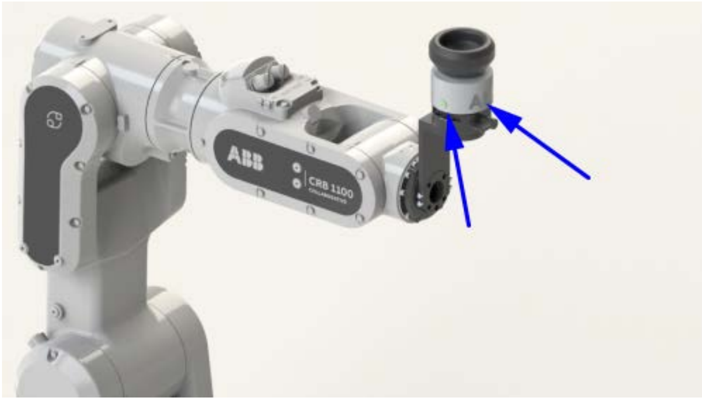
Continues on next page

Four installation configurations are predefined, **Up**, **Right**, **Down** and **Left**. Observe your device and refer to the following table to make sure the actual device installation position is consistent with the selected configuration.

<table>
<tr><th>Device type</th><th>Observe...</th></tr>
<tr><td>No-button type</td><td>

The ABB logo on the device is in the correct direction.
The indicator on the lead-through is in the correct relative position with the lamp unit on the process hub.

The following figure takes the configuration Up as an example.



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The device details are as follows.

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

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<table>
<tr><th>Device type</th><th>Observe...</th></tr>
<tr><td>Two-button type</td><td>The indicator and locking knob on the lead-through are in the correct relative position with the lamp unit on the process hub.
The following figure takes the configuration Up as an example.

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The device details are as follows.

xx2200000598</td></tr>
</table>

5 If users want to define customized installation position, tap **Advanced installation.**

6 In the displayed window, set corresponding parameters according to actual requirements.

- For robots operating in RobotWare version earlier than 7.7, the device offset and orientation are available to set.
- For robots operating in RobotWare version 7.7 or later, the device offset, orientation, tool load mass and mass center are available to set.

7 Tap **Apply**.

Enabling lead-through

Use the following procedure to enable lead-through:

1 Make sure the robot is in Manual mode.

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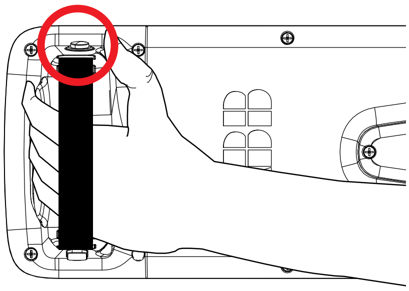
2 Enable lead-through in one of the following ways:
   - Press the thumb button on the FlexPendant.



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

> **Note**
>
> If the robot is in motors off state, set the controller to Motors On state first by pressing the three-position enabling device or changing the state in the **Control Panel** tab page.

> **Note**
>
> For robots operating in RobotWare version earlier than 7.7, the lead-through device can only be enabled from the **Jog Setting** tab page by tapping **Jog** in the **QuickSet** window.

3 In the **Lead-through Mode** section select a mode.

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

5 Hold the handler of the lead-through device and gently move the robot 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.

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

6 If desired, save the position.

Continues on next page

> **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.

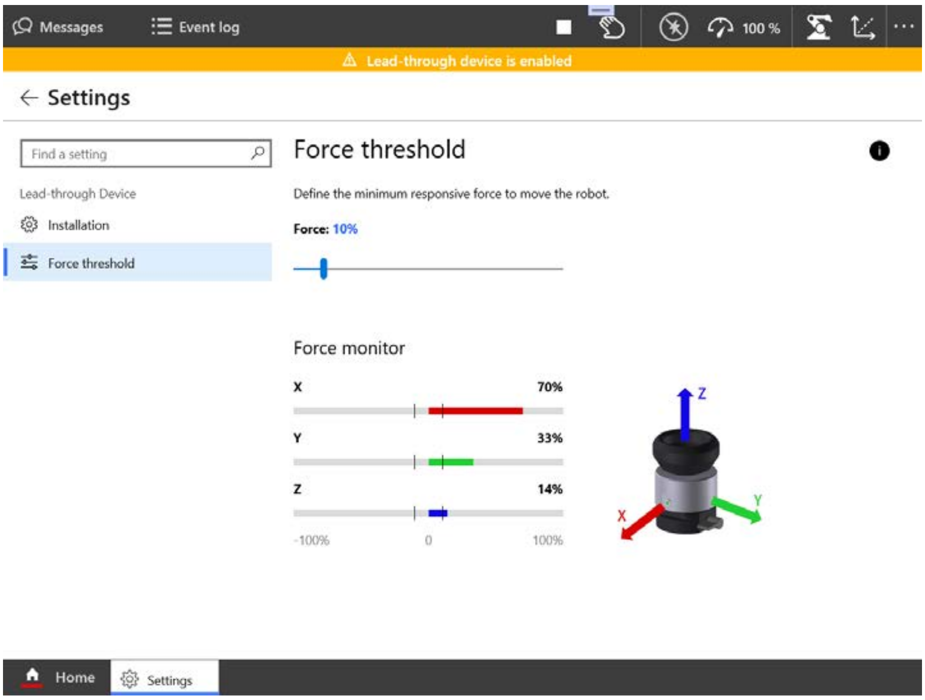
Setting force threshold

In actual applications, some strong background noises, for example, EMC and radiation, may be treated as a force by the lead-through device, which may results in an unexpected movement of the robot. To reduce such affections, users are allowed to set a force threshold. All the forces that are lower than the threshold will be filtered out.

Use the following procedure to set the force threshold:

1. Tap **Settings** on the home page of the FlexPendant.
2. Tap **Lead-through Device.**
3. Tap **Force threshold** on the left pane.
4. In the displayed window, drag the **Force** slider to define a response force to move the robot.

   The default force threshold is **10%**.

   xx2100000176
5. Observe the forces applied on the lead-through device in real time in the **Force monitor** area.

Continues on next page

Configuring button functions

> **Note**
>
> The procedure is valid only for two-button type lead-through device.

The button-type lead-through device provides two buttons, flat and raised, for users to configure specific functions according to application requirements. The button function configuration is only available to robots:

- operating in RobotWare version 7.6.1 or later, and,
- installing with the Collaborative Speed Control add-in in version 1.1 or later

Use the following procedure to configure the button functions:

1. Tap **Settings** on the home page of the FlexPendant.
2. Tap **Lead-through Device.**
3. Tap **Configurable buttons** on the left pane.
4. Select desired function from the drop-down list for the required button.
   - **Add a move location**: a **Move** block will be added to Wizard app. This is the default configuration for the flat button.
   - **Linear** / **Reorient**: the lead-through mode will be changed between linear and reorient. This is the default configuration for the raised button.
   - **Lock Z**: the movement along the Z direction will be locked.
   - **Lock XY**: the movement along the X and Y directions will be locked.

After selection, configured action takes effect when pressing the button.

3.7.4 SafeMove

3.7.4.1 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 108*.

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.

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

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.

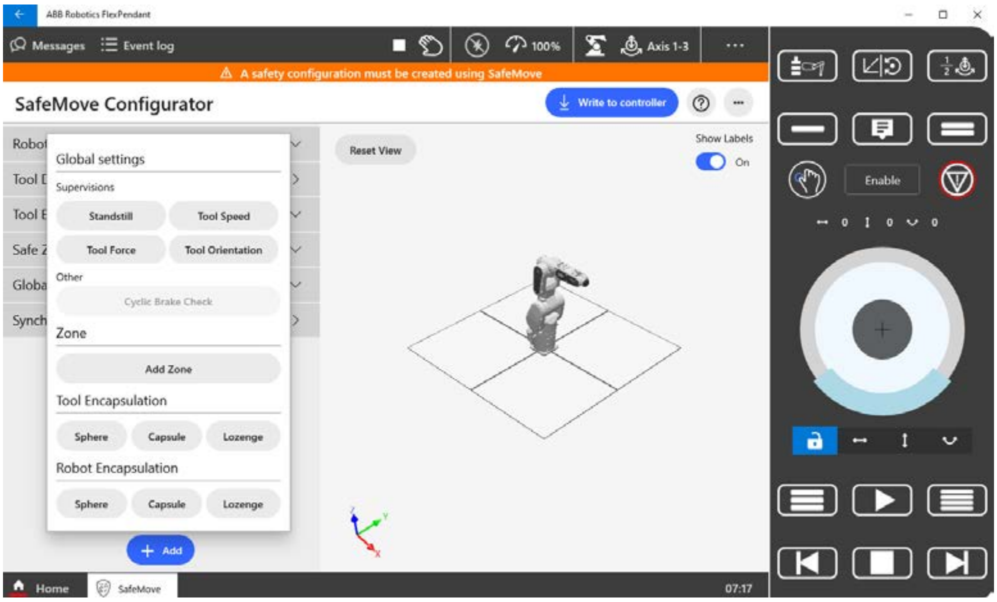
Template configurations

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



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> **Note**
>
> For the CRB 1100 and CRB 1300, the SafeMove configurator app offers the same functionality. The screenshots used in the manual can therefore show either one of the robots.

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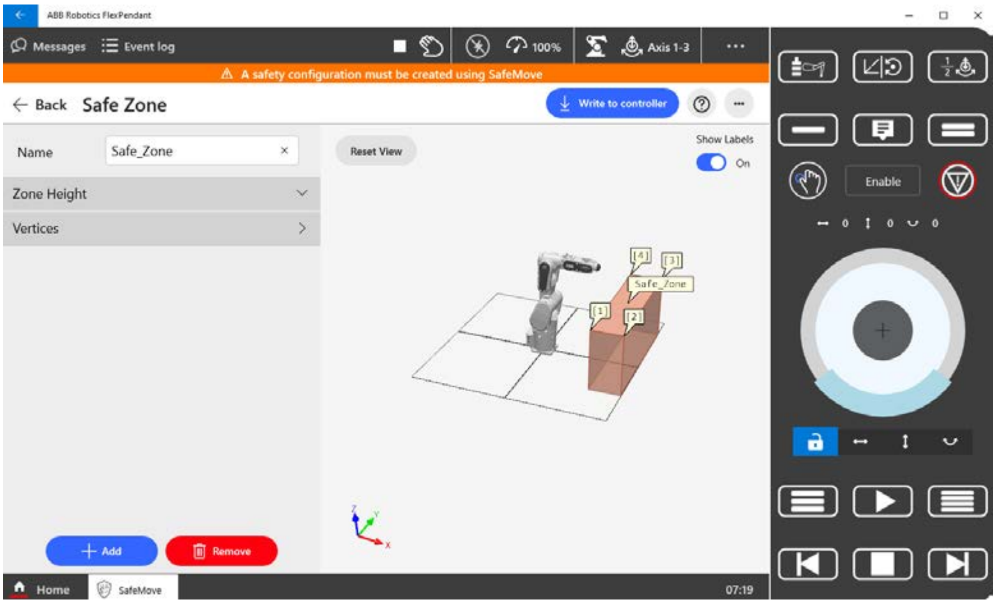
Safe zones

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*.

Continues on next page

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*.

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.

   The robot controller is automatically restarted in this step.
7. Validate the configuration.
8. Set the safety configuration to validated and lock it.

For more details, see *Use cases on page 108*.

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 108*.

Load a safety configuration template

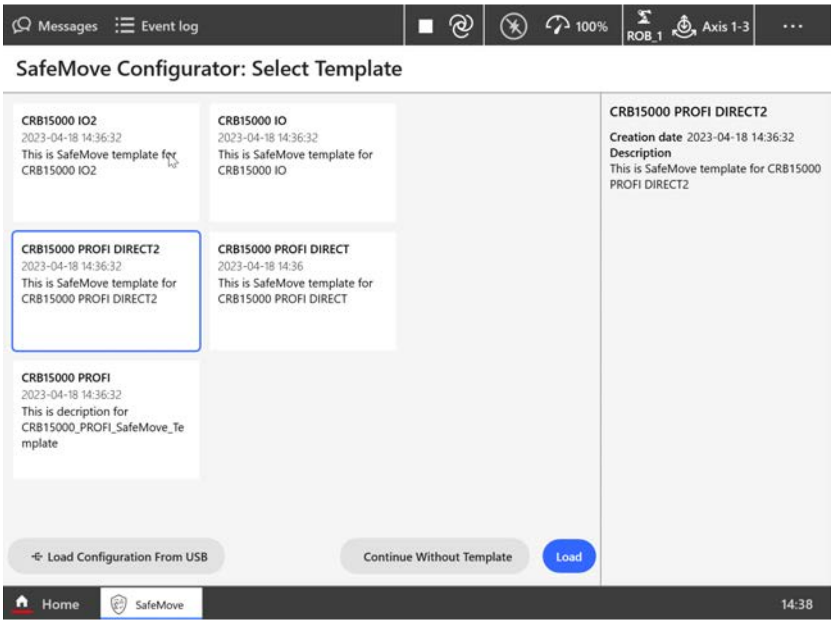
The safety configuration template feature is available from RW 7.12 onwards. Systems with RW 7.10 or earlier will still have the default template solution.

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.**

Continues on next page

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



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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 110*.

   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 114*. 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

Continues on next page

11 Tap **Restart Controller**.

   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 111*.
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.

Continues on next page

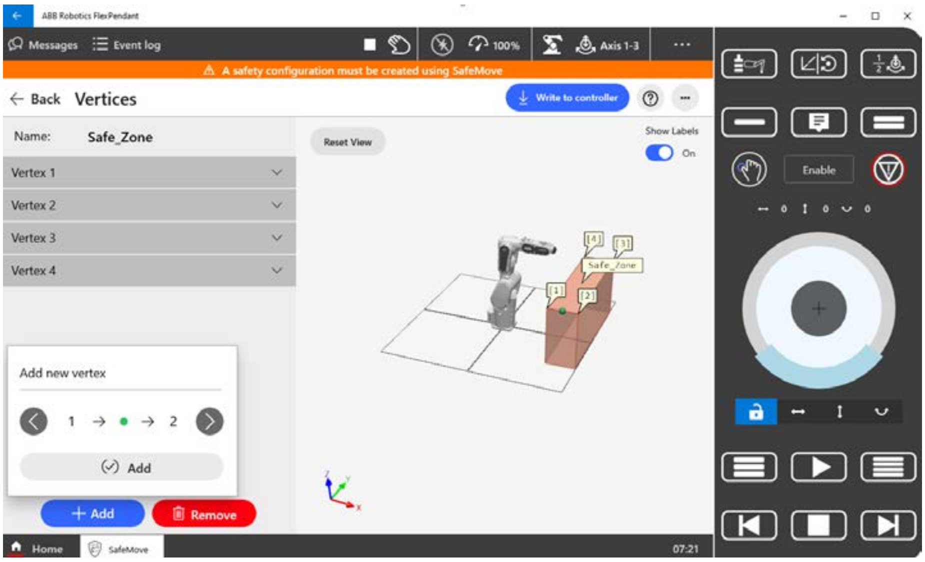
Modify a safe zone

Use the following procedure to modify a safe zone.

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

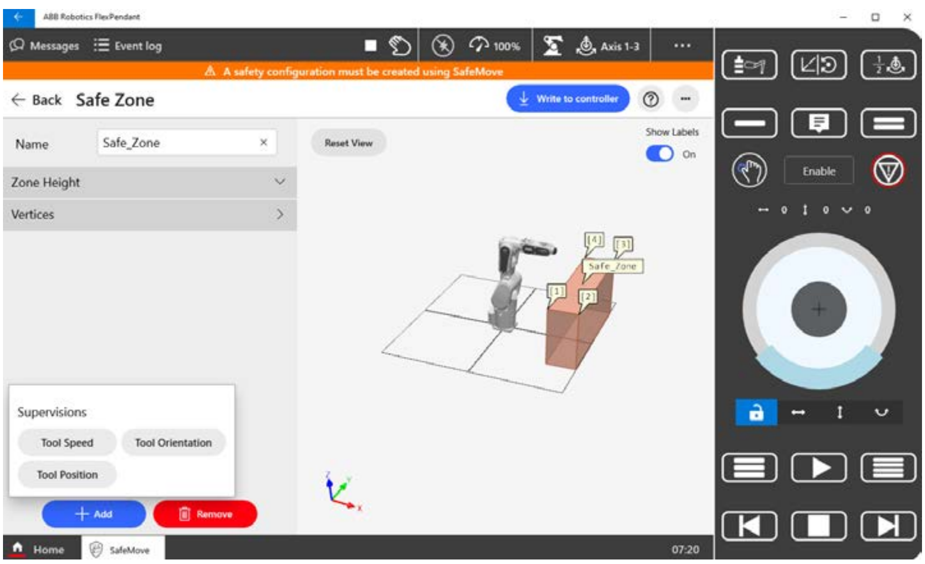
   The green dot in the 3D visualization shows where the new vertex is located. Use the arrows to change the position (index).

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

   xx2200000448

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.

   xx2200000449

Continues on next page

6 For supervision functions, select stop category, signal, and any other available setting applicable for the function.

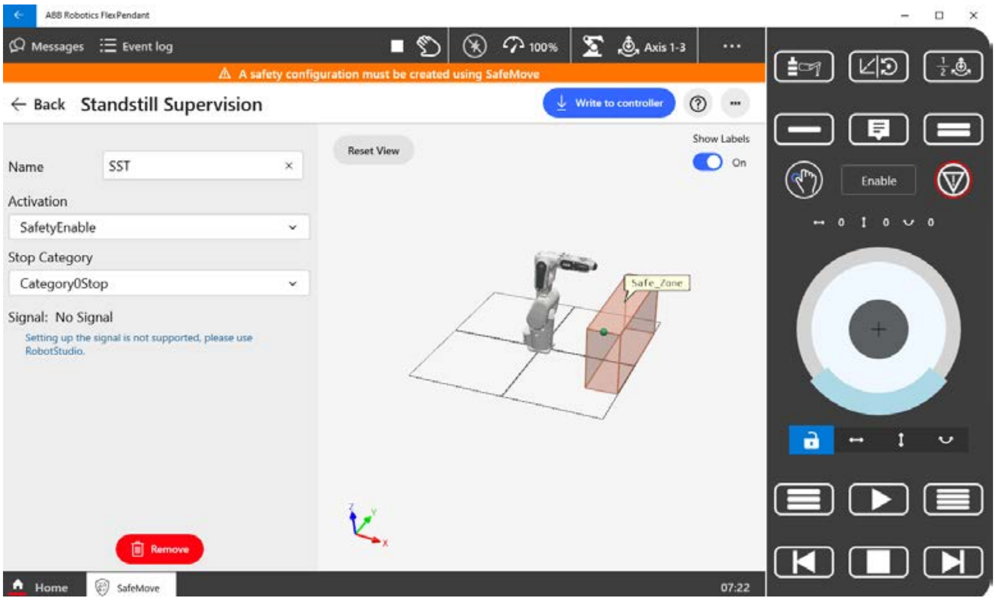
Tip

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

Modify the Standstill Supervision settings

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

The CRB 1100 has support for both category 0 stop and category 1 stop.



xx2200000450

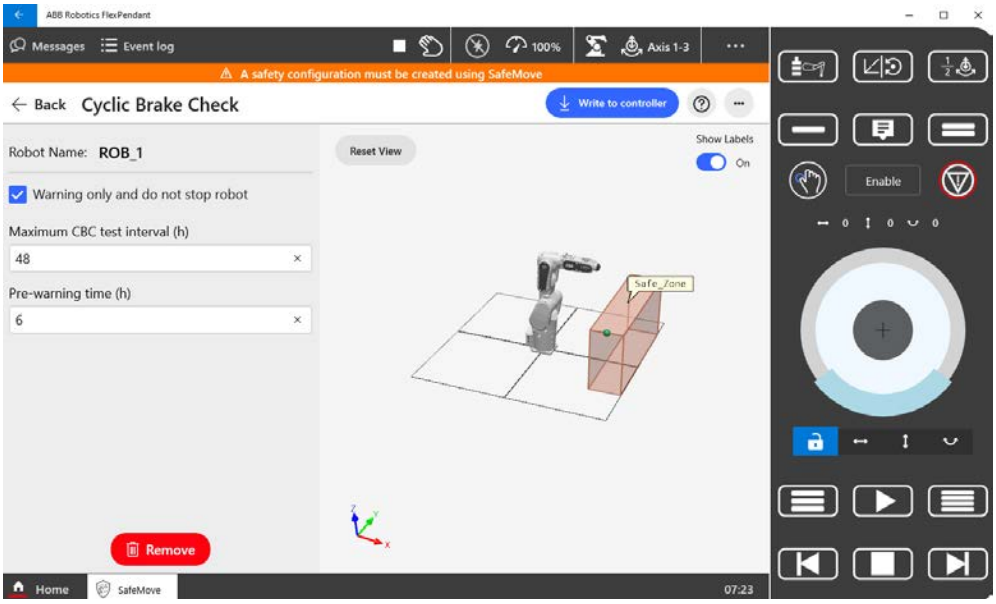
Modify the global supervision settings

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

Continues on next page

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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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
- All tools with corresponding supervision functions

Continues on next page

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.

Continues on next page

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*.

3.7.4.2 Configuration of SafeMove using Visual SafeMove in RobotStudio

General

This section describes SafeMove configuration using Visual SafeMove for scenarios with PROFIsafe-based laser scanners connected and OmniCore controller acting as master.

What is Visual SafeMove

Visual SafeMove is the configuration tool for SafeMove and the functional safety options. The tool is completely integrated into the RobotStudio user interface and takes full advantage of the user interface elements such as tabs, browsers, and 3D graphics.

Visual SafeMove is enabled for robots with the safety module. It offers an intuitive way to visualize and configure safety zones. Zones can be adjusted by direct manipulation in the 3D window. Users with previous experience from SafeMove will recognize the same terminology used as before.

Visual SafeMove is used to configure safety stops. For this purpose, the SafeMove options are not required, that is, this functionality is available for all robots. More information about the configuration is available in the product manual for the robot controller.

Visual SafeMove works both with the real controller and the virtual controller. For a virtual controller, a RobotStudio station should be used, which allows zones to be generated automatically. When not running a RobotStudio station, **Online Monitor** is used to visualize the robot.

Starting Visual SafeMove

	Action
1	Start RobotStudio with a virtual controller (with or without a station) or connect a real controller. • The user account logging in the controller must be granted with the Safety Services permission. • The write access to the controller is also requested
2	In the **Controller** tab, click **Online Monitor**. (Not needed when running a RobotStudio station.)
3	In the **Controller** tab, click **Safety**, then select **Visual SafeMove**.

Configuring SafeMove

Configuring pre logic

1. On the **Visual SafeMove** tab page, click **Safe IO Configurator** in the **Configuration** group.
2. Click **Pre Logic** view in the **Safe IO Configuration** page.
3. Click **New expression** and create the following expressions.
   - ISH_Activate_SST
   - ISH_Activate_TSP
   - ISH_Delay_SST

Continues on next page

- ISH_Delay_TSP
- ISH_EnableDelay_Protecting
- ISH_EnableDelay_Warning
- ISH_Combination_Protecting
- ISH_Combination_Waning

In which, the expressions *ISH_Combination_Protecting* and *ISH_Combination_Waning* are required only when two PROFIsafe-based laser scanners are connected.

4 At the bottom of the **Safe IO Configuration** page, type the corresponding logical expression in the text box for each expression and click **Create signals**.

Expression	Logic
ISH_Activate_SST	**Valid for scenarios with 1 PROFIsafe-based laser scanner connected** ISH_Supervise_SST := ((NOT EDGE((NOT ProtectingArea1),ISH_Delayed_SST)) OR (NOT ISH_Enabler_Delay_SST))
	Valid for scenarios with 2 PROFIsafe-based laser scanners connected ISH_Supervise_SST := ((NOT EDGE((NOT ProtectingAreaSM),ISH_Delayed_SST)) OR (NOT ISH_Enabler_Delay_SST))
ISH_Activate_TSP	**Valid for scenarios with 1 PROFIsafe-based laser scanner connected** ISH_Supervise_TSP := ((NOT EDGE((NOT WarningArea1),ISH_Delayed_TSP)) OR (NOT ISH_Enabler_Delay_TSP))
	Valid for scenarios with 2 PROFIsafe-based laser scanners connected ISH_Supervise_TSP := ((NOT EDGE((NOT WarningAreaSM),ISH_Delayed_TSP)) OR (NOT ISH_Enabler_Delay_TSP))
ISH_Delay_SST	**Valid for scenarios with 1 PROFIsafe-based laser scanner connected** DELAY(ISH_Enabler_Delay_SST,ProtectingArea1,(ISH_AtUser_Period_ms_Until_SST / ISH_SMctrl_Frequency),ISH_CountDelay_SST,ISH_Delayed_SST)
	Valid for scenarios with 2 PROFIsafe-based laser scanners connected DELAY(ISH_Enabler_Delay_SST,ProtectingAreaSM,(ISH_AtUser_Period_ms_Until_SST / ISH_SMctrl_Frequency),ISH_CountDelay_SST,ISH_Delayed_SST)

Continues on next page

Expression	Logic
ISH_Delay_TSP	**Valid for scenarios with 1 PROFIsafe-based laser scanner connected** DELAY(ISH_Enabler_Delay_TSP,WarningArea1,(ISH_AtUser_Period_ms_Until_TSP / ISH_SMctrl_Frequency),ISH_CountDelay_TSP,ISH_Delayed_TSP)
	Valid for scenarios with 2 PROFIsafe-based laser scanners connected DELAY(ISH_Enabler_Delay_TSP,WarningAreaSM,(ISH_AtUser_Period_ms_Until_TSP / ISH_SMctrl_Frequency),ISH_CountDelay_TSP,ISH_Delayed_TSP)
ISH_EnableDelay_Protecting [i]	ISH_Enabler_Delay_SST := (NOT ISH_UserMODE_bNot_IntermitCollab)
ISH_EnableDelay_Warning [i]	ISH_Enabler_Delay_TSP := ((NOT ISH_UserMODE_bNot_Cooperation) OR (NOT ISH_UserMODE_bNot_IntermitCollab))
ISH_Combination_Protecting [ii]	ProtectingAreaSM := (ProtectingArea1 AND ProtectingArea2)
ISH_Combination_Waning [ii]	WarningAreaSM := (WarningArea1 AND WarningArea2)

i Required no matter one or two PROFIsafe-based laser scanners are connected.
ii Required only when two PROFIsafe-based laser scanners are connected.

5 Click **Signals** view in the **Safe IO Configuration** page and then click **Global signals** to expand the signal list.
6 Click on the **Create new signal** row and create the following signals.
   - ISH_TFO_Active
   - ISH_TSP_Active
   - ISH_TSP_Viol
   - ISH_SST_Active
   - ISH_SST_Viol
7 Change the default value of following signals.

Signal	Default value
ISH_AtUser_Period_ms_Until_SST	650
ISH_AtUser_Period_ms_Until_TSP	550
ISH_SMctrl_Frequency	4
ISH_UserMODE_bNot_Cooperation	1

Creating encapsulation

1 In the **Visual SafeMove** browser on the left pane of the window, select the robot (ROB_1) and click **Capsule** in the **Visual SafeMove** ribbon tab.
2 Set capsule properties for the robot.

Parameter	Value
Radius (mm)	150
Length (mm)	650

Continues on next page

Parameter		Value
Start (Flange coordinates) (mm)	X value	0
	Y value	0
	Z value	0
End (Flange coordinates) (mm)	X value	650
	Y value	0
	Z value	0

3. In the **Visual SafeMove** browser, select the tool and click **Capsule** in the **Visual SafeMove** ribbon tab.
4. Set capsule properties for the tool.

Parameter		Value
Radius (mm)		150
Length (mm)		300
Start (Flange coordinates) (mm)	X value	0
	Y value	0
	Z value	0
End (Flange coordinates) (mm)	X value	0
	Y value	300
	Z value	300

Configuring Cyclic Brake Check

1. In the **Visual SafeMove** ribbon tab, click **Cyclic Brake Check**.
2. Select the **Warning only, no stop** check box, enable CBC for all the joints, and set other cyclic brake check properties.

Parameter	Value
Max CRC test interval (h)	48
Pre warning time (h)	6
Standstill tolerance	2
Supervision threshold	0.02

Configuring the supervision functions

1. In the **Visual SafeMove** ribbon tab, choose **Create Safe Zone** from the **Safe Zone** list.
2. Set zone properties.

Parameter		Value
Tool Speed Supervision Priority		BASE
Reference		Task frame
Botton, Top (mm)	Bottom value	0.000
	Top value	2100.000

Continues on next page

Parameter		Value
Vertices X, Y (mm)	X and Y values for vertices 1	-1400, -1400
	X and Y values for vertices 2	1400, -1400
	X and Y values for vertices 3	1400, 1400
	X and Y values for vertices 4	-1400, 1400

3 Click **Tool Position Supervision** in the **Modify** ribbon tab and set the properties.

Parameter		Value
Activation		PermanentlyActive
Function active status		No signal
Violation action	Stop category	Category1Stop
	Signal	No signal
Settings		Checked the **Include upper arm geometry** and **Allow inside** check boxes.

4 In the **Visual SafeMove** browser, right-click **Tool Speed Supervisions** and choose **Create Global Tool Speed Supervision.**

Parameter		Value
Activation		ISH_Supervise_TSP
Function active status		ISH_TSP_Active
Violation action	Stop category	Category1Stop
	Signal	ISH_TSP_Viol
Settings	Max speed (mm/s)	250.000
	Min speed (mm/s)	Leave blank

5 In the **Visual SafeMove** browser, right-click **Stand Still Supervisions** and choose **Create Global Stand Still Supervision.**

Parameter		Value
Activation		ISH_Supervise_SST
Function active status		ISH_SST_Active
Violation action	Stop category	Category0Stop
	Signal	ISH_SST_Viol
Tolerances		Enabled for all joints and remain default tolerance values.

Uploading the settings to the controller

1 In the **Visual SafeMove** ribbon tab, click **Controller** in the **Configuration** group.
2 Click **Write to controller**.
   The configurations are uploaded to the controller after the controller restarts.

3.7.5 Speed control

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

Preparing the robot system

Required options for system setup

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

Supported parameters for connections to scanner and PLC

Both the laser scanner and the PLC uses a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded to after the Collaborative Speed Control add-in is installed, see *Information about Collaborative Speed Control add-in on page 97*.

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

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

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

  - PROFIsafe parameter values

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

  - device mapping information

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

Continues on next page

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

Tip

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

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

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

GSD file

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

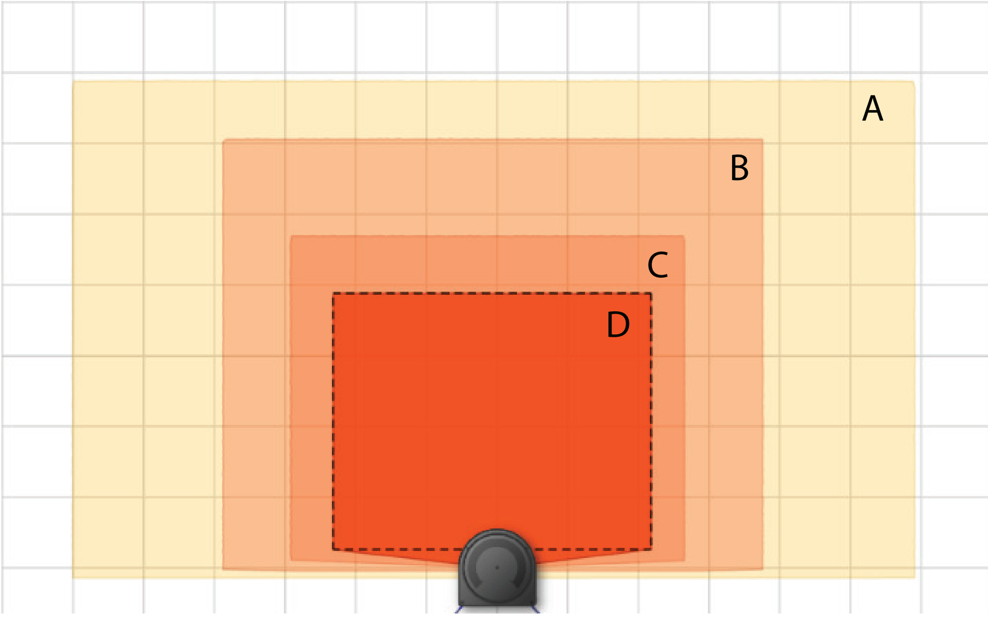
- **In the RobotWare installation folder in RobotStudio**: *...\DistributionPackages\ABB.RobotWare-x.x.x-xxx\RobotPackages \RobotControl_x.x.xxx\utility\service\GSDML*
- **On the OmniCore Controller**: *...\products\RobotControl_x.x.x\utility\service\GSDML*

Continues on next page

Configuring the laser scanner

Protection fields

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



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

Continues on next page

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

Configuration procedure

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

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

1. Connect the laser scanner to the PLC and controller.

   See the physical connection in *Connecting the laser scanner(s) on page 79*.
2. Open configuration software tool *Safety Designer®*.
3. Set IP address and PROFINET name in **Configuration** > **Addressing**.
   - The scanner IP address must be in the same network segment with the PLC and controller, that is, 192.168.10.XXX.
   - The PROFINET name must be the same in the PLC configuration.
4. Set **F-destination address** to **12** in **PROFINET** area in **Configuration** > **Protocol Settings**.
5. Define the four protection fields in **Configuration** > **Fields**.
6. Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs**.

   The **Use one input source** checkbox must be selected and choose **Rx: Process image (6 Bytes)** from the drop-down list.
7. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.

Continues on next page

Configuring the PLC

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

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

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

  The parameters f_dest_address and f_source_address are set to 12 and 1, respectively.
- Add the controller to the PLC by adding the **DI 8 bytes**, **DO 8 bytes**, **SDI 8 bytes** and **SDO 8 bytes** modules.

  The parameters f_dest_address and f_source_address for the SDI are set to 3 and 2, respectively, and for the SDO are set to 5 and 4, respectively.
- Make sure the address for the SDO signal is the first address of **SDO 8 bytes** slot.
- Create variables.

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

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

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

Configuring SafeMove

With RobotStudio

Basic steps for configuring SafeMove are as follows:

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

Continues on next page

For CRB 1100, required settings for communication between laser scanner, PLC and OmniCore controller are predefined in the configuration file.

4 Set up safety user grants.

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

5 Configure robot properties.
6 Configure the synchronization position.
7 Configure the SafeMove tool definitions.
8 Configure safe I/O signals.

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

9 Configure zones and/or ranges.
10 Configure the supervision functions.

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

11 Configure other functions.
12 Load the configuration to the safety controller.
13 Restart the robot controller.

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

With FlexPendant

1 Log in the FlexPendant.

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

2 Tap **Settings** on the home page.
3 Tap **Safety Controller**.
4 Tap **Synchronization** in the left pane.
5 Jog the robot to match the **Actual Positions** values with the **Sync Positions** values. Make sure they are the same.
6 Tap **Synchronize**.

3.7.5.2 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.6 or later and PLC acting as Master)

Preparing the robot system

Required options for system setup

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

Supported parameters for connections to scanner and PLC

Both the laser scanner and the PLC uses a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded after the Collaborative Speed Control add-in is installed, see *Information about Collaborative Speed Control add-in on page 97*. The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

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

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

  - PROFIsafe parameter values

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

  - device mapping information

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

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

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GSD file

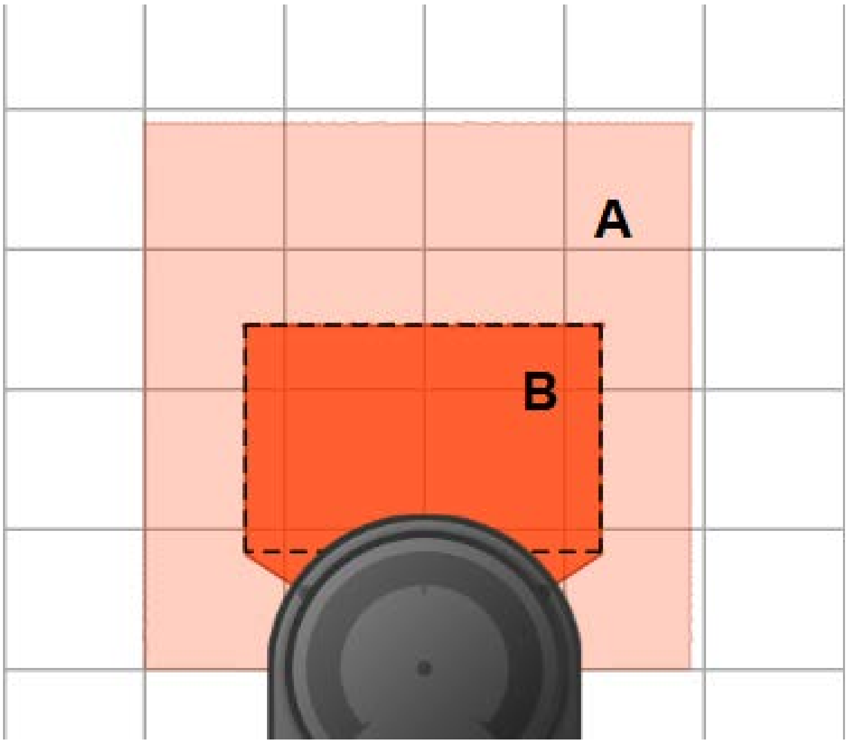
The GSD file, *GSDML-V2.xx-ABB-Robotics-OmniCore-YYYYMMDD.xml*, can be obtained from the RobotStudio or the OmniCore controller.

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

Configuring the laser scanner

Protection fields

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



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

Continues on next page

Configuration procedure

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

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

1. Connect the laser scanner to the PLC and controller.

   See the physical connection in *Connecting the laser scanner(s) on page 79*.
2. Open configuration software tool *Safety Designer®*.
3. Set IP address and PROFINET name in **Configuration** > **Addressing**.
   - The scanner IP address must be in the same network segment with the PLC and controller, that is, 192.168.10.XXX.
   - The PROFINET name must be the same in the PLC configuration.
4. Set **F-destination address** to **12** in **PROFINET** area in **Configuration** > **Protocol Settings**.
5. Define the two protection fields in **Configuration** > **Fields**.
6. Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs**.

   The **Use one input source** checkbox must be selected and choose **Rx: Process image (6 Bytes)** from the drop-down list.
7. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.

Configuring the PLC

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

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

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

  The parameters f_dest_address and f_source_address are set to 12 and 1, respectively.
- Add the controller to the PLC by adding the **DI 8 bytes**, **DO 8 bytes**, **SDI 8 bytes** and **SDO 8 bytes** modules.

  The parameters f_dest_address and f_source_address for the SDI are set to 3 and 2, respectively, and for the SDO are set to 5 and 4, respectively.
- Make sure the address for the SDO signal is the first address of **SDO 8 bytes** slot.

Continues on next page

- Create variables.

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

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

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

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1 Log in the FlexPendant.

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

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

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

The controller restarts.

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

5 Tap **Safety Controller**.

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

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

Make sure the values are the same.

8 Tap **Synchronize**.

3.7.5.3 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.6 or later and PLC acting as Master)

Preparing the robot system

Required options for system setup

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

Supported parameters for connections to scanners and PLC

Both laser scanners and the PLC uses a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded after the Collaborative Speed Control add-in is installed, see *Information about Collaborative Speed Control add-in on page 97*. The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

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

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

  - PROFIsafe parameter values

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

  - device mapping information

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

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

Continues on next page

GSD file

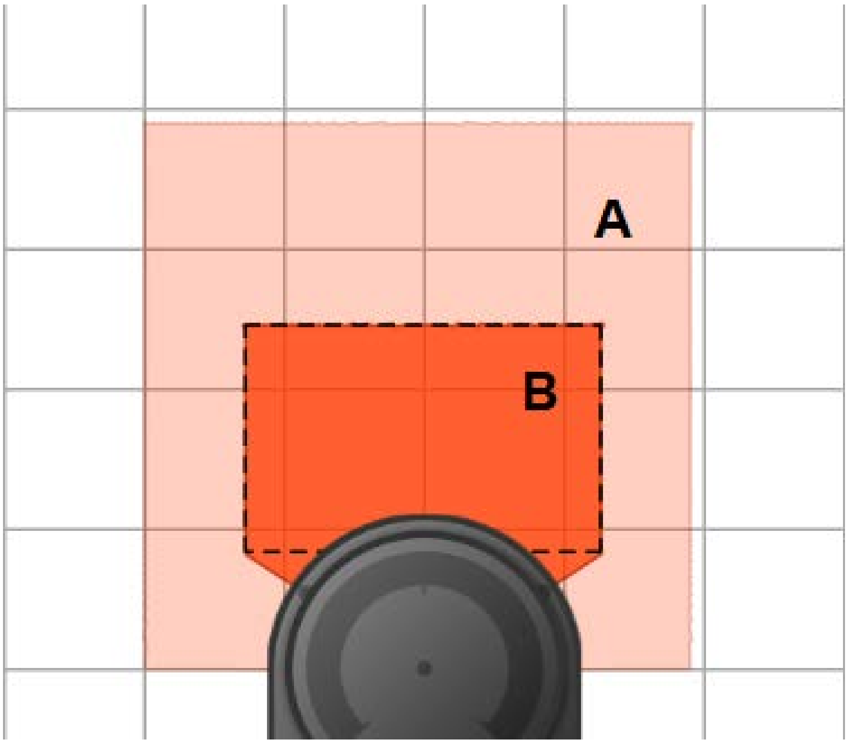
The GSD file, *GSDML-V2.xx-ABB-Robotics-OmniCore-YYYYMMDD.xml*, can be obtained from the RobotStudio or the OmniCore controller.

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

Configuring the laser scanner

Protection fields

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



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

Continues on next page

Configuration procedure

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

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

1. Connect the laser scanners to the PLC and controller.

   See the physical connection in *Connecting the laser scanner(s) on page 79*.
2. Open configuration software tool *Safety Designer®*.
3. Set IP address, F-destination and PROFINET name in **Configuration** > **Addressing**.
   - The scanner IP address must be in the same network segment with the PLC and controller, that is, 192.168.10.XXX.
   - The PROFINET name must be the same in the PLC configuration.
   - The two scanners must be set to different IP address, F-destination and PROFINET name.
4. Set **F-destination address** to **12** for the first scanner and to **13** for the second scanner, in **PROFINET** area in **Configuration** > **Protocol Settings**.
5. Define the two protection fields for each scanners in **Configuration** > **Fields**.
6. Define the source for input signals of each scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs**.

   The **Use one input source** checkbox must be selected and choose **Rx: Process image (6 Bytes)** from the drop-down list.
7. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.

Configuring the PLC

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

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

- Add two scanners to the PLC by adding two **mS3 6Byte In/Out PROFIsafe V2.6.1** modules.

  - The parameters f_dest_address and f_source_address are set to 12 and 1, for the first scanner, respectively.

  - The parameters f_dest_address and f_source_address are set to 13 and 1, for the second scanner, respectively.
- Add the controller to the PLC by adding the **DI 8 bytes**, **DO 8 bytes**, **SDI 8 bytes** and **SDO 8 bytes** modules.

Continues on next page

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

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

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

i %I3.*X*, %I4.*X*, %I14.*X* and %I15.*X* are the addresses of laser scanners; %Q68.*X* is the address of the OmniCore controller.
%Q3.0 and %Q14.0 are for activating the monitoring cases of the laser scanners.

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

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

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

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1. Log in the FlexPendant.

   Make sure the user logged in have access grants to lock safety controller configurations, safety services and software synchronization.
2. Tap **SafeMove** on the home page.
3. Tap **Load** in the pop-up message box to confirm loading of template SafeMove configuration files.

   The controller restarts.
4. After the controller is restarted, tap **Settings** on the home page.
5. Tap **Safety Controller**.
6. Tap **Synchronization** in the left pane.
7. Jog the robot to match the **Actual Positions** values with the **Sync Positions** values.

   Make sure the values are the same.
8. Tap **Synchronize**.

3.7.5.4 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.10 or later and OmniCore acting as Master)

Preparing the robot system

Required options for system setup

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

Configuring supported parameters of the robot system

The laser scanner needs to use a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are configure using I/O Engineering Tool in RobotStudio. Use the following procedure to perform the configuration:

1. Start RobotStudio and connect the controller.
   - The user account logging in the controller must be granted with the Safety Services permission.
   - The write access to the controller is requested.
2. In the **Controller** tab, click **I/O Engineering**.

   The **I/O Engineering** window is displayed.
3. In the **Configuration** tab page on the left pane of the window, right-click **PROFINET** under **I/O system** and select **Scan Network**.

   The connected laser scanner is displayed.
4. Right-click on the laser scanner and choose **Add as**.

   The laser scanner is added under **Controller** in the **Configuration** tab page.

   > **Note**
   >
   > Two device names are displayed in the list by default. You shall right-click on the device name *mS3 12Byte In/Out PROFIsafe V2.6.1* and choose **Delete** to delete it. The name may vary according to the actual laser scanner connected.
5. Click the laser scanner with the asterisk(*) mark, and then in the **Device Catalog** tab page on the right pane of the window, double-click **mS3 6Byte In/Out PROFIsafe V2.6.1**.
6. In the displayed **Signal Editor** tab page, add signals with following settings.

Name	Type of Signal	Device Mapping [i]	Default value
ActiveDevice1	Digital Output	*8*	1
ProtectingArea1	Digital Input	*17*	0
WarningArea1	Digital Input	*8*	0

i The mappings are only for examples. Refer to the cut-off setting defined in the *Safety Designer* software and enter the actual value.

Continues on next page

A new device name *mS3 6Byte In/Out PROFIsafe V2.6.1* is displayed under the scanner in the **Configuration** tab page.

7 Click the new device name and check the settings in the **Properties** tab page on the right pane of the window.

   Make sure the Destination value is the same as the F-Destination address value for the scanner in the *Safety Designer* software.

8 In the **I/O Engineering** tab, click **Cross Connections** in the **Configuration** group, and check the created signals.

   Make sure the created signals are in the same name as the displayed signals.

9 In the **I/O Engineering** tab, click **Write Config** to write the configurations to the controller.

10 Restart the controller.

11 After the controller is restarted, check the laser scanner name in the RAPID program InternalSpeedHandling_User in task T_ROB1, and make sure it is consistent with the name that the user defines for the laser scanner.

   If the names are inconsistent, use the following steps to modify:

   a In the **Controller** pane, double-click the RAPID program InternalSpeedHandling_User in task T_ROB1.

      The RAPID program is displayed in the right pane.

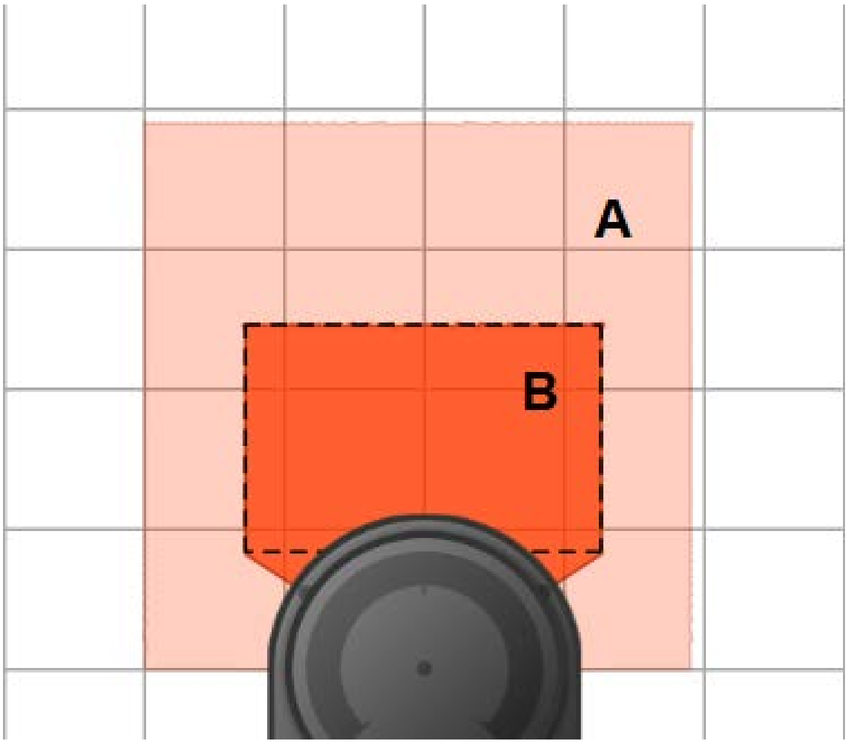
   b Find the parameter *Scanner1* and modify its value to the user-defined laser scanner name.

Continues on next page

Configuring the laser scanner

Protection fields

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



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

Configuration procedure

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

Detailed procedures about how to configure the laser scanner are detailed in *Operating instructions microScan3 - PROFINET*. Following described roughly:

1 Connect the laser scanner to the PC using a network cable.

See the physical connection in *Connecting the laser scanner(s) on page 79*.

Continues on next page

2. Open configuration software tool *Safety Designer®*.
3. Set IP address and PROFINET name in **Configuration** > **Addressing**.

   The scanner IP address must be in the same network segment with the controller, that is, 192.168.10.XXX.
4. Set **F-destination address** to **12** in **PROFINET** area in **Configuration** > **Protocol Settings**.
5. Define the two protection fields in **Configuration** > **Fields**.
6. Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs**.

   The **Use one input source** checkbox must be selected and choose **Rx: Process image (6 Bytes)** from the drop-down list.
7. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1. Start RobotStudio and connect the controller.
   - The user account logging in the controller must be granted with the Safety Services permission.
   - The write access to the controller is requested.
2. In the **Controller** tab, click **Safety**, then select **Visual SafeMove**.
3. In the **Visual SafeMove** window, configure SafeMove function as instructed in *Configuration of SafeMove using Visual SafeMove in RobotStudio on page 116*.

3.7.5.5 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.10 or later and OmniCore acting as Master)

Preparing the robot system

Required options for system setup

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

Configuring supported parameters of the robot system

The laser scanners need to use a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are configure using I/O Engineering Tool in RobotStudio. Use the following procedure to perform the configuration:

1. Start RobotStudio and connect the controller.
   - The user account logging in the controller must be granted with the Safety Services permission.
   - The write access to the controller is requested.
2. In the **Controller** tab, click **I/O Engineering**.

   The **I/O Engineering** window is displayed.
3. In the **Configuration** tab page on the left pane of the window, right-click **PROFINET** under **I/O system** and select **Scan Network**.

   The connected laser scanners are displayed.
4. Right-click one of the laser scanners and choose **Add as**.

   The laser scanner is added under **Controller** in the **Configuration** tab page.

   Note

   Two device names are displayed in the list by default. You shall right-click on the device name *mS3 12Byte In/Out PROFIsafe V2.6.1* and choose **Delete** to delete it. The name may vary according to the actual laser scanner connected.
5. Click the laser scanner with the asterisk(*) mark, and then in the **Device Catalog** tab page on the right pane of the window, double-click **mS3 6Byte In/Out PROFIsafe V2.6.1**.
6. In the displayed **Signal Editor** tab page, add signals with following settings.

Name	Type of Signal	Device Mapping [i]	Default value
ActiveDevice1	Digital Output	*8*	1
ProtectingArea1	Digital Input	*17*	0
WarningArea1	Digital Input	*8*	0

i The mappings are only for examples. Refer to the cut-off setting defined in the *Safety Designer* software and enter the actual value.

Continues on next page

A new device name *mS3 6Byte In/Out PROFIsafe V2.6.1* is displayed under the scanner in the **Configuration** tab page.

7. Click the new device name and check the settings in the **Properties** tab page on the right pane of the window.

   Make sure the Destination value is the same as the F-Destination address value for the scanner in the *Safety Designer* software.

8. In the **I/O Engineering** tab, click **Cross Connections** in the **Configuration** group, and check the created signals.

   Make sure the created signals are in the same name as the displayed signals.

9. Repeat steps *4* to *8* to add the other laser scanner, for which the signal settings shall be as follows.

Name	Type of Signal	Device Mapping [i]	Default value
ActiveDevice2	Digital Output	*8*	1
ProtectingArea2	Digital Input	*17*	0
WarningArea2	Digital Input	*8*	0

i The mappings are only for examples. Refer to the cut-off setting defined in the *Safety Designer* software and enter the actual value.

10. In the **I/O Engineering** tab, click **Write Config** to write the configurations to the controller.

11. Restart the controller.

12. After the controller is restarted, check the laser scanner name in RAPID program InternalSpeedHandling_User in task T_ROB1, and make sure it is consistent with the name that the user defines for the laser scanner.

    If the names are inconsistent, use the following steps to modify:

    a. In the **Controller** pane, double-click the RAPID program InternalSpeedHandling_User in task T_ROB1.

       The RAPID program is displayed in the right pane.

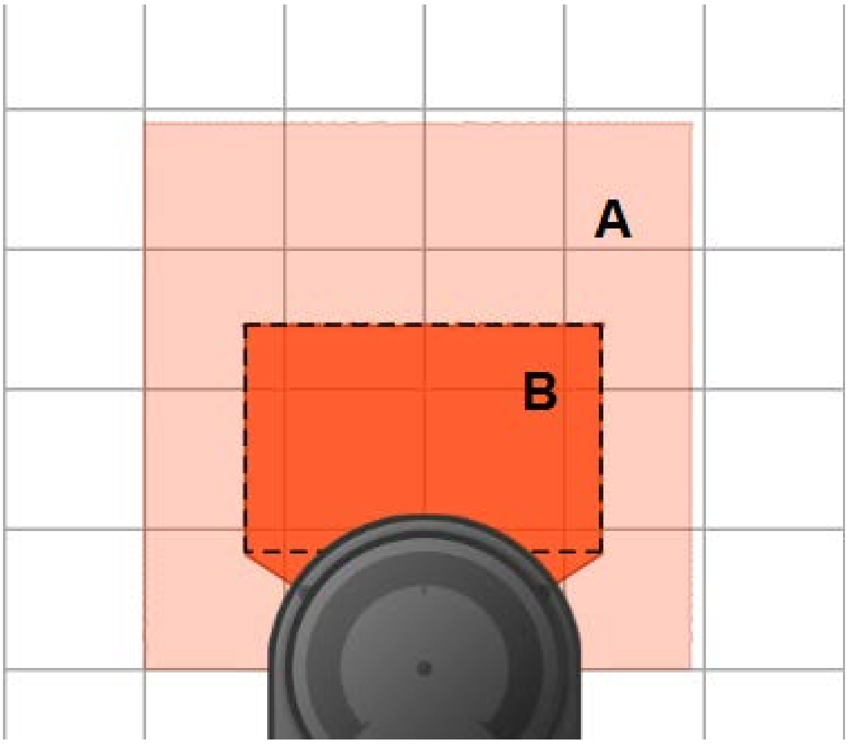
    b. Find the parameters *Scanner1* and *Scanner2*, and modify their values to the user-defined laser scanner names.

Continues on next page

Configuring the laser scanner

Protection fields

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



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

Configuration procedure

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

Detailed procedures about how to configure the laser scanner are detailed in *Operating instructions microScan3 - PROFINET* . Following described roughly:

1. Connect the laser scanner to the controller using a network cable.

   See the physical connection in *Connecting the laser scanner(s) on page 79*.

Continues on next page

2. Open configuration software tool *Safety Designer®*.
3. Set IP address, F-destination and PROFINET name in **Configuration** > **Addressing**.
   - The scanner IP address must be in the same network segment with the controller, that is, 192.168.10.XXX.
   - The two scanners must be set to different IP address, F-destination and PROFINET name.
4. Set **F-destination address** to **12** for the first scanner and to **13** for the second scanner, in **PROFINET** area in **Configuration** > **Protocol Settings**.
5. Define the two protection fields in **Configuration** > **Fields**.
6. Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs.**

   The **Use one input source** checkbox must be selected and choose **Rx: Process image (6 Bytes)** from the drop-down list.
7. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases.**

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1. Start RobotStudio and connect the controller.
   - The user account logging in the controller must be granted with the Safety Services permission.
   - The write access to the controller is requested.
2. In the **Controller** tab, click **Safety**, then select **Visual SafeMove**.
3. In the **Visual SafeMove** window, configure SafeMove function as instructed in *Configuration of SafeMove using Visual SafeMove in RobotStudio on page 116*.

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

Preparing the robot system

Required options for system setup

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

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

The laser scanner uses a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded to the system after the Collaborative Speed Control add-in is installed, see *Information about Collaborative Speed Control add-in on page 97*. The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

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

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

i Value of ProtectingArea depends on logic AND value of ABB_Scalable_IO_0_DI1 and ABB_Scalable_IO_0_DI2. For definition of ProtectingArea, see *Configuring the laser scanner on page 144*.

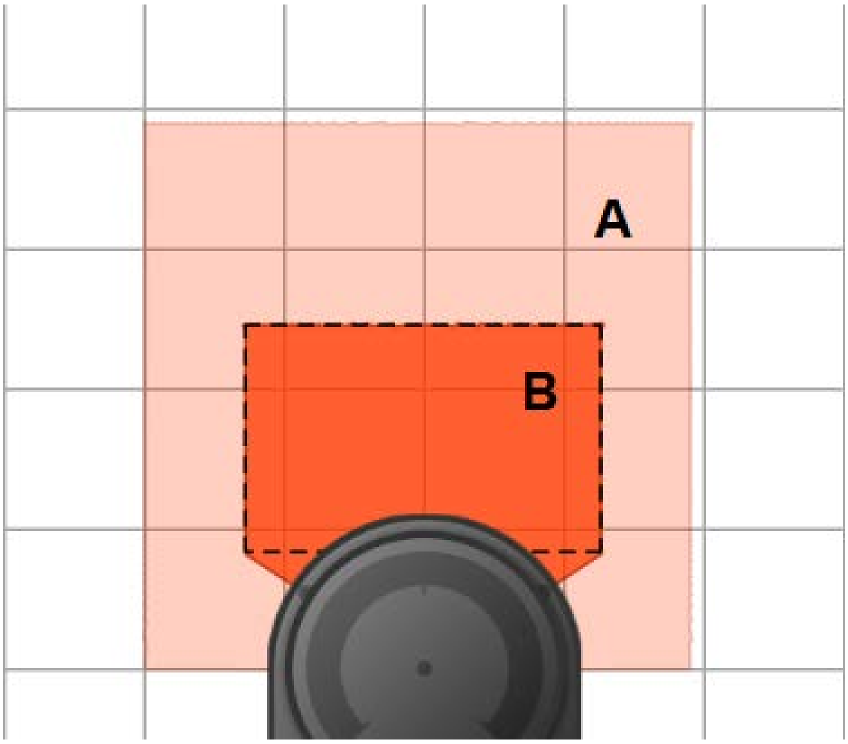
ii Value of WarningArea depends on logic AND value of ABB_Scalable_IO_0_DI3 and ABB_Scalable_IO_0_DI4. For definition of WarningArea, see *Configuring the laser scanner on page 144*.

Continues on next page

Configuring the laser scanner

Protection fields

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



xx2200000301

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

Configuration procedure

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

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

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

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

Continues on next page

3. Define the two protection fields for the scanner in **Configuration** > **Fields.**
4. Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs.**
5. Select one OSSD pair from the **Signals** panel to pin1 and pin2, and select another OSSD pair to pin3 and pin4.

   The two OSSD pairs will be used for defining the monitoring cases.
6. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.
7. Refer to the following table to obtain the pins defined to OSSD pairs. The pins are from a 17-pin cable that will be used to connect the laser scanner and scalable I/O device.

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

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

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

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

Configuring the scalable I/O device

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

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

Continues on next page

5 Log in the RobotStudio using the admin use account and configure the device to make sure the device communication works.

   a Click the **Controller** tab and, in the **Controller** pane, choose **I/O System** > **EtherNetIP**.

      Information of three devices can be observed:

      - CabinetIO is used for the I/O device DSQC1030, and the communication status is normal.

      - ABB_Scalable_IO and ABB_Scalable_IO1 are used for the I/O device DSQC1042, and the communication status is abnormal.

   b Check the IP address and serial numbers associated with ABB_Scalable_IO and ABB_Scalable_IO1, which will display as follows.

Device name	IP address	Serial number
ABB_Scalable_IO	192.168.125.130	0
ABB_Scalable_IO1	192.168.125.131	Actual serial number of the device

   c Right-click **ABB_Scalable_IO1** and choose **Configure** from the shortcut menu.

   d In the displayed dialog box, choose the **Configure as replacement device** option and select **ABB_Scalable_IO** from the drop-down list.

   e Remove the texts in the **Create new I/O signals using name prefix** text box and then click **OK**.

      Information of two devices can be observed, CabinetIO and ABB_Scalable_IO. Communication status of ABB_Scalable_IO will turn to normal after the SafeMove template file is uploaded using the SafeMove configurator app.

> **Note**
>
> The configuration could also be done using the I/O application in FlexPendant.

> **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*.

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1 Log in the FlexPendant.

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

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

Continues on next page

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

   The controller restarts.

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

5 Tap **Safety Controller**.

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

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

   Make sure the values are the same.

8 Tap **Synchronize**.

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

Preparing the robot system

Required options for system setup

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

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

The laser scanners use a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded to the system after the Collaborative Speed Control add-in is installed, see *Information about Collaborative Speed Control add-in on page 97*. The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

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

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

i Value of ProtectingArea depends on logic AND value of ABB_Scalable_IO_0_DI1, ABB_Scalable_IO_0_DI2, ABB_Scalable_IO_0_DI5 and ABB_Scalable_IO_0_DI6. For definition of ProtectingArea, see *Configuring the laser scanner on page 149*.

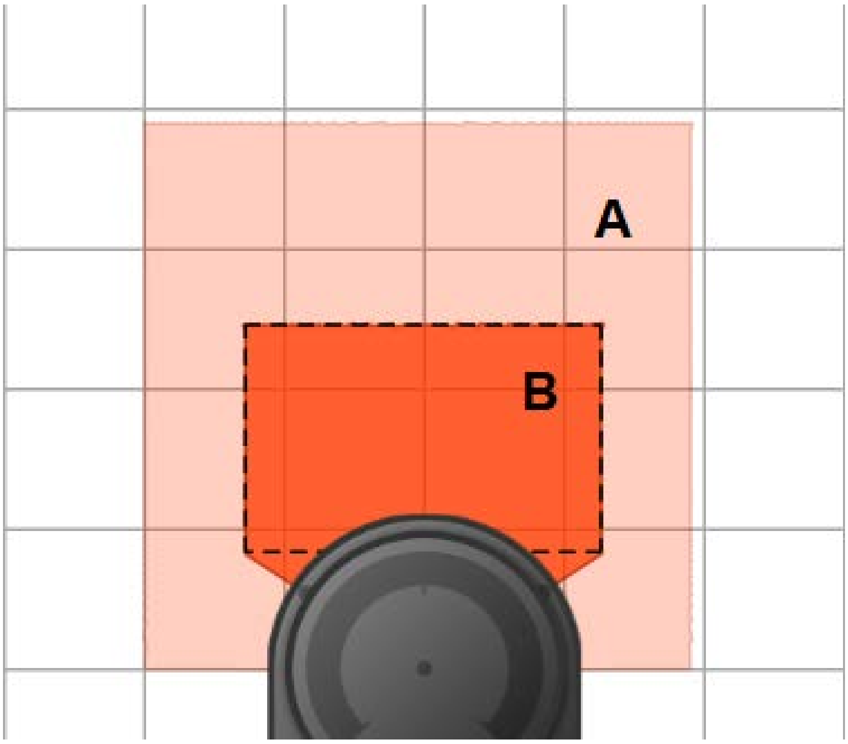
ii Value of WarningArea depends on logic AND value of ABB_Scalable_IO_0_DI3, ABB_Scalable_IO_0_DI4, ABB_Scalable_IO_0_DI7 and ABB_Scalable_IO_0_DI8. For definition of WarningArea, see *Configuring the laser scanner on page 149*.

Continues on next page

Configuring the laser scanner

Protection fields

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



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

Configuration procedure

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

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

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

Continues on next page

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

3. Define the two protection fields for each scanner in **Configuration** > **Fields**.
4. Define the source for input signals of each scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs**.
5. For both scanners, select one OSSD pair from the **Signals** panel to pin1 and pin2, and select another OSSD pair to pin3 and pin4.

   The two OSSD pairs will be used for defining the monitoring cases.
6. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.
7. Refer to the following table to obtain the pins defined to OSSD pairs. The pins are from a 17-pin cable that will be used to connect a laser scanner and scalable I/O device.

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

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

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

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

Configuring the scalable I/O device

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

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

Continues on next page

2. Connect the process power supply to connector X1 of the scalable I/O device via pin locations PWR DO and GND DO.
3. Connect the logic power supply to connector X4 of the scalable I/O device via pin locations PWR and GND.
4. Connect the Ethernet cable from the robot controller to connector X5.
5. Log in the RobotStudio using the admin use account and configure the device to make sure the device communication works.
   a. Click the **Controller** tab and, in the **Controller** pane, choose **I/O System** > **EtherNetIP**.

      Information of three devices can be observed:

      - CabinetIO is used for the I/O device DSQC1030, and the communication status is normal.

      - ABB_Scalable_IO and ABB_Scalable_IO1 are used for the I/O device DSQC1042, and the communication status is abnormal.
   b. Check the IP address and serial numbers associated with ABB_Scalable_IO and ABB_Scalable_IO1, which will display as follows.

Device name	IP address	Serial number
ABB_Scalable_IO	192.168.125.130	0
ABB_Scalable_IO1	192.168.125.131	Actual serial number of the device

   c. Right-click **ABB_Scalable_IO1** and choose **Configure** from the shortcut menu.
   d. In the displayed dialog box, choose the **Configure as replacement device** option and select **ABB_Scalable_IO** from the drop-down list.
   e. Remove the texts in the **Create new I/O signals using name prefix** text box and then click **OK**.

      Information of two devices can be observed, CabinetIO and ABB_Scalable_IO. Communication status of ABB_Scalable_IO will turn to normal after the SafeMove template file is uploaded using the SafeMove configurator app.

Note

The configuration could also be done using the I/O application in FlexPendant.

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*.

Continues on next page

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1. Log in the FlexPendant.

   Make sure the user logged in have access grants to lock safety controller configurations, safety services and software synchronization.
2. Tap **SafeMove** on the home page.
3. Tap **Load** in the pop-up message box to confirm loading of template SafeMove configuration files.

   The controller restarts.
4. After the controller is restarted, tap **Settings** on the home page.
5. Tap **Safety Controller**.
6. Tap **Synchronization** in the left pane.
7. Jog the robot to match the **Actual Positions** values with the **Sync Positions** values.

   Make sure the values are the same.
8. Tap **Synchronize**.

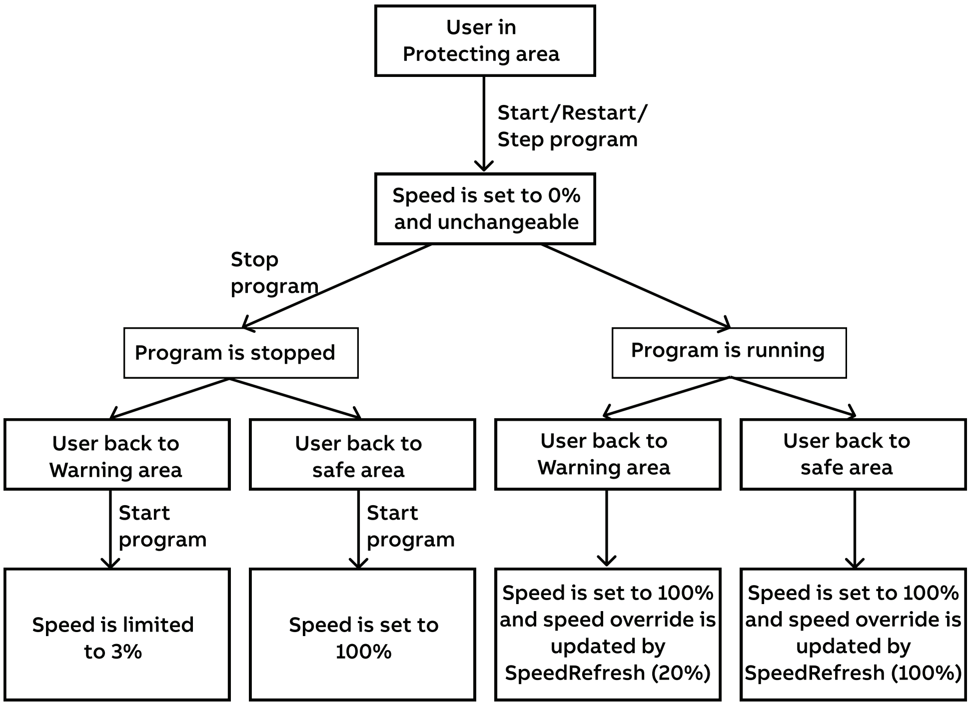
3.7.5.8 Speed control strategies

General

The speed control of CRB 1100 is affected by several factors, such as, the RobotWare version, the speed setting in the FlexPendant, the speed setting in motion instruction and the `SpeedRefresh` value. Users in different protection fields defined for laser scanner to monitor and perform different program execution actions may result in different movement speed. This section describes the speed control strategies for typical scenarios.

Strategies (RobotWare 7.5)

Users in Protecting area



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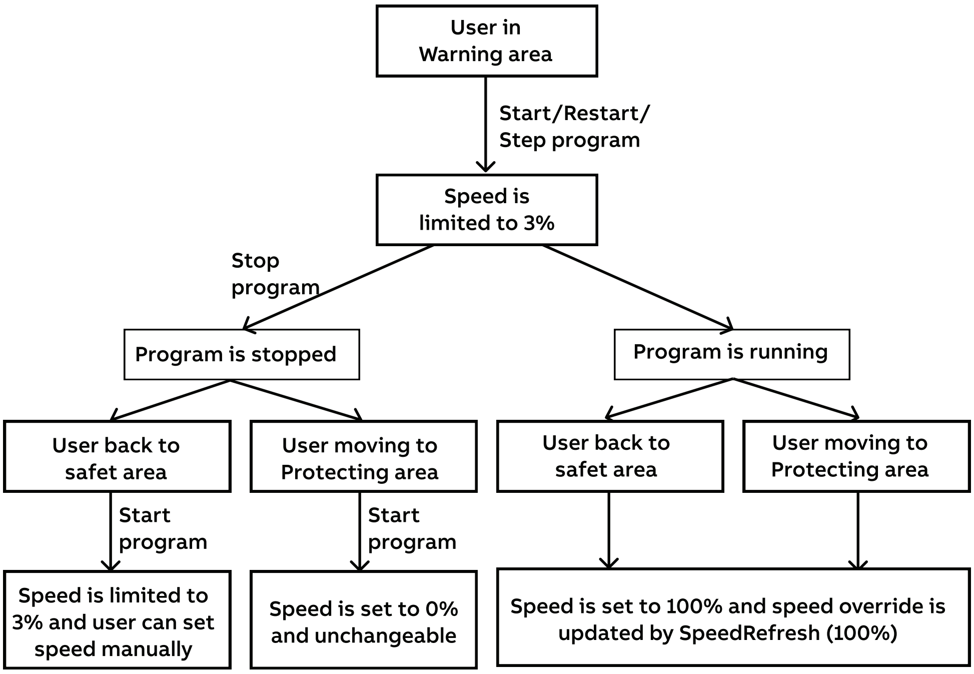
Users in Warning area



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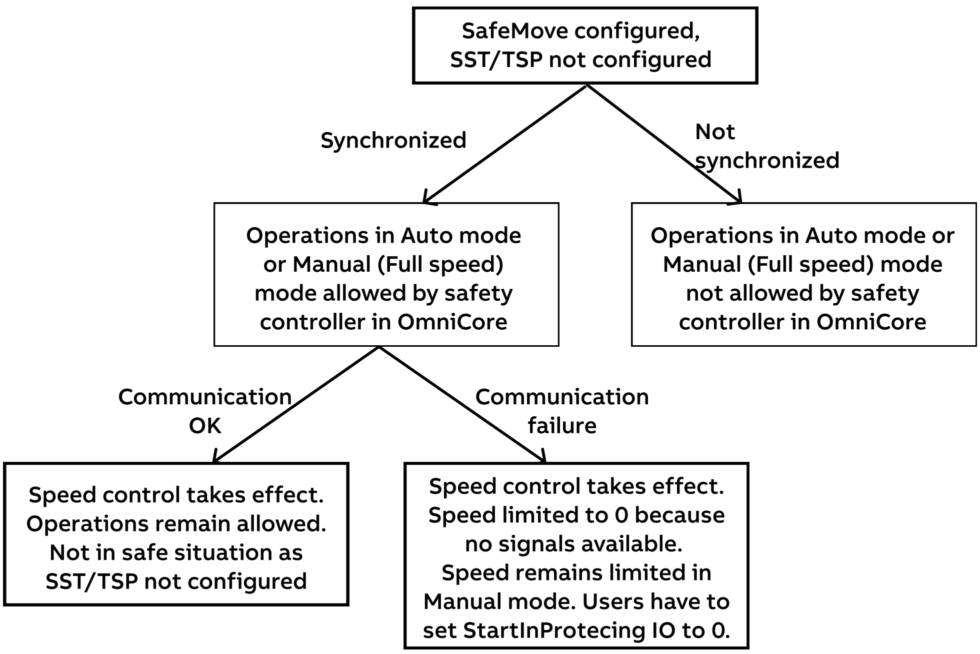
SafeMove triggered but SST/TSP not configured



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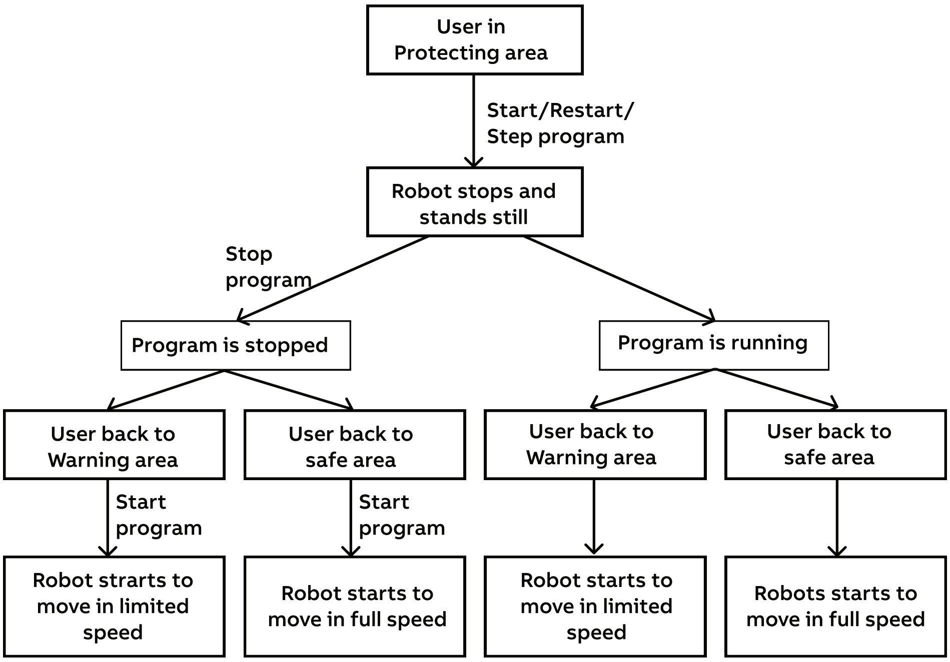
Strategies (RobotWare 7.6 or later)

Users in Protecting area



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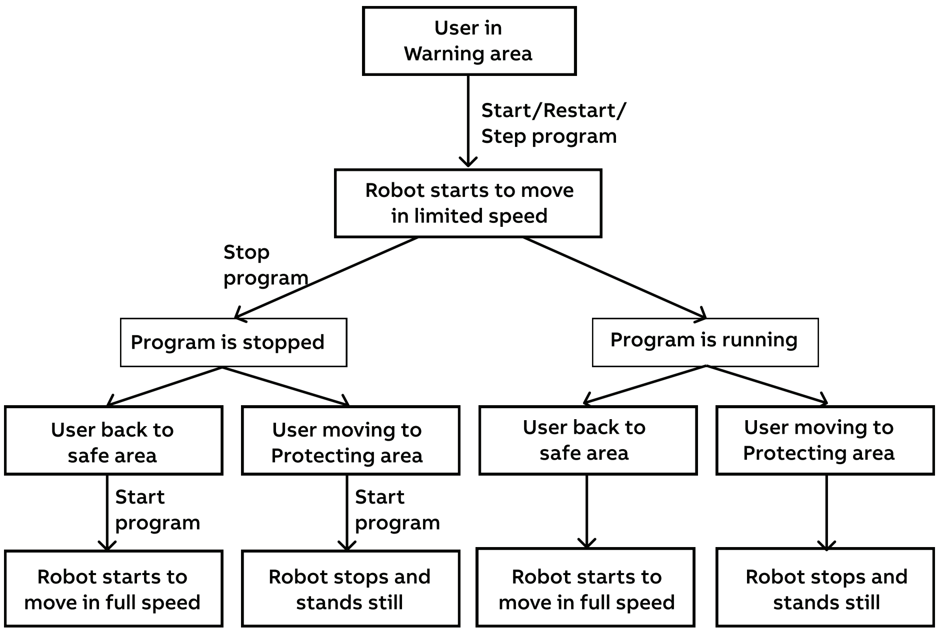
Users in Warning area



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3.7.6 Robot status indication

Description

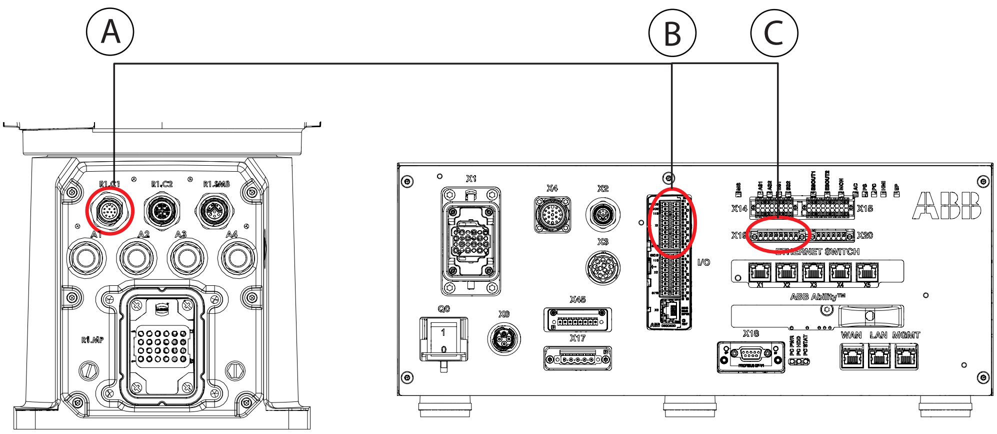
The lamp unit on process hub of CRB 1100 indicates robot status in four colors. Operators should always be aware of the indicator color and handle the situation correspondingly.

Cabling

The lamp unit cabling is integrated in the CP/CS cable. Do not use other types of CP/CS cables that are not provided by ABB; otherwise, the lamp unit will not work. See *Robot cabling and connection points on page 88*.

The cable end connecting the manipulator connects to the R1.C1 connector on the robot base; the other end of the cable is divided to two connectors, which connect to the X1 connector of the base I/O device (DSQC 1030) and X19 connector on the controller respectively.

The following figure illustrates the lamp unit cabling connection between the manipulator base and controller with base I/O module configured. For more details about cabling, see the circuit diagram of the manipulator.



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A	R1.C1 connector on robot base	
B	X1 connector of I/O module on controller	Pins GND, DO1, DO2 and DO3 are occupied for lamp unit
C	X19 connector on controller	Pins 1 and 2 are occupied for lamp unit

Functionality

Color	Manual mode	Automatic mode	Manual full speed mode
White	Standby (in motor on/off state and program is stopped, available for users to perform next actions)		
Green	Program is executing		
Yellow	Lead-through function is enabled	Yellow warning area is triggered (manipulator speed will be limited according to the actual configured value)	

Continues on next page

Color	Manual mode	Automatic mode	Manual full speed mode
Red	Emergency stop or error is raised	Emergency stop, error is raised or red protecting area is triggered. For RobotWare 7.5 or earlier, the manipulator will reduce to 0% speed and stands still. For RobotWare 7.6 or later, the speed shown on the FlexPendant remains but the manipulator will stand still.	

3.7.7 Use cases of safety configurations

General

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

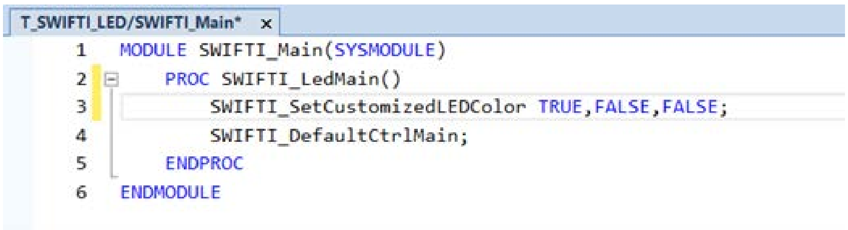
Note

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

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

Modifying lamp indicator colors

RGB of the LED lamp is controlled by values defined in RAPID instruction SWIFTI_SetCustomizedLEDColor in routine SWIFTI_LedMain, which can affect the color that the lamp shows. The routine exists in the system module SWIFTI_Main of task T_SWIFTI_LED.



```
T_SWIFTI_LED/SWIFTI_Main*
MODULE SWIFTI_Main(SYSMODULE)
    PROC SWIFTI_LedMain()
        SWIFTI_SetCustomizedLEDColor TRUE,FALSE,FALSE;
        SWIFTI_DefaultCtrlMain;
    ENDPROC
ENDMODULE
```

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The following table lists the logical value combinations and corresponding lamp colors.

Color	Parameter value 1	Parameter value 2	Parameter value 3
White	TRUE	TRUE	TRUE
Blue	FALSE	FALSE	TRUE
Green	FALSE	TRUE	FALSE
Red	TRUE	FALSE	FALSE
Yellow	TRUE	TRUE	FALSE
Cyan	FALSE	TRUE	TRUE
Purple	TRUE	FALSE	TRUE

Continues on next page

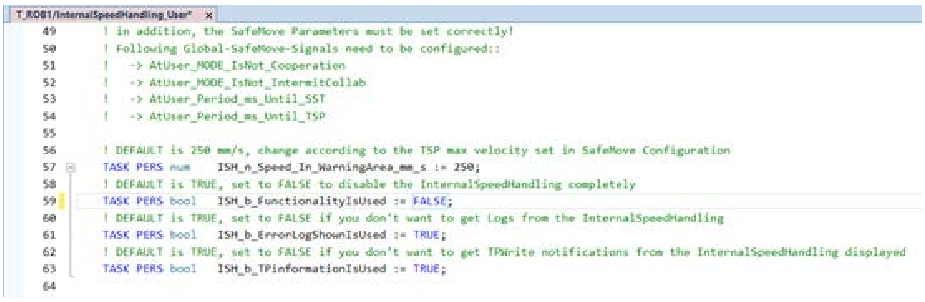
Deactivating the SpeedHandling function

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

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

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

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



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3. Save the change and apply to the controller.

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

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

1. Open the RobotStudio.
2. Log in the controller using the Admin account and request the write access.
3. In the **Controller** tab, choose **Visual SafeMove** from the **Safety** group in the **Configuration** category.
4. In the **Visual SafeMove** tab, click **Safe IO Configurator** in the **Configuration** group.

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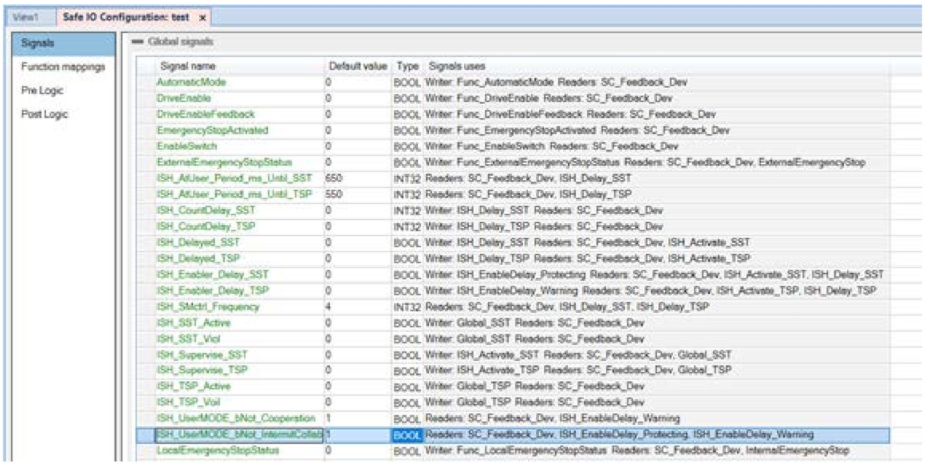
5 In the displayed **Safe IO Configuration** window, go to the signal **ISH_UserMODE_bNot_IntemitCollab** in the global signal list and set the value to **1**.



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

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

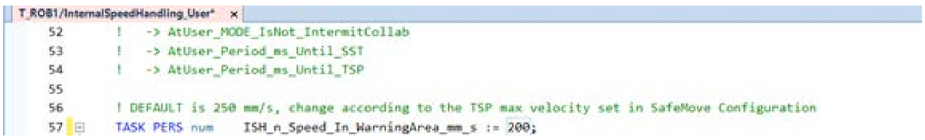
- the signal ISH_UserMODE_bNot_IntemitCollab in SafeMove configuration is set to **0**, and,
- the function ISH_b_FunctionlityIsUsed in RAPID program is set to TRUE.

Changing the speed limit when WarningArea is triggered

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

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

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



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3 Save the change and apply to the controller.

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

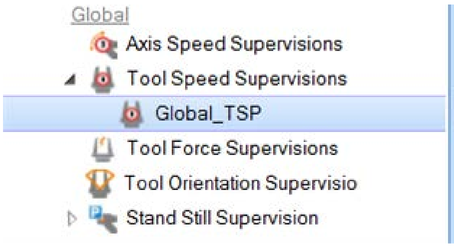
1 Open the RobotStudio.

2 Log in the controller using the Admin account and request the write access.

Continues on next page

3 In the **Controller** tab, choose **Visual SafeMove** from the **Safety** group in the **Configuration** category.

4 In the left pane of the window, choose **Global_TSP** under the **Tool Speed Supervisions** from the navigation tree.



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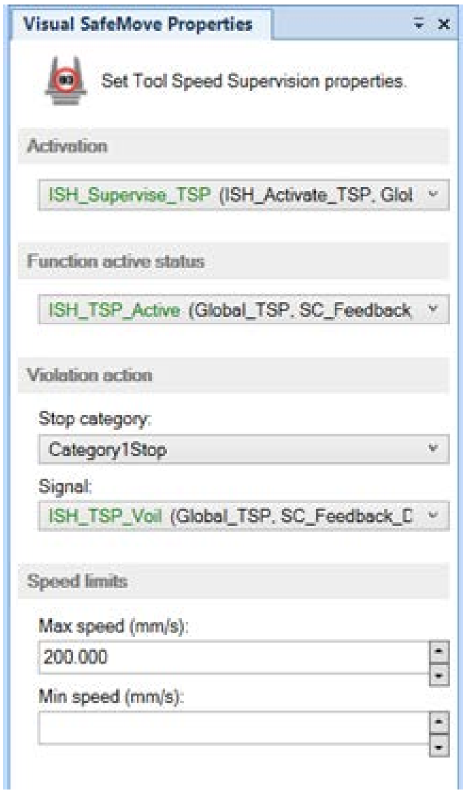
5 In the **Visual SafeMove Properties** window, set the **Max speed (mm/s)** in the **Speed limits** area to a required value.



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

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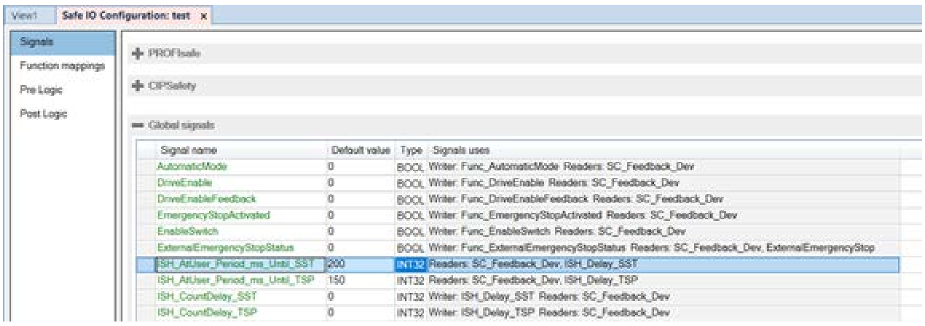
Changing the execution delay time in template SafeMove configuration file

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

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

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

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



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

3.8 Test run after installation, maintenance, or repair

Safe handling

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

DANGER

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

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

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4 Maintenance

4.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the CRB 1100.

It is based on the maintenance schedule found at the beginning of the chapter. The schedule contains information about required maintenance activities including intervals, and refers to procedures for the activities.

Each procedure contains all the information required to perform the activity, including required tools and materials.

The procedures are gathered in different sections and divided according to the maintenance activity.

Safety information

Observe all safety information before conducting any service work.

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

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

Note

If the CRB 1100 is connected to power, always make sure that the CRB 1100 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 88*.

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 1100:

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

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

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

4.2.2 Maintenance schedule

Scheduled and non-predictable maintenance

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

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

Life of each component

The inspection intervals *do not* specify the life of each component. Values for these are specified in the section *Expected component life on page 169*

Maintenance schedule

Maintenance activities	Regularly[i]	Every 12 months	Every 36 months	Every 30,000 hours[ii]	Reference
Cleaning the robot	x				*Cleaning the CRB 1100 on page 170*
Inspecting the robot	x				Check for abnormal wear or contamination.
Inspecting the laser scanners	x				Check for damages, defective or lack of effectiveness.
Inspecting the information labels		x			*Inspecting the information labels on page 171*
Inspecting the timing belt[iii]			x		*Inspecting timing belts on page 174*
Inspecting the robot harness		x[iv]			*Inspecting the robot cabling on page 173*
Lubricating the robot harness		x[v]			*Lubricating the cable package on page 178*
Replacing the SMB battery pack			x[vi]		*Replacing the battery pack on page 180*
Running the *Cyclic Brake Check* routine[vii]	x[viii]				Recommended to robots with the SafeMove option. See *Application manual - Functional safety and SafeMove*.
Overhaul of complete robot				x	

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

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

iii Axis-1 and axis-4 timing belts can be accessed and inspected only after the axis-1 and axis-4 motors are removed. It is recommended to inspect the timing belts when replacing the motors.

Continues on next page

[iv] Replace when damage or cracks is detected or life limit is approaching.
[v] Replace when damage or cracks is detected or life limit is approaching.
[vi] The battery is to be replaced at given maintenance interval or at battery low alert.
[vii] Not needed separately if already included in the application.
[viii] Recommended test interval is within the range 8-48 hours.

4.2.3 Expected component life

Expected life depends on usage

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

Expected component life

Component	Expected life	Note
Cable harness, normal usage [i]	30000 hours [ii]	
Cable harness, extreme usage [iii]	30000 hours [ii]	
Gearboxes	30000 hours	

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

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

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

4.3 Cleaning activities

4.3.1 Cleaning the CRB 1100

General

To secure high uptime it is important that the CRB 1100 is cleaned regularly. The frequency of cleaning depends on the environment in which the manipulator works.

Different cleaning methods are allowed depending on the type of protection of the CRB 1100.

Note

Always verify the protection type of the robot before cleaning.

WARNING

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

Special cleaning considerations

This section specifies some special considerations when cleaning the robot.

- Always use cleaning equipment as specified. Any other cleaning equipment may shorten the life of the robot.
- Always check that all protective covers are fitted to the robot before cleaning.
- Do not point the water jet at connectors, joints, sealings or gaskets.
- Do not use compressed air to clean the robot.
- Do not use solvents that are not approved by ABB to clean the robot.
- Do not remove any covers or other protective devices before cleaning the robot.

Cleaning methods

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

Protection type	Cleaning method			
	Vacuum cleaner	Wipe with cloth	Rinse with water	High pressure water, steam or spray
Standard IP40	Yes	Yes. With light cleaning detergent.	No	No

Cables

Movable cables need to be able to move freely:

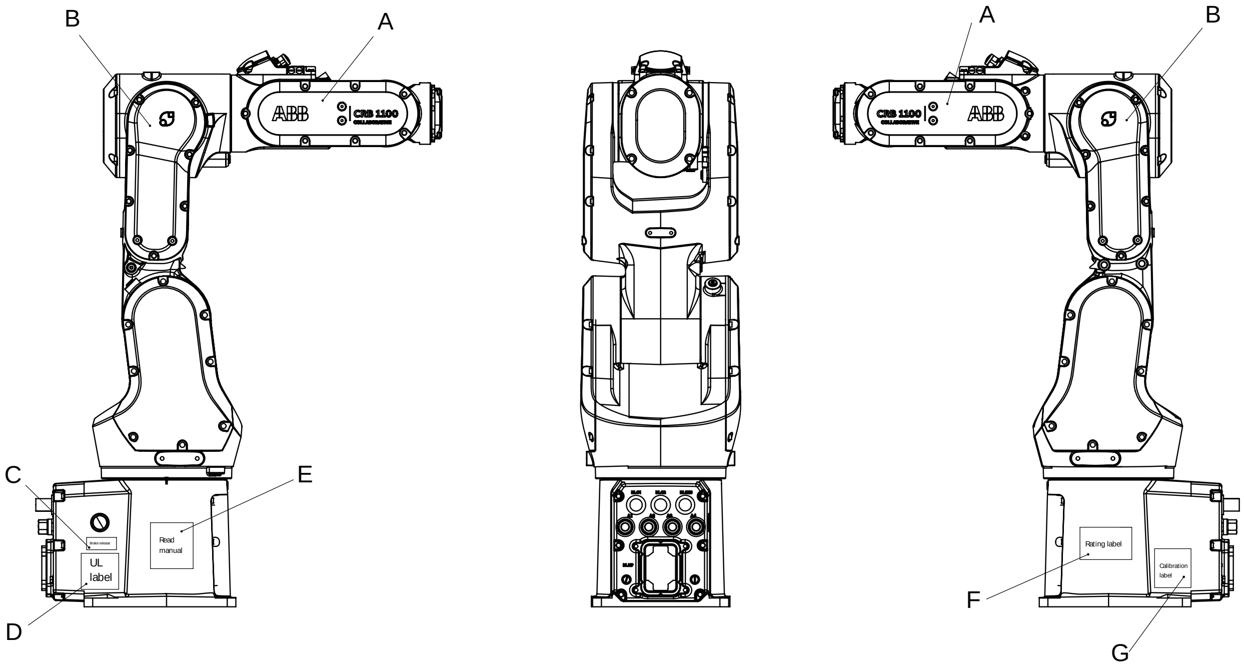
- Remove waste material, such as sand, dust and chips, if it prevents cable movement.
- Clean the cables if they have a crusty surface, for example from dry release agents.

4.4 Inspection activities

4.4.1 Inspecting the information labels

Location of labels

These figures show the location of the information labels to be inspected. The symbols are described in section *Safety symbols on manipulator labels on page 21*.



xx2100000161

A	ABB logo, also specifying robot type
B	Cobot label
C	Instruction label **Brake release**
D	UL label
E	Read manual label, also specifying warning labels
F	Rating label, CE label and AbsAcc label
G	Calibration label

Required tools and equipment

Visual inspection, no tools are required.

Continues on next page

Inspecting, labels

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
2	Inspect the labels, located as shown in the figures.	
3	Replace any missing or damaged labels.	Article numbers for the labels and plate set is specified in *Spare parts on page 715*.

4.4.2 Inspecting the robot cabling

Required tools and equipment

Visual inspection, no tools are required.

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

Inspection, robot cabling

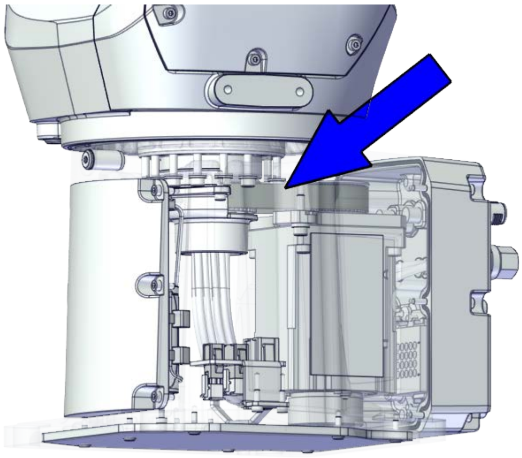
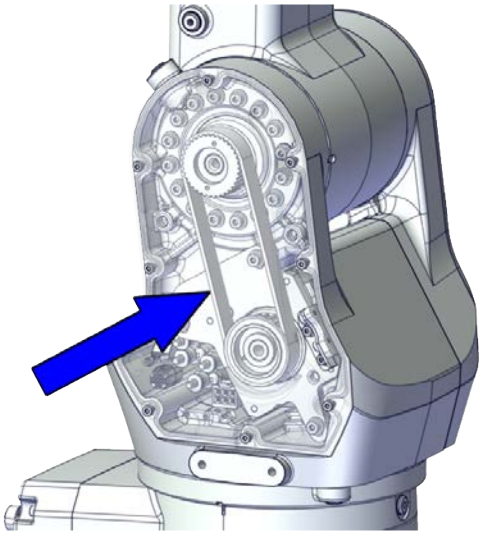
Use this procedure to inspect the robot cabling.

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

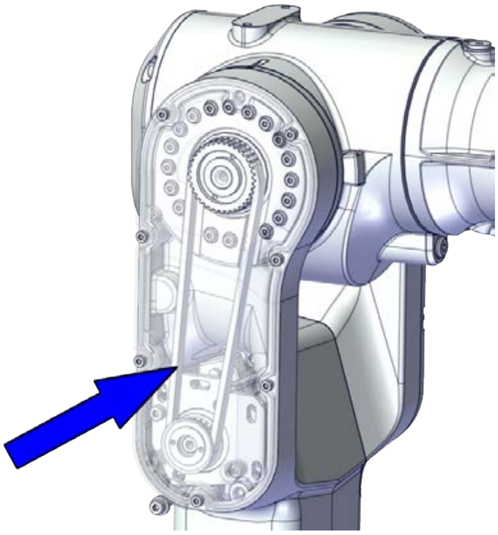
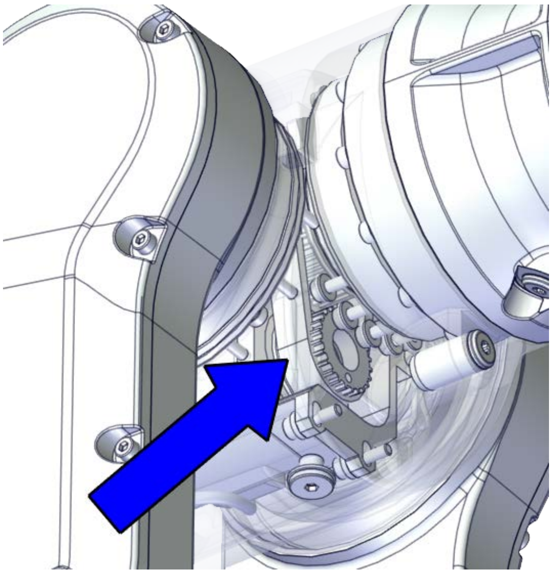
4.4.3 Inspecting timing belts

Location of timing belts

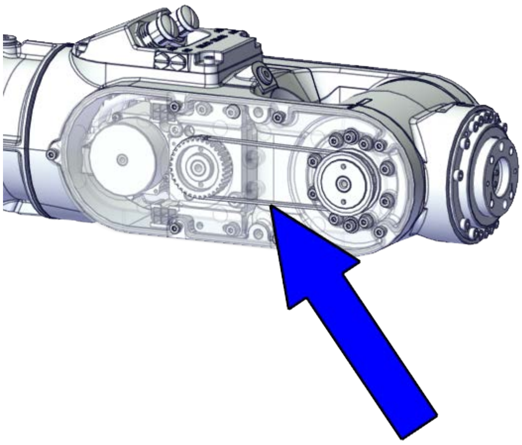
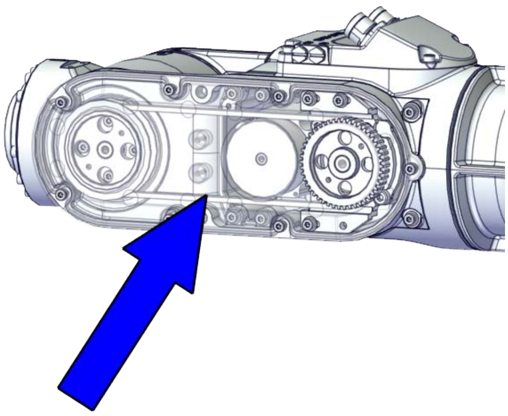
The timing belts are located as shown in the figures.

Axis	Location
1	 xx1800002457
2	 xx1800002458

Continues on next page

Axis	Location
3	 xx1800002459
4	 xx1800002460

Continues on next page

Axis	Location
5	 xx1800002461
6	 xx1800002462

Required tools and equipment

Equipment	Note
Standard toolkit	The content is defined in the section *Standard toolkit on page 712*.
Other tools and procedures may be required if the spare part needs to be replaced. These are specified in the replacement procedure.	

Continues on next page

Timing belt tension

The table describes the timing belt tension.

Axis	Force		Frequency	
	Used timing belt[i]	New timing belt	Used timing belt[i]	New timing belt
Axis 1	58.24-63.56 N	83.2-90.8 N[ii]	255-273 Hz[ii]	281-359 Hz
Axis 2	68.18-75.04 N[ii]	97.4-107.2 N	163-174 Hz	180-229 Hz[ii]
Axis 3	21.7-23.94 N[ii]	31-34.2 N	102-109 Hz	113-143 Hz[ii]
Axis 4	20.09-22.05 N	28.7-31.5 N	285-304 Hz[ii]	314-400 Hz[ii]
Axis 5	13.58-14.84 N[ii]	19.4-21.2 N	151-162 Hz	167-213 Hz[ii]
Axis 6	8.96-9.8 N[ii]	12.8-14	81.3-86.9 Hz	90-114 Hz[ii]

i Used belt is the one having been installed and used for more than 12 hours.
Compared with the new timing belt, the force value decreases 15% and the frequency value decreases 28% when the timing belt has been installed and used for more than 12 hours but less than 150 hours. When the timing belt has been installed and used for more than 150 hours, both the force and frequency values decrease 30%.

ii The value range is only for reference.

Inspecting timing belts

Use this procedure to inspect timing belts.

	Action	Information
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Gain access to each *timing belt* by removing the cover.	
3	Check the timing belts for damage or wear.	
4	Check the *timing belt pulleys* for damage.	
5	If any damage or wear is detected, the part must be replaced!	
6	Use a sonic tension meter to measure the timing belt tension. If the belt has no tension, adjust it!	See *Timing belt tension on page 177*.

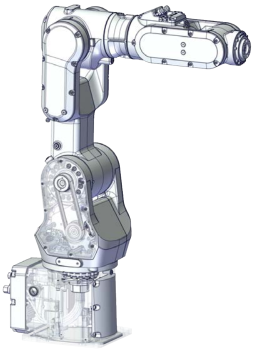
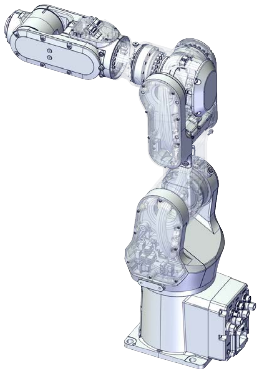
4.5 Lubricating activities

4.5.1 Lubricating the cable package

Location of the cable package

The CRB 1100 main cable package has two segments, upper and lower. Inside the swing there is a division point.

The cable packages are located as shown in the figure.

Lower cable package	Upper cable package
 xx1800002465	 xx1800002466

Required tools and equipment

Equipment	Note
Standard toolkit	The content is defined in the section *Standard toolkit on page 712*.
Other tools and procedures may be required if the spare part needs to be replaced. These are specified in the replacement procedure.	

Required consumables

Consumable	Article number	Note
Grease	3HAC029132-001	FM 222

Lubricating the cable package

Use this procedure to lubricate the cable package.

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

Continues on next page

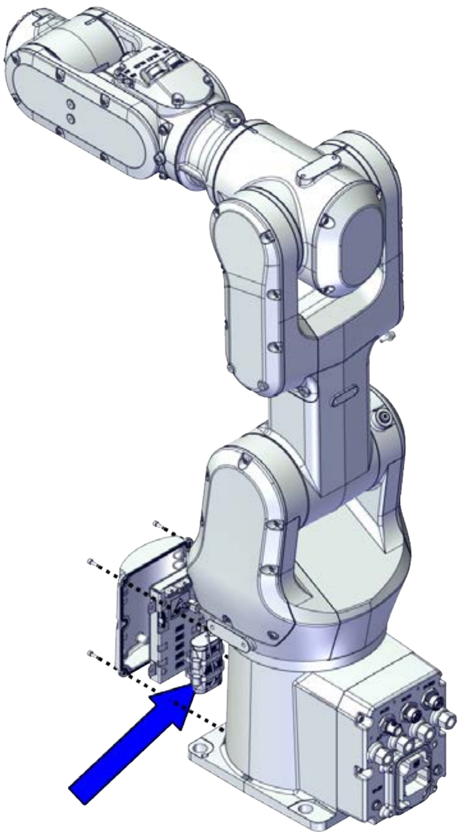
	Action	Information
2	Gain access to the cable package by removing the covers.	
3	Check the cable package for damage or wear.	
4	If any damage or wear is detected, the part must be replaced!	See *Replacing the upper cable package on page 194* and *Replacing the lower cable package on page 238*.
5	Apply grease to the cable package, cover all moving area of the package.	
6	Apply grease to the covers that have contacting area with the cable package.	

4.6 Replacing/changing activities

4.6.1 Replacing the battery pack

Location of the battery pack

The battery pack is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 1100 via myABB Business Portal, *www.abb.com/myABB*.

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

Continues on next page

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.

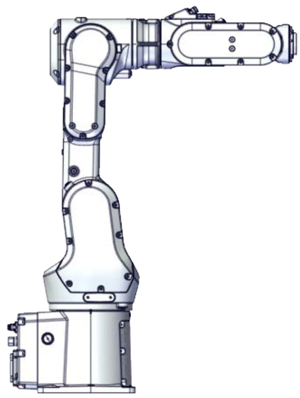
Required consumables

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

Removing the battery pack

Use these procedures to remove the battery pack.

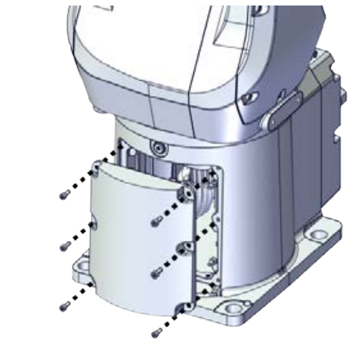
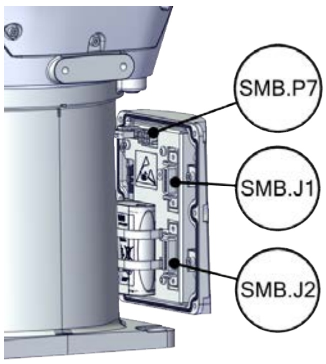
Preparations before removing the battery pack

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx1800003288

Continues on next page

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

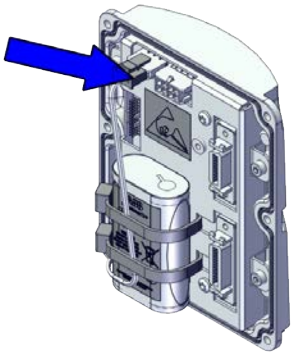
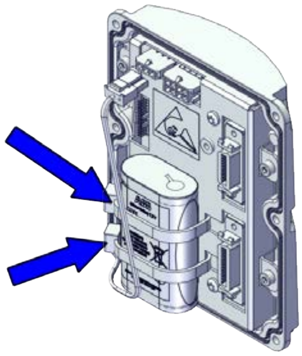
Disconnecting the SMB connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Remove the SMB cover attachment screws and carefully open the cover. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures. **CAUTION** There are cabling attached to the cover. The cover cannot be removed completely until the connectors are removed.	 xx1800002467
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002468

Continues on next page

	Action	Note
5	Remove the SMB cover completely from the base.	

Removing the battery pack

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Disconnect the battery cable.	 xx1800002469
4	Remove the battery pack by cutting the cable strap.	 xx1800002470

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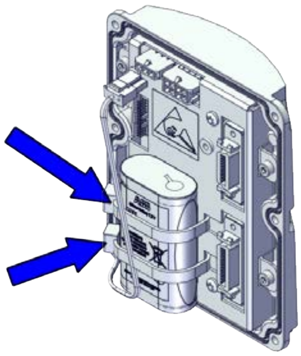
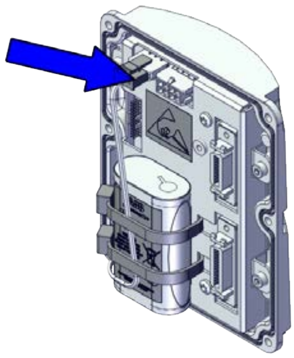
Refitting the battery pack

Use these procedures to refit the battery pack.

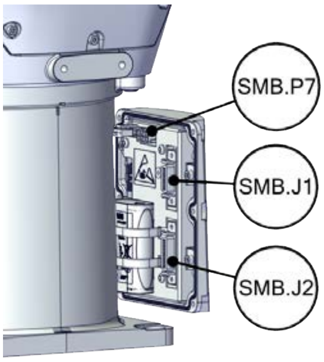
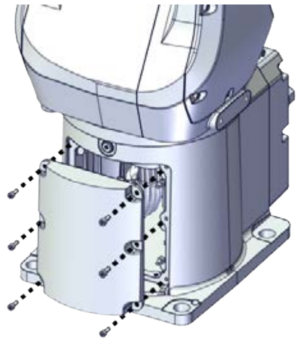
Refitting the battery pack

	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 48*.	
2	Secure the battery pack using the cable strap.	 xx1800002470
3	Reconnect the battery cable.	 xx1800002469

Reconnecting the SMB connectors

	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 48*.	

Continues on next page

	Action	Note
2	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	Tightening torque: 0.3 Nm  xx1800002468
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the SMB cover to the base.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm  xx1800002467

Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

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5 Repair

5.1 Introduction

Structure of this chapter

This chapter describes repair activities for the CRB 1100. Each procedure contains the information required to perform the activity, for example spare parts numbers, required special tools, and materials.

WARNING

Repair activities not described in this chapter must only be carried out by ABB.

Report replaced units

Note

When replacing a part on the CRB 1100, 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 1100 is connected to power, always make sure that the CRB 1100 is connected to protective earth and a residual current device (RCD) before starting any repair work.

For more information see:

- *Product manual - OmniCore C30*

5.2 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	3HAC031695-001	Harmonic Grease 4B No.2 Used to lubricate the seals.

Rotating sealings

The following procedures describe how to fit rotating sealings.

CAUTION

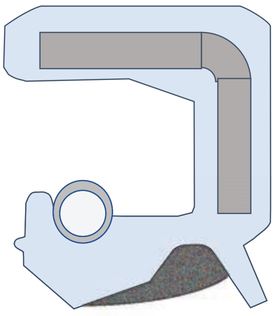
Please observe the following before commencing any assembly of sealings:

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

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

Radial sealings

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



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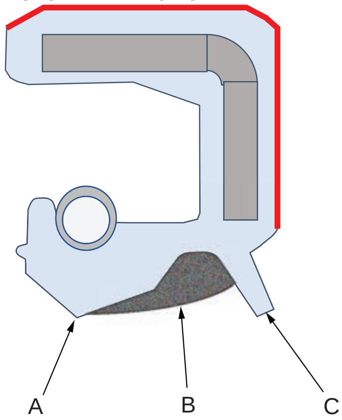
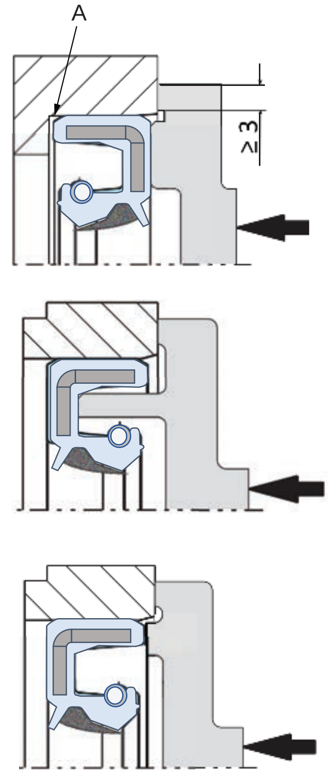
	Action	Note
1	Check the sealing to ensure that: • The sealing is of the correct type. • There is no damage on the main lip.	
2	Inspect the shaft surface before mounting. If scratches or damage are found, the shaft must be replaced since it may result in future leakage. Do not try to grind or polish the 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 188*.  xx2000000071 A Main lip B Grease C Dust lip **Note** Ensure that no grease is applied to the red marked surface.

Continues on next page

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

Flange sealings and static sealings

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

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

O-rings

The following procedure describes how to fit o-rings.

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

Continues on next page

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

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

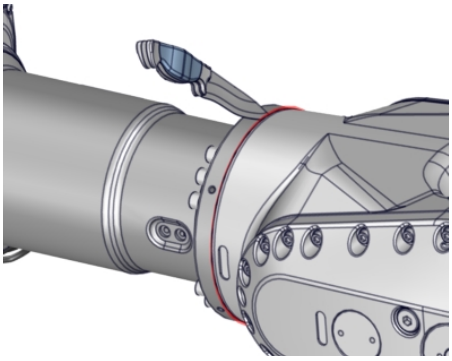
General

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

Required equipment

Equipment	Spare parts	Note
Cleaning agent		Ethanol
Knife		
Lint free cloth		

Removing

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

5.3 Cable harness

General

The CRB 1100 main cable package has two segments, upper and lower. Inside the swing there is a division point.

The lower cable package runs from the base and up through into the swing. The upper cable package runs from the swing, up through the lower arm, into the housing and then into the wrist.

The main cable package includes the cabling for all the six motors. Optional air hoses, CP/CS cabling and Ethernet cabling can also be included.

As standard feature, the connector interface is located at the rear of the base. The interface can also be bottom mounted, as an option. This section describes both configurations.

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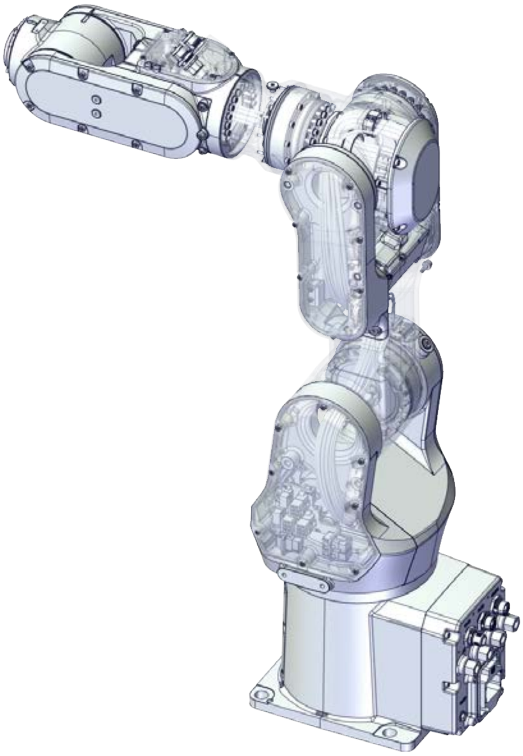
5.3.1 Replacing the upper cable package

Location of the upper cable package

The upper cable package is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 1100 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Upper cable harness (CP/CS and air hose, with Ethernet)	3HAC060419-003	Used with CRB 1100-4/0.475.
Extension upper cable harness (CP/CS and air hose, with Ethernet)	3HAC060416-003	Used with CRB 1100-4/0.58.
Process hub with lamp unit (CP/CS and air hose, with Ethernet)	3HAC077335-001	
Multi-color lamp unit (14 mm)	3HAC076495-001	
Lamp unit cover	3HAC075972-001	
Motor with flange, axis 2	3HAC083588-001	.
Timing belt, axis 2	3HAC061935-001	

Continues on next page

Spare part	Article number	Note
Motor with flange, axis 3	3HAC083587-001	
Timing belt, axis 3	3HAC061936-001	
Motor with flange, axis 6	3HAC083584-001	
Timing belt, axis 6	3HAC061939-001	
Swing cover	3HAC069051-001	
Swing support cover	3HAC069052-001	
Wrist cover	3HAC069061-001	
Housing cover	3HAC069054-001	
Lower arm cover	3HAC069057-001	
Lower arm support cover	3HAC069059-001	
Cooling pad for axis-1 and -2 motors	3HAC071020-001	Cooling pads are wear parts. One cooling pad sheet contains 6 pieces of small pad. Replace if damaged with one piece each time.
Cooling pad for axis-3 and -4 motors	3HAC071021-001	Cooling pads are wear parts. One cooling pad sheet includes 10 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel
Washer	3HAC064765-001	7x3.2x1.5, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.
M3x25 eye bolt	-	Included in the special toolkit 3HAC071022-001.

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Equipment	Article number	Note
J5.C2 connector assembly tool	-	Included in the special toolkit 3HAC071022-001. Used to remove and refit the J5.C2 connector, if the Ethernet cabling is equipped.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

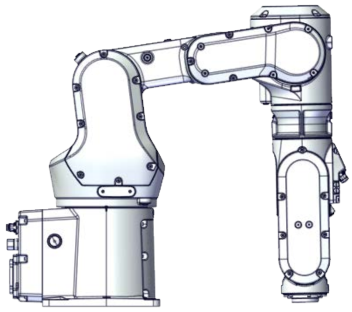
Removing the upper cable package

Use these procedures to remove the upper cable package.

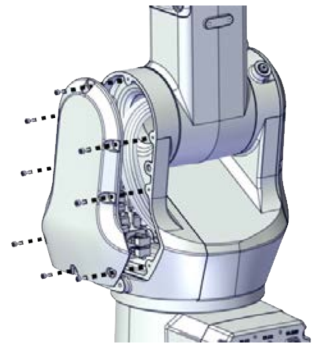
Preparations before removing the upper cable package

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

Continues on next page

	Action	Note
2	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 110° (CRB 1100-4/0.475) /95° (CRB 1100-4/0.58) • Axis 3: -20° (CRB 1100-4/0.475)/ -6° (CRB 1100-4/0.58) • Axis 4: 0° • Axis 5: 0° • Axis 6: No significance.	 xx1800003289
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Remove the swing support cover.	 xx1800002488

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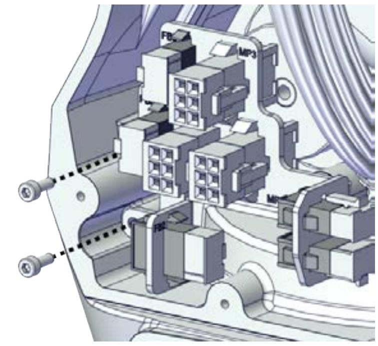
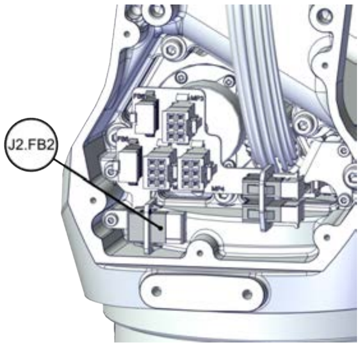
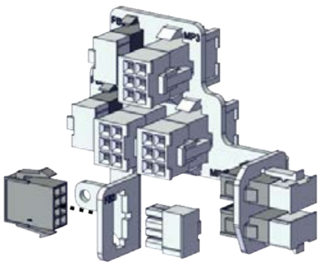
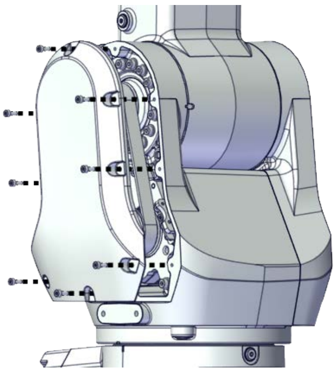
	Action	Note
4	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate.	 xx1800002489
5	Disconnect the connector. • J2.FB2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002490
6	Snap loose and remove the female head of the connector from the connector plate.	 xx1800002491
7	Remove the swing cover.	 xx1800002492

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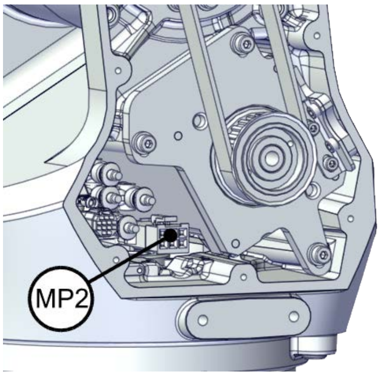
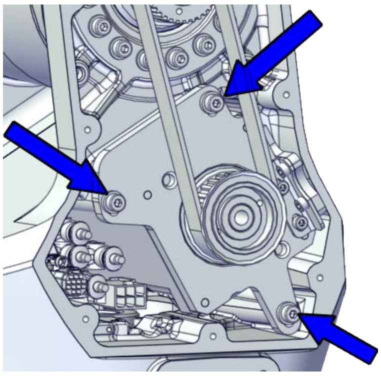
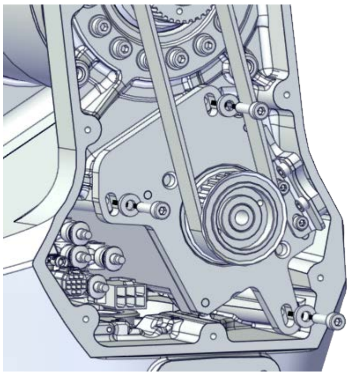
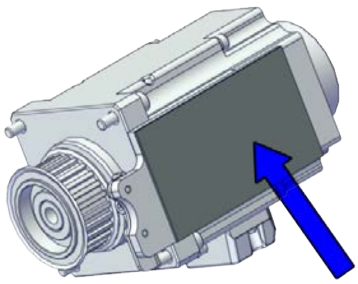
	Action	Note
8	Disconnect the connector. • MP2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002495
9	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002493
10	Remove the screws and washers.	 xx1800002494
11	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad. **CAUTION** Be aware of the motor cabling. The motor cannot be removed completely until the connector is disconnected, as shown in following step.	Cooling pad location  xx1800003603

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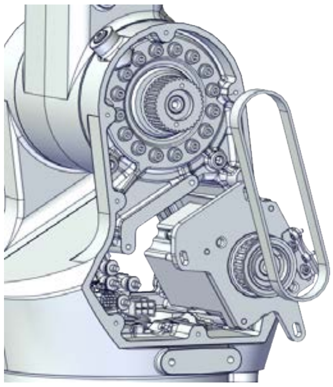
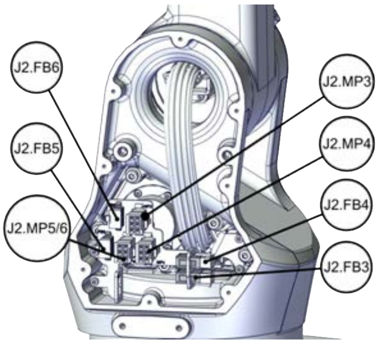
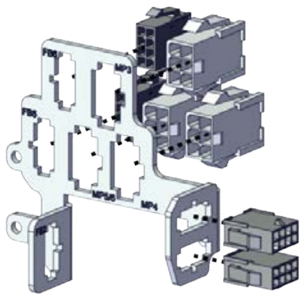
	Action	Note
12	Remove the timing belt from its groove on the motor.	 xx1800002496

Disconnecting the connectors at the division point

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • J2.FB3,4,5,6 • J2.MP3,4,5/6 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002497
3	Snap loose and remove the female head of the connectors from the connector plate.	 xx1800002498

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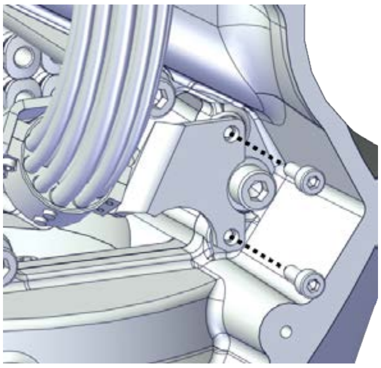
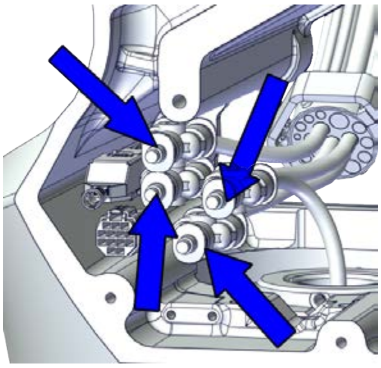
Separating the cable package from the swing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable bracket.	 xx1800002499

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

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the air hoses from the Y-shaped connectors.	 xx1800002500

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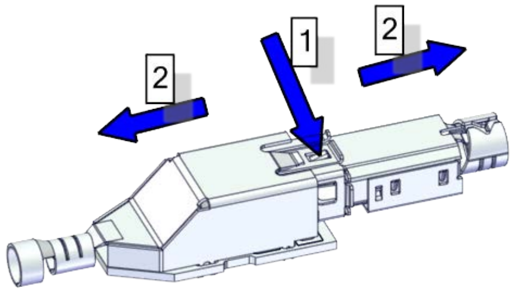
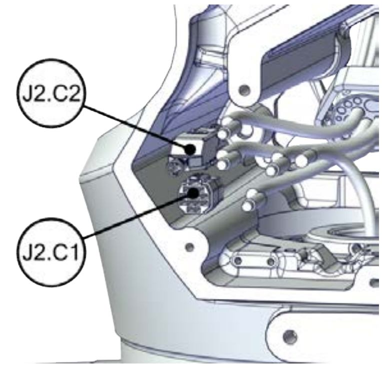
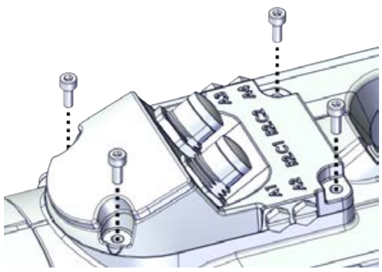
	Action	Note
3	Disconnect the connectors. • J2.C1 • J2.C2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the J2.C2 (for Ethernet cabling).  xx1800002943	 xx1800002501

Removing the process hub

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and carefully open the cover. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	 xx2000002219

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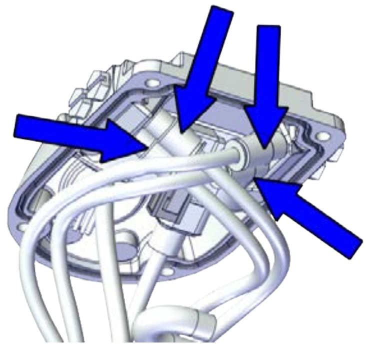
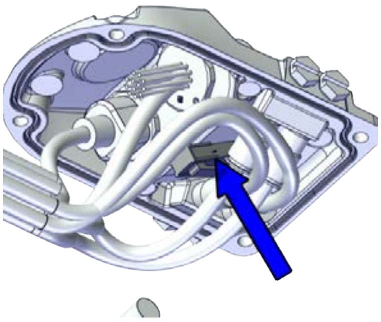
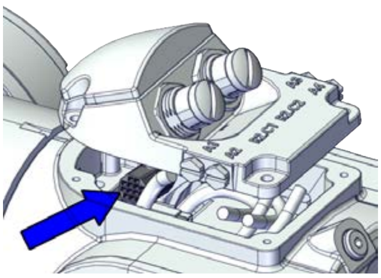
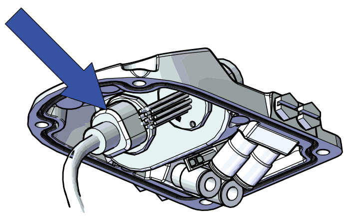
	Action	Note
3	Disconnect the air hoses.	 xx1800002945
4	Carefully pull out lamp unit connector behind the air hose connectors and disconnect the connector J5.UL.	 xx1800002946
5	**For robots with CP/CS cabling** Disconnect the connector. • J5.C1	 xx2100000293
6	**For robots with Ethernet cabling** Disconnect the connector J5.C2 using the tool.	J5.C2 connector assembly tool: -  xx1800002948

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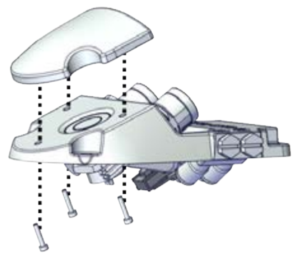
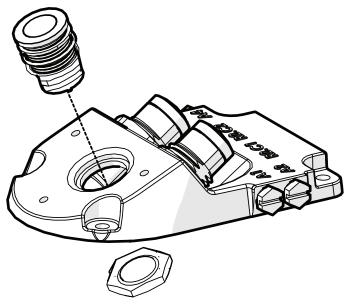
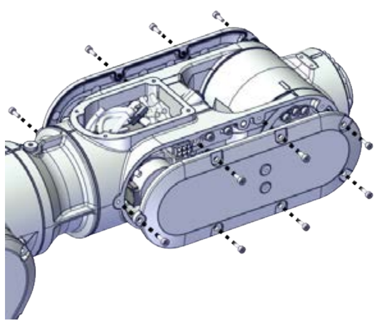
Removing the lamp unit

Notice that the procedure is valid only when the lamp unit needs a replacement.

	Action	Note
1	Remove the lamp unit cover.	 xx2000002220
2	Remove the lamp unit.	 xx2000002221

Removing the wrist covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the wrist covers from both sides.	 xx1800002949

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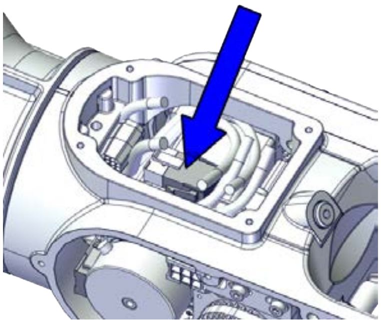
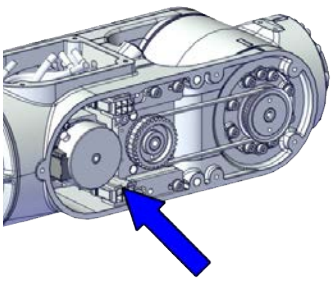
Disconnecting the axis-5 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Access the connector FB5 from the process hub and disconnect the connector.	 xx1800002950
3	Disconnect the connector. • MP5	 xx1800002993

Disconnecting the axis-6 motor connectors

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

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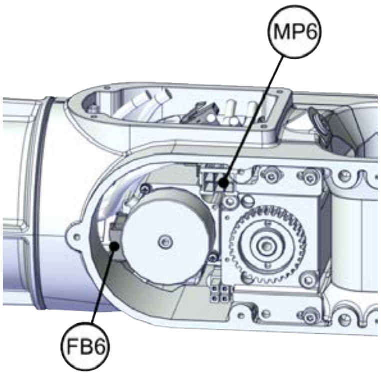
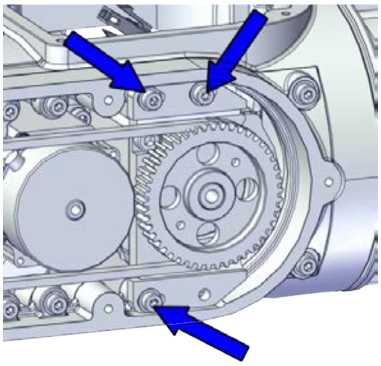
	Action	Note
2	Disconnect the connectors. • MP6 • FB6	 xx1800002994

Removing the axis-6 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002995

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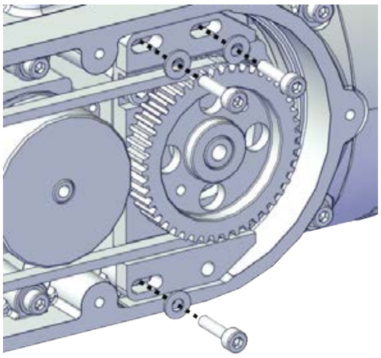
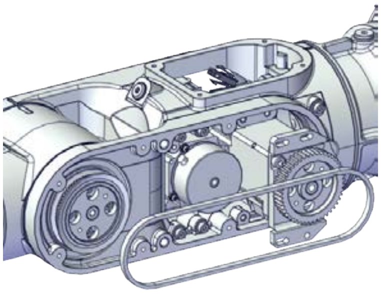
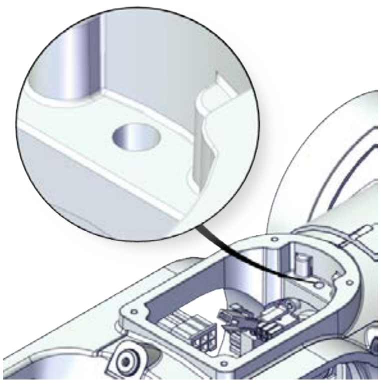
	Action	Note
4	Remove the screws and washers.	 xx1800002996
5	Carefully lift out the motor.	
6	Remove the timing belt from its groove on the motor.	 xx1800002997

Loosening the cable package from axis-4 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**Valid for CRB 1100-4/0.475** Access the cable package locking screw on the axis-4 gearbox from the wrist and then loosen the locking screw.	 xx1800003031

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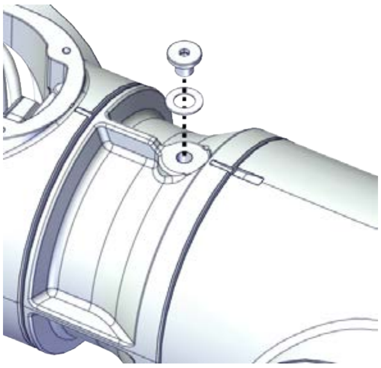
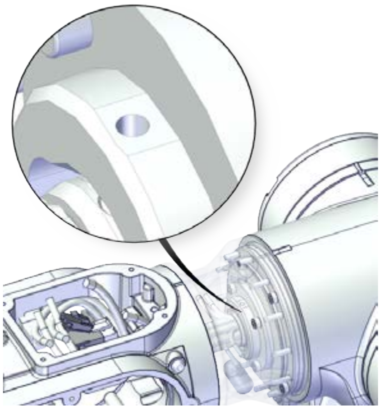
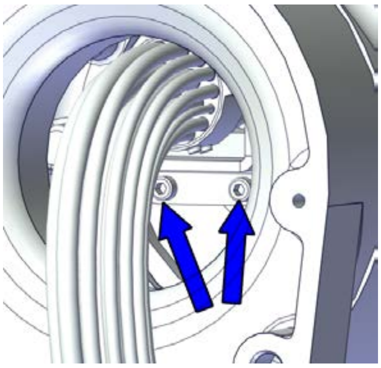
	Action	Note
3	Remove the plug screw and washer on the extender unit to access the cable package locking screw on the axis-4 gearbox and then loosen the locking screw.	 xx1800003000  xx1800003001

Separating the upper cable harness from the axis-2 gearbox

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable bracket.	 xx1800003002

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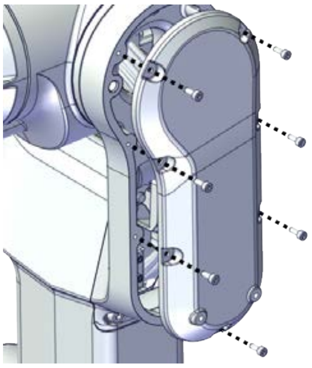
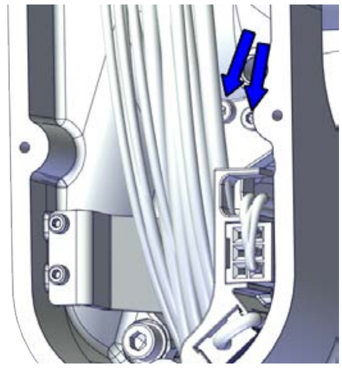
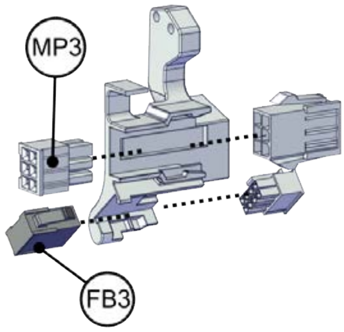
Disconnecting the axis-3 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the lower arm support cover.	 xx1800003003
3	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate, as shown in following step.	 xx1800003004
4	Slide the connectors out of the connector plate and disconnect the connectors. • FB3 • MP3 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003005

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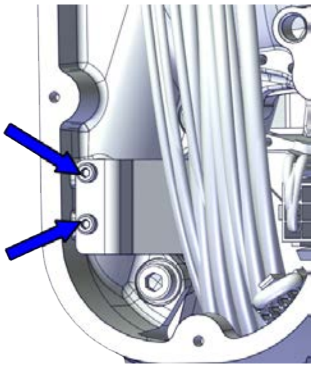
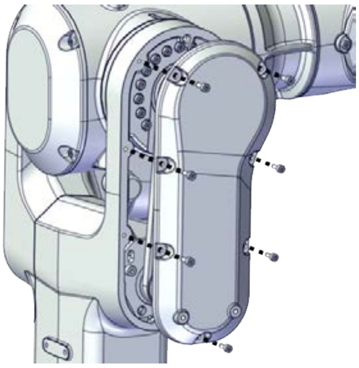
	Action	Note
5	Remove the cable bracket.	 xx1800003006

Removing the axis-3 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Remove the lower arm cover.	 xx1800003007

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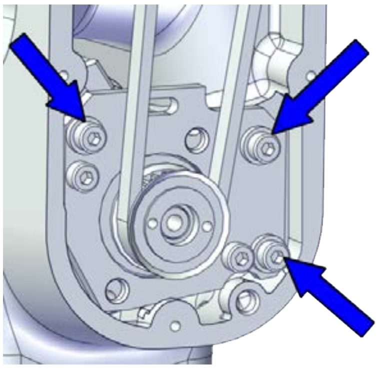
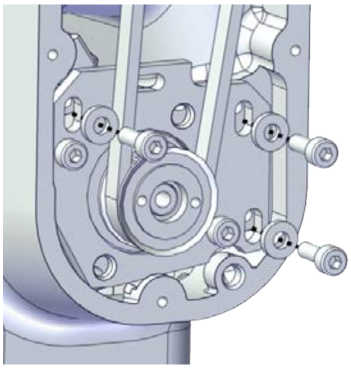
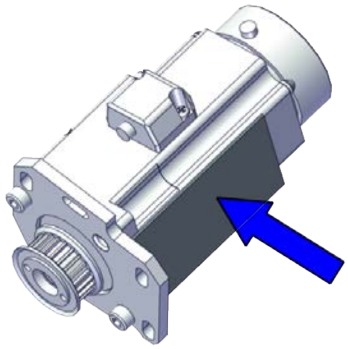
	Action	Note
4	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003008
5	Remove the screws and washers.	 xx1800003009
6	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad.	Cooling pad location  xx1800003604

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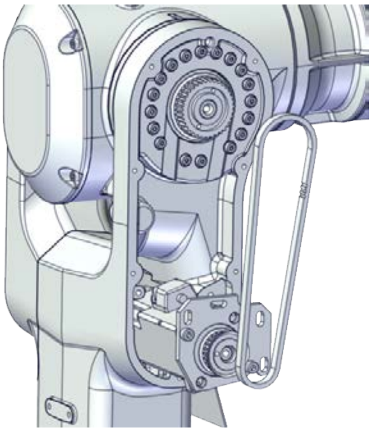
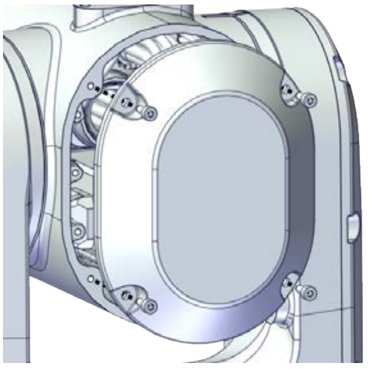
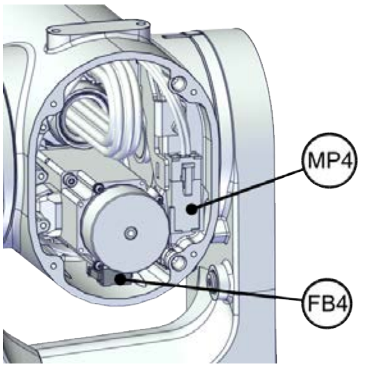
	Action	Note
7	Remove the timing belt from its groove on the motor.	 xx1800003010

Disconnecting the axis-4 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the housing cover.	 xx1800003011
3	Disconnect the motor connectors. • FB4 • MP4	 xx1800003012

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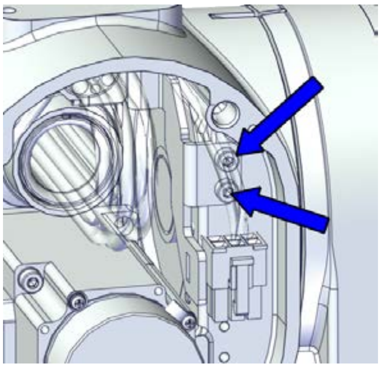
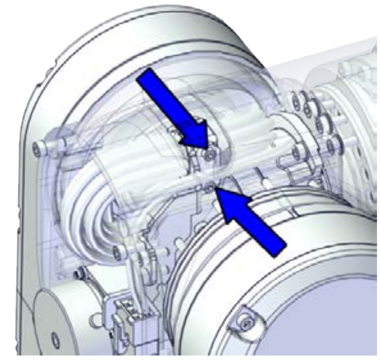
Separating the upper cable package from the housing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable bracket.	 xx1800003013  xx1800003014

Pulling out the upper cable harness

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

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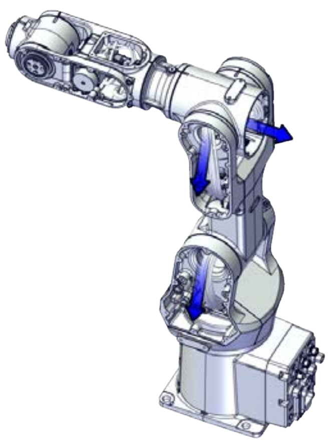
	Action	Note
2	Pull out the upper cable harness from the robot in the direction shown in the figure.	 xx1800003015

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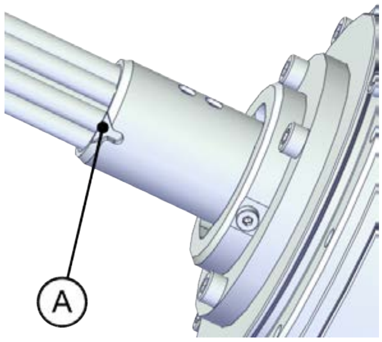
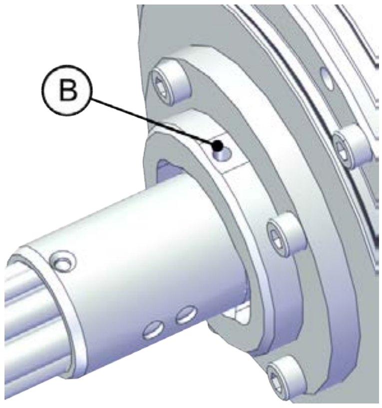
Refitting the upper cable package

Use these procedures to refit the upper cable package.

Refitting the upper cable harness through the axis-4 gearbox

	Action	Note
1	Insert the cable package in the housing and through the axis-4 gearbox. **Tip** Wrap the connectors with the masking tape. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	Cable protection tube orientation: use the notch (A) on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole (B) on the gearbox.  xx1800003017  xx1800003601

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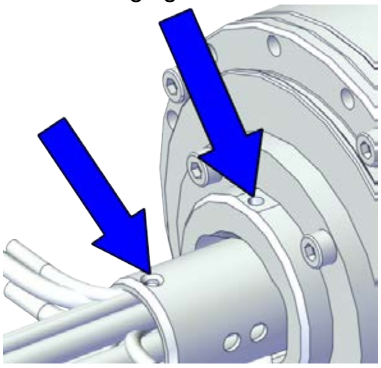
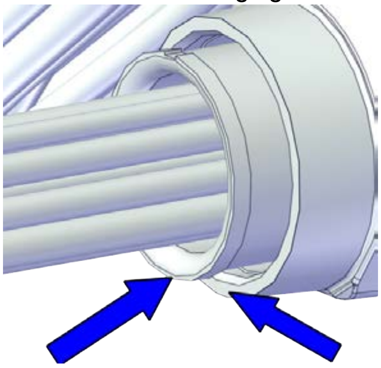
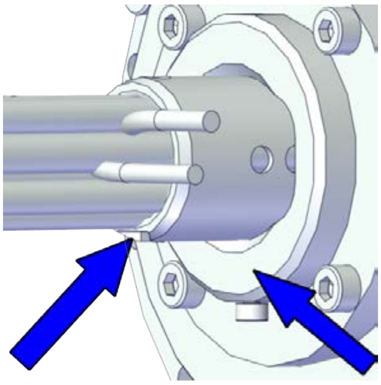
Securing the upper cable package to the axis-4 gearbox

	Action	Note
1	Make sure that: • The hole on the cable protection tube is aligned with the locking screw hole on the gearbox. • The cable protection tube surface is completely parallel with the pulley cover at one side and with the flange at the other side.	Holes to be aligned are shown in the following figure.  xx1800003018 Surfaces to be paralleled are shown in the following figures.  xx1800003019  xx1800003020

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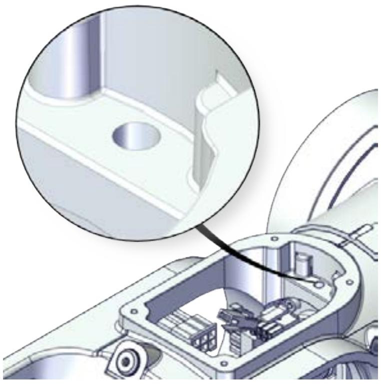
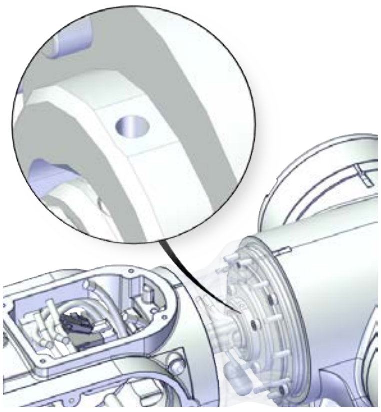
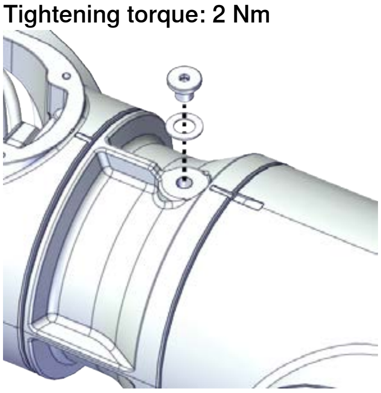
	Action	Note
2	Apply a little Loctite 243 to the locking screw and refit the locking screw. **Note** Make sure the locking screw header is parallel with flange surface. **Note** If there is locking liquid residues on the screw or screw hole, please clean it before refitting. Remove residual locking liquid after refitting.	Screw: M3x8 (1 pcs) Tightening torque: 0.4 Nm **Valid for CRB 1100-4/0.475**  xx1800003031  xx1800003001
3	Refit the plug screw and washer on the extender unit.	Plug screw: 3HAC064146-001 Tightening torque: 2 Nm  xx1800003000

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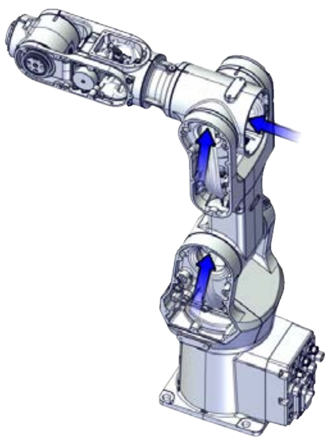
Guiding the upper cable package down to the swing

	Action	Note
1	Guide the upper cable package to go though from the housing, though the lower arm, down to the swing. When inserting the cable package, leave the axis-4 motor connectors in the housing and the axis-3 motor connectors in the lower arm. **Tip** Wrap the connectors with the masking tape. **Tip** It is possible to remove the lower arm support and swing support for easy routing of the cable package. Remember to refit the lower arm support and swing support after the cable package is inserted to place.	 xx1800003016

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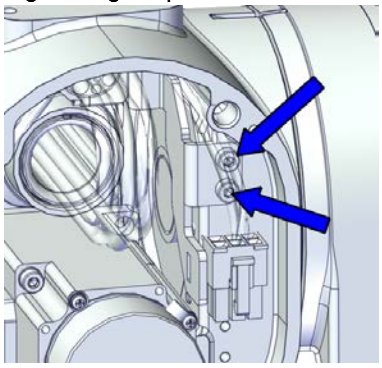
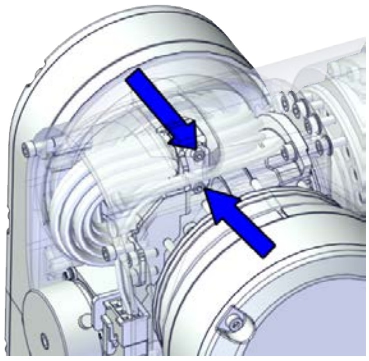
Securing the upper cable package to the housing

	Action	Note
1	Refit the cable bracket.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800003013 Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003014
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

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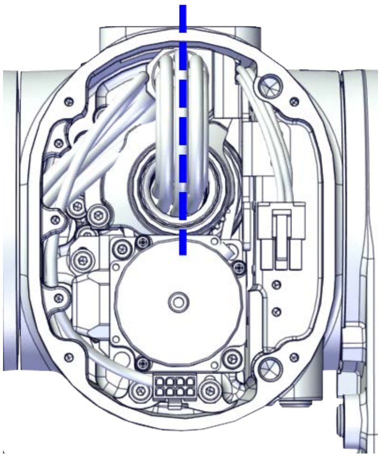
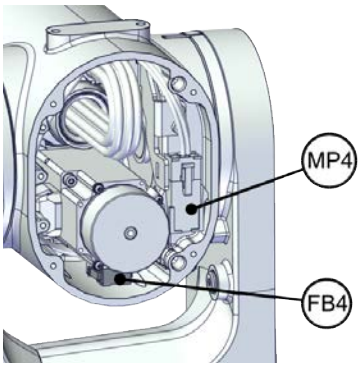
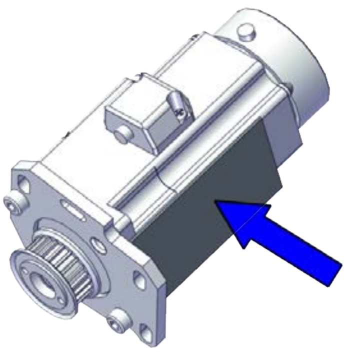
Reconnecting the axis-4 motor connectors

	Action	Note
1	Check the cabling status. Make sure the cabling is in vertical state and is not twisted.	 xx1800003618
2	Reconnect the connectors. • FB4 • MP4 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003012

Refitting the axis-3 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged.	Cooling pad for axis-3 and -4 motors: 3HAC071021-001  xx1800003604

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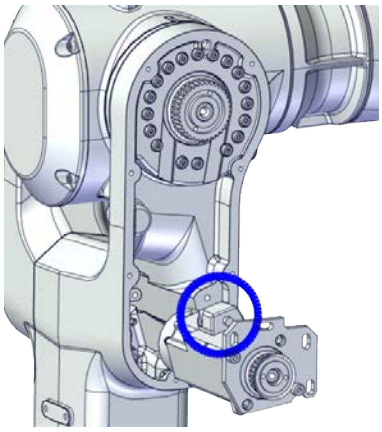
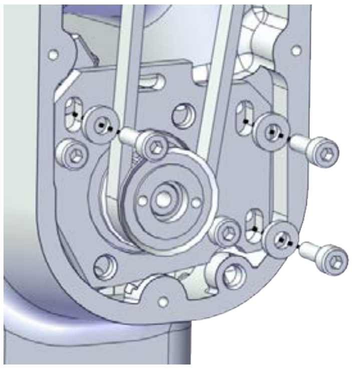
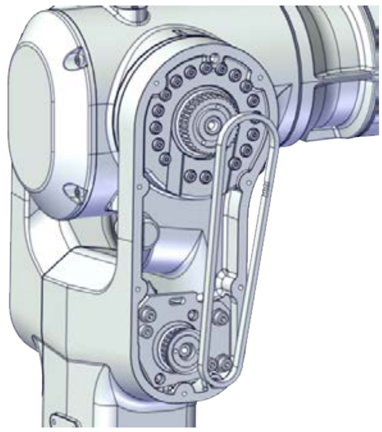
	Action	Note
3	Orient the motor correctly and fit it into the lower arm.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003021
4	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800003009
5	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003022

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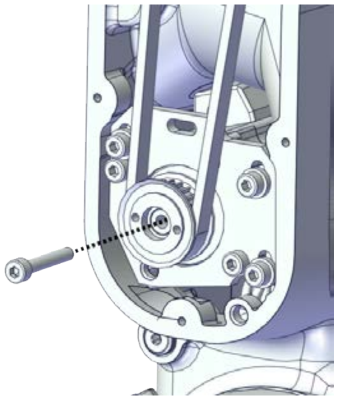
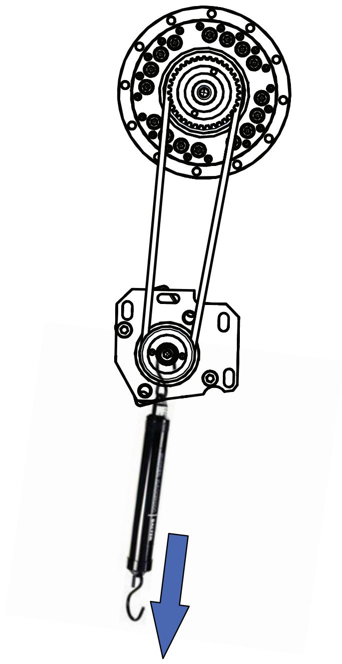
	Action	Note
6	Install an M4x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000009
7	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 21.7-23.94 N (for reference only) Initial referenced force for new belt: 31-34.2 N  xx1900000028

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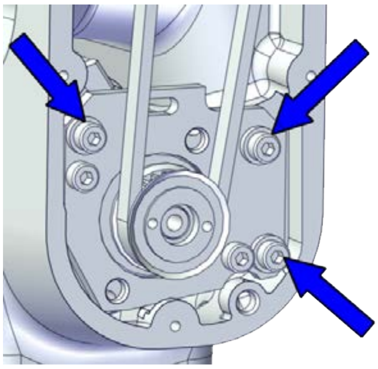
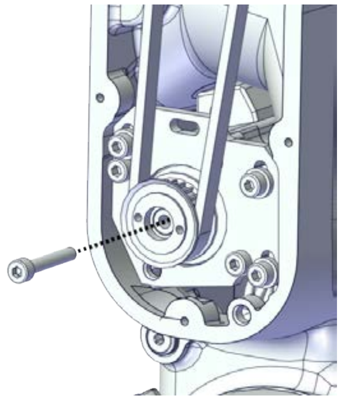
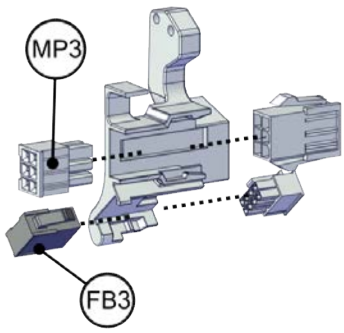
	Action	Note
8	Secure the motor with the screws.	Tightening torque: 3 Nm  xx1800003008
9	Use a sonic tension meter to measure the timing belt tension.	Used belt: 102-109 Hz New belt:113-143 Hz (for reference only)
10	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	
11	Remove the adjustment screw from the motor.	 xx1900000009

Reconnecting the axis-3 motor connectors

	Action	Note
1	Slide the connectors into the connector plate and reconnect the connectors. • FB3 • MP3 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003005

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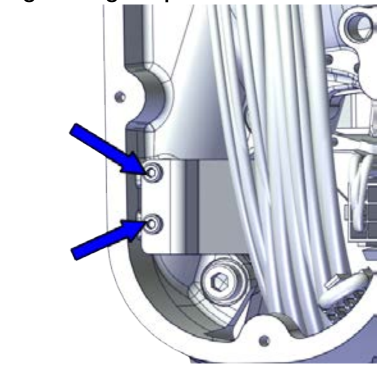
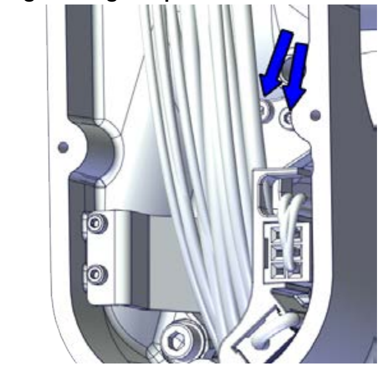
	Action	Note
2	Route and secure the cabling with cable straps.  **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003006
4	Refit the connector plate.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.4 Nm  xx1800003004

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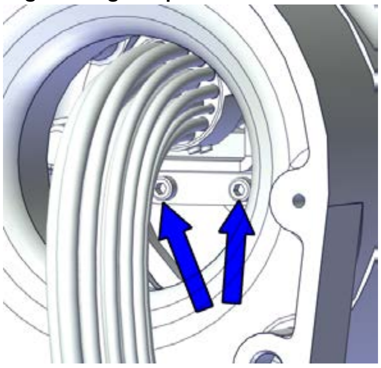
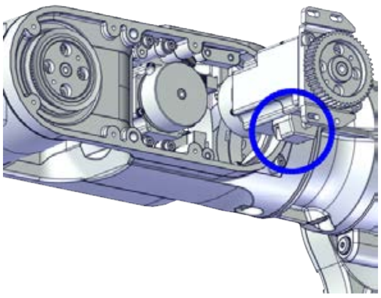
Securing the upper cable package to the axis-2 gearbox

	Action	Note
1	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003002

Refitting the axis-6 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Orient the motor correctly and fit it into the lower arm.  **Tip** Leave the connectors FB5 and FB6 accessible from the process hub and the connectors MP5 and MP6 accessible from wrist side.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003023

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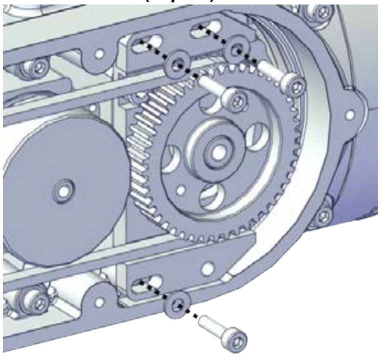
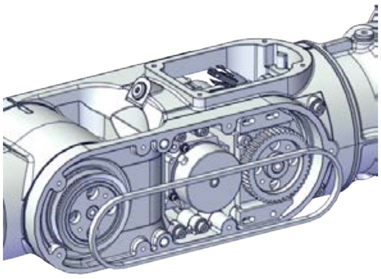
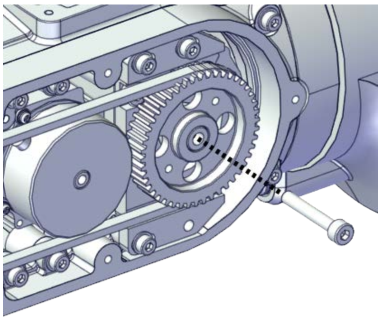
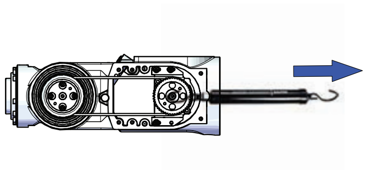
	Action	Note
3	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs)  xx1800002996
4	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003024
5	Install an M4x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000007
6	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 8.96-9.8 N (for reference only) Initial referenced force for new belt: 12.8-14  xx1900000026

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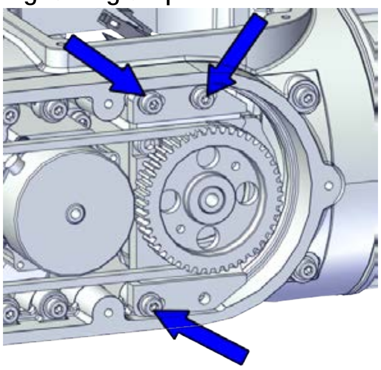
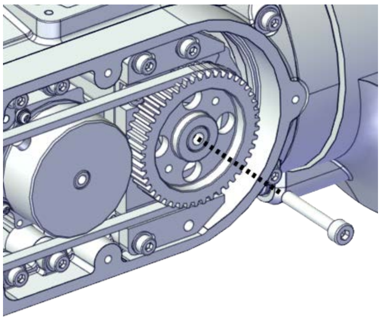
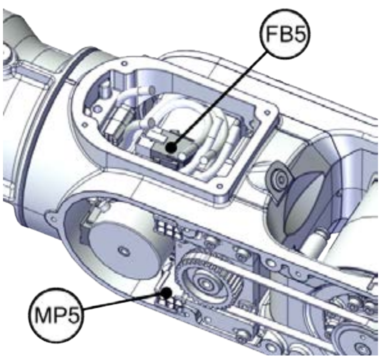
	Action	Note
7	Secure the motor with the screws.	Tightening torque: 1.4 Nm  xx1800002995
8	Use a sonic tension meter to measure the timing belt tension.	Used belt: 81.3-86.9 Hz New belt:90-114 Hz (for reference only)
9	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	
10	Remove the adjustment screw from the motor.	 xx1900000007

Reconnecting the axis-5 motor connectors

	Action	Note
1	Reconnect the connectors. • FB5 • MP5 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003025

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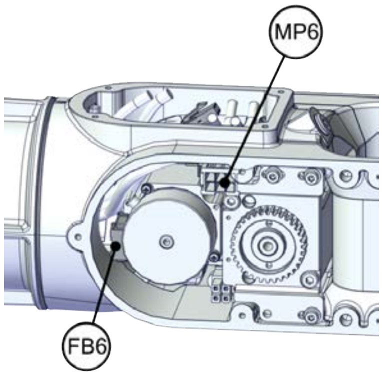
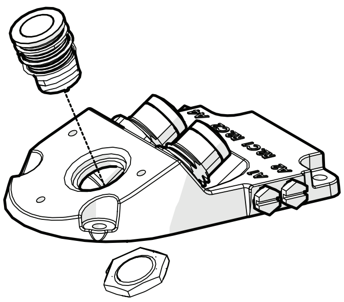
	Action	Note
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Insert the cabling and connectors into the wrist.	

Reconnecting the axis-6 motor connectors

	Action	Note
1	Reconnect the connectors. • FB6 • MP6 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002994
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Insert the cabling and connectors into the wrist.	

Refitting the lamp unit

Notice that the procedure is valid only when the lamp unit needs a replacement.

	Action	Note
1	Refit the lamp unit.	Multi-color lamp unit (14 mm): 3HAC076495-001  xx2000002221

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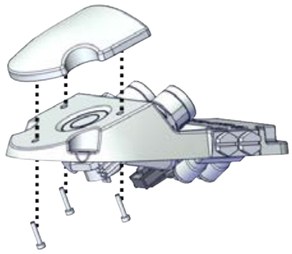
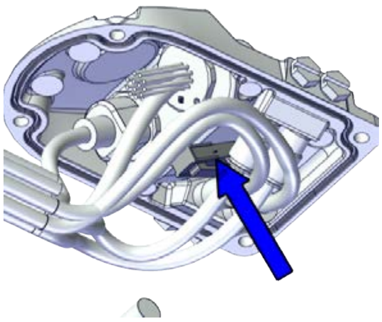
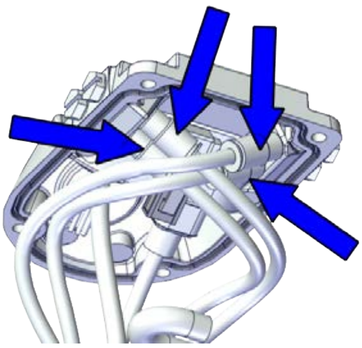
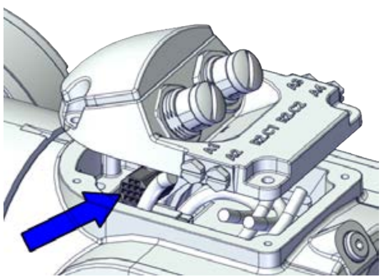
	Action	Note
2	Refit the lamp unit cover.	Lamp unit cover: 3HAC075972-001 Screw: M2x8 12.9 Gleitmo 605 (3 pcs) Tightening torque: 0.1 Nm  xx2000002220

Refitting the process hub

	Action	Note
1	Reconnect the lamp unit connector J5.UL and place the connector behind the air hose connectors.	 xx1800002946
2	Reconnect the air hoses in a cross pattern. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	 xx1800002945
3	**For robots with CP/CS cabling** Reconnect the connector. • J5.C1	 xx2100000293

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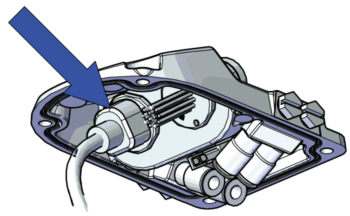
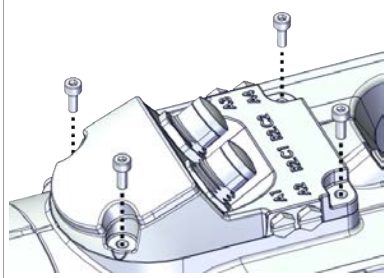
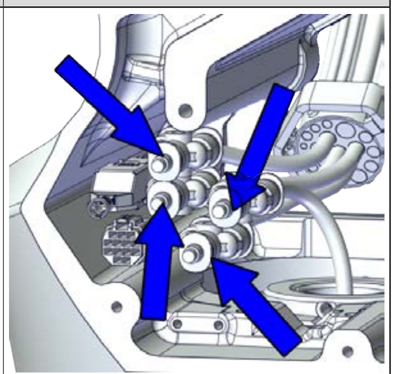
	Action	Note
4	**For robots with Ethernet cabling** Reconnect the connector J5.C2 using the tool.	J5.C2 connector assembly tool, included in the special toolkit 3HAC071022-001  xx1800002948
5	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
6	Refit the cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.2 Nm  xx2000002219

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

	Action	Note
1	Reconnect the air hoses in a cross pattern to the Y-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	 xx1800002500

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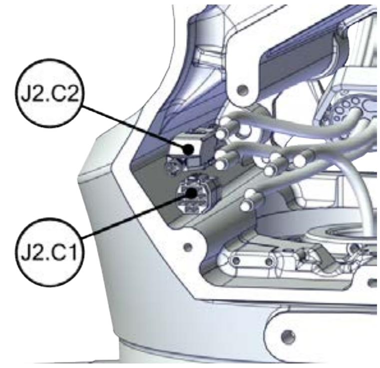
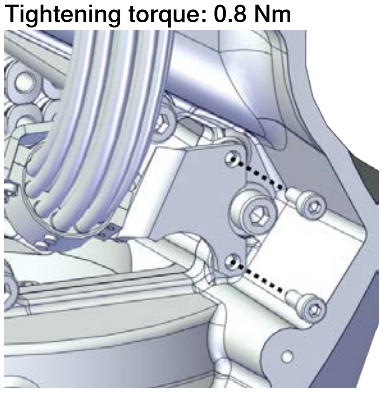
	Action	Note
2	Reconnect the connectors. • J2.C1 • J2.C2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002501

Securing the cable package to the swing

	Action	Note
1	Refit the cable bracket.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002499

Refitting the axis-2 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	

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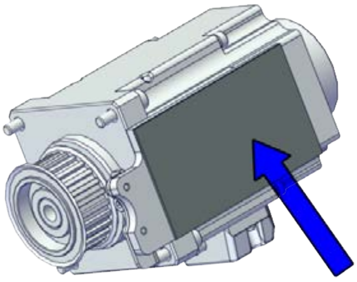
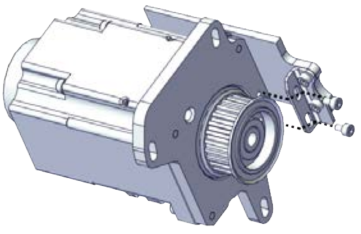
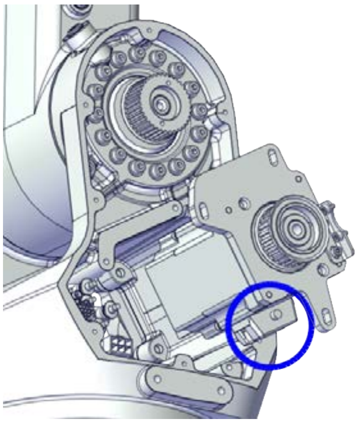
	Action	Note
2	Check the cooling pad. Replace if damaged, as shown in the following step.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001  xx1800003603
3	Remove the screws. Replace with a new cooling pad and then refit the screws.	Screw: M3x5 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 1.2 Nm  xx1800003026
4	Orient the motor correctly and fit it into the swing.  **Tip** Bend the motor signal cable back towards the swing support.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003027

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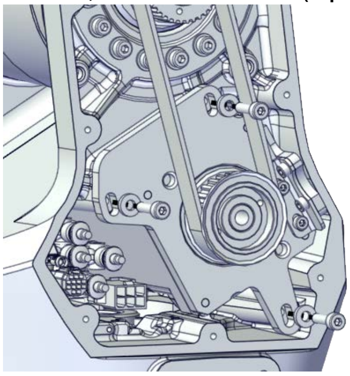
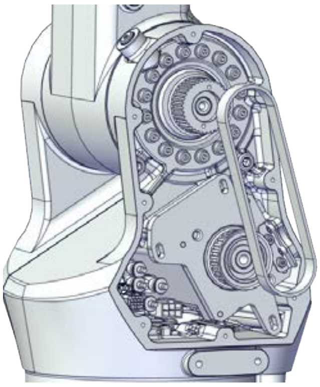
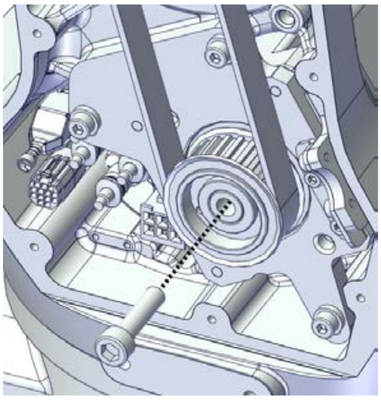
	Action	Note
5	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800002494
6	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003028
7	Install an M6x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000010

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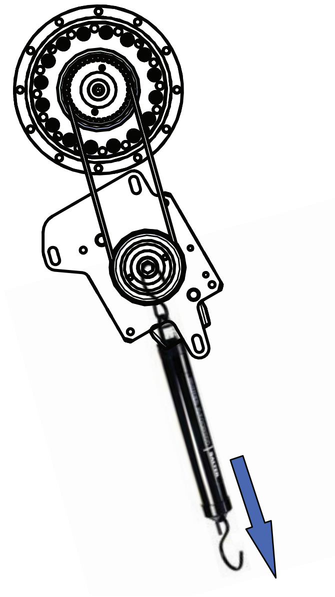
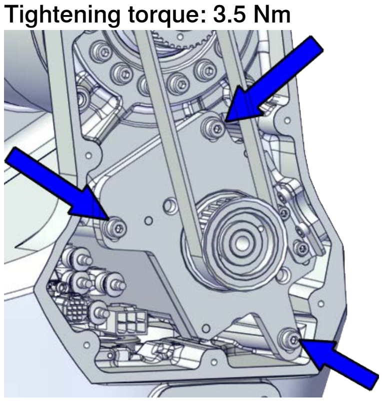
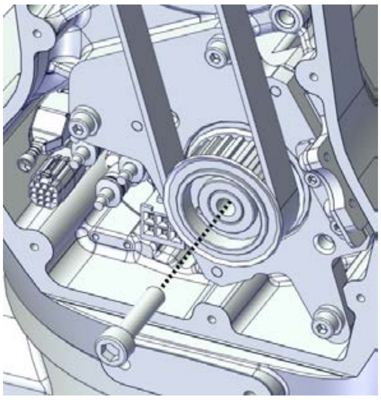
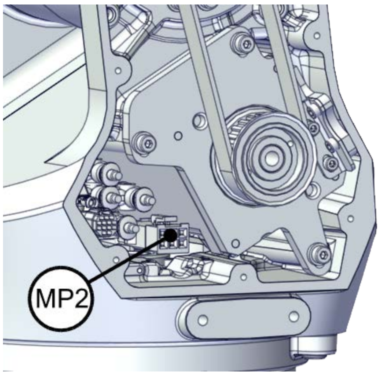
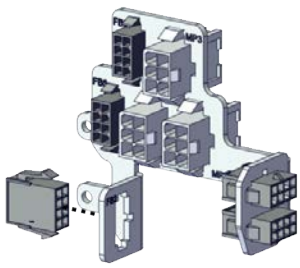
	Action	Note
8	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 68.18-75.04 N (for reference only) Initial referenced force for new belt: 97.4-107.2 N  xx1900000029
9	Secure the motor with the screws.	Tightening torque: 3.5 Nm  xx1800002493
10	Use a sonic tension meter to measure the timing belt tension.	Used belt: 163-174 Hz New belt:180-229 Hz (for reference only)
11	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	

Continues on next page

	Action	Note
12	Remove the adjustment screw from the motor.	 xx1900000010
13	Reconnect the connector. • MP2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002495

Reconnecting the connectors at the division point

	Action	Note
1	Insert the female header of the connectors to the connector plate.	 xx1800003029

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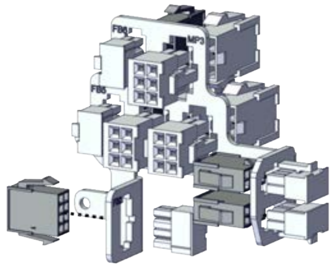
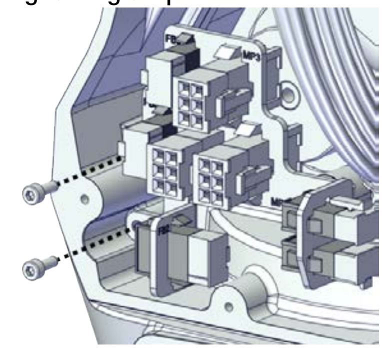
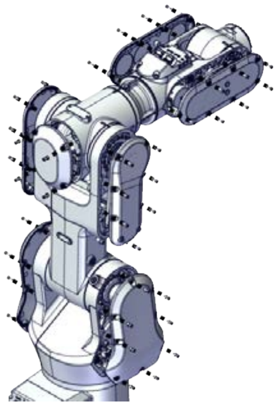
	Action	Note
2	Reconnect the connectors. • J2.FB2,3,4,5,6 • J2.MP3,4,5/6 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003030
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002489

Refitting the covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	

Continues on next page

	Action	Note
3	Refit the covers. • Wrist covers • Housing cover • Lower arm cover • Lower arm support cover • Swing cover • Swing support cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003606

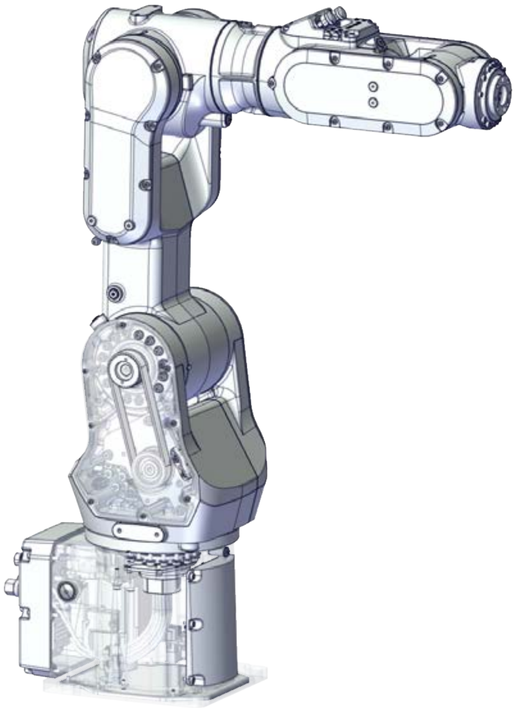
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

5.3.2 Replacing the lower cable package

Location of the lower cable package

The lower cable package is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 1100 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Lower cable harness (CP/CS and air hose, with Ethernet)	3HAC075523-001	
Motor with flange, axis 2	3HAC083588-001	.
Timing belt, axis 2	3HAC061935-001	
Base bottom cover	3HAC060463-001	Standard configuration, used for robots with rear connector interface.
Base rear cover	3HAC070312-001	Used for robots with bottom connector interface.
Base adapter	3HAC070313-001	Used for robots with bottom connector interface.
Swing cover	3HAC069051-001	

Continues on next page

Spare part	Article number	Note
Swing support cover	3HAC069052-001	
SMB cover	3HAC069060-001	
Cooling pad for axis-1 and -2 motors	3HAC071020-001	Cooling pads are wear parts. One cooling pad sheet contains 6 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.
brake release button assembly tool	-	Included in the special toolkit 3HAC071022-001. Used to remove and refit the brake release button.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)

Continues on next page

Deciding calibration routine

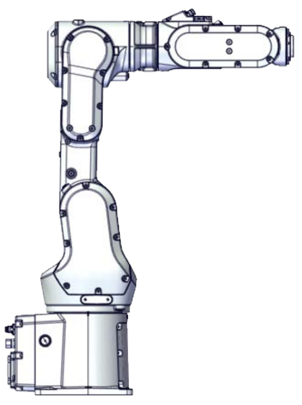
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the lower cable package

Use these procedures to remove the lower cable package.

Preparations before removing the lower cable package

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx1800003288

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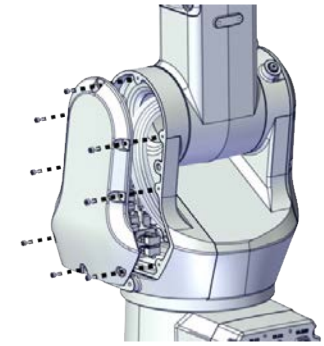
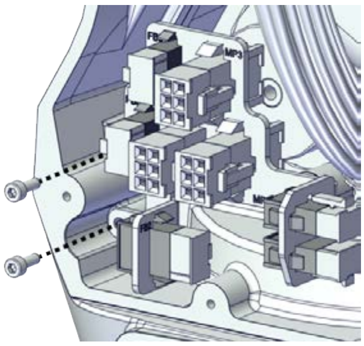
	Action	Note
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Remove the swing support cover.	 xx1800002488
4	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate.	 xx1800002489

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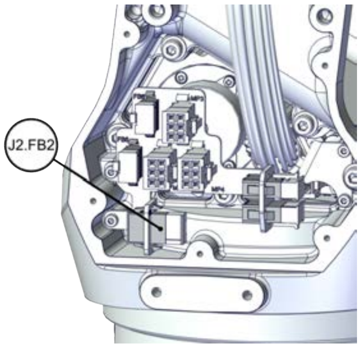
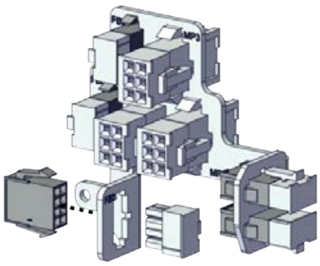
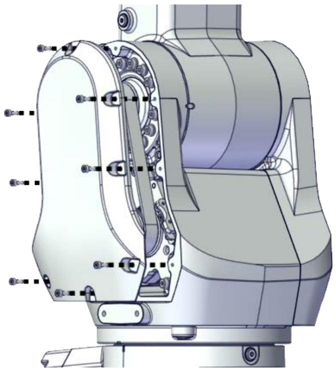
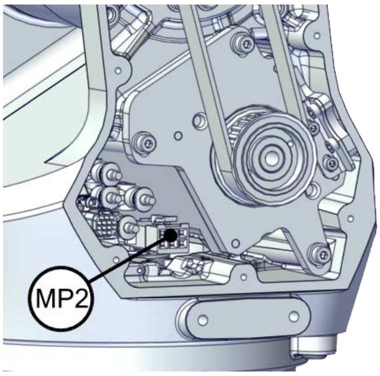
	Action	Note
5	Disconnect the connector. • J2.FB2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002490
6	Snap loose and remove the female head of the connector from the connector plate.	 xx1800002491
7	Remove the swing cover.	 xx1800002492
8	Disconnect the connector. • MP2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002495

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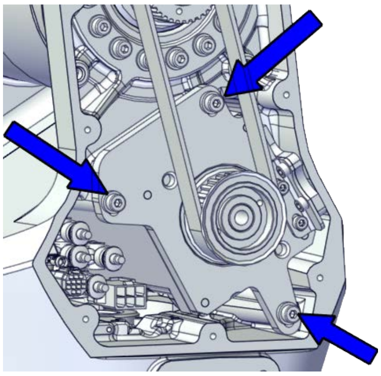
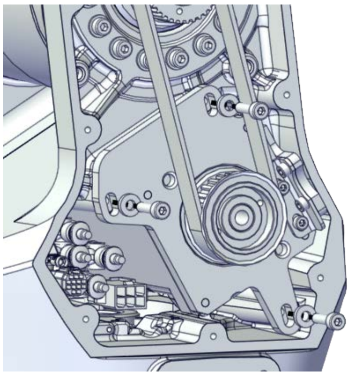
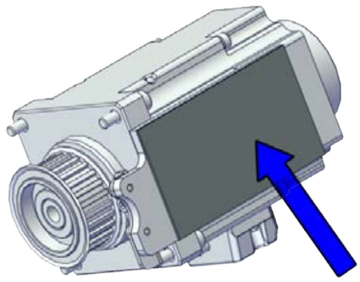
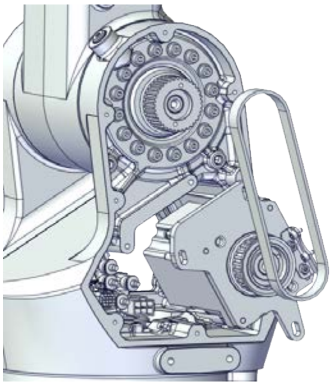
	Action	Note
9	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002493
10	Remove the screws and washers.	 xx1800002494
11	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad. **CAUTION** Be aware of the motor cabling. The motor cannot be removed completely until the connector is disconnected, as shown in following step.	Cooling pad location  xx1800003603
12	Remove the timing belt from its groove on the motor.	 xx1800002496

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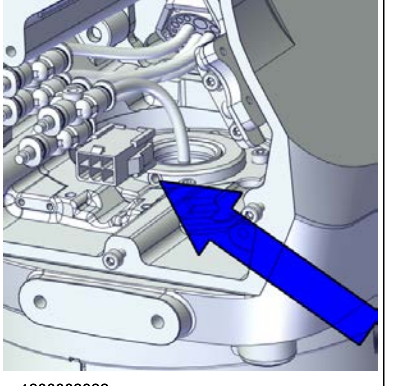
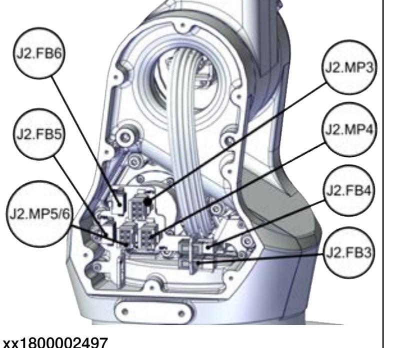
Loosening the cable package from axis-1 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Access the cable package locking screw on the axis-1 gearbox from the swing and then loosen the locking screw.	 xx1800003032
3	Remove the locking screw.	

Disconnecting the connectors at the division point

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • J2.FB3,4,5,6 • J2.MP3,4,5/6 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002497

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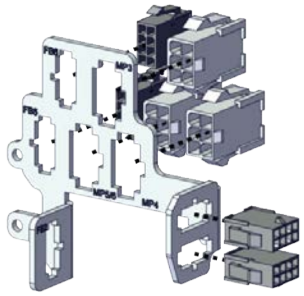
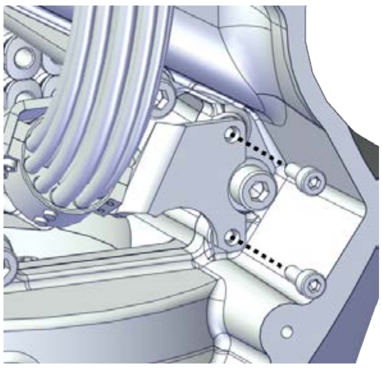
	Action	Note
3	Snap loose and remove the female head of the connectors from the connector plate.	 xx1800002498

Separating the cable package from the swing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable bracket.	 xx1800002499

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

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

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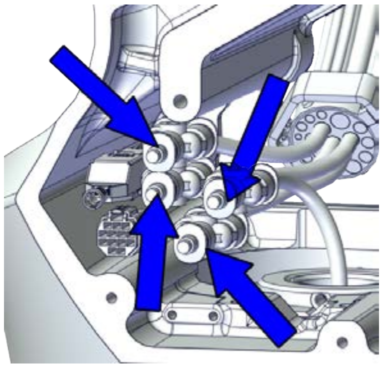
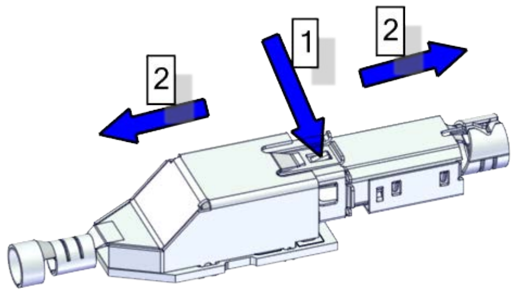
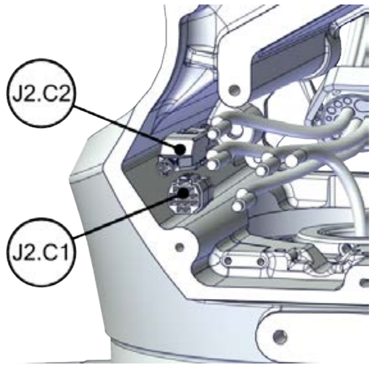
	Action	Note
2	Disconnect the air hoses from the Y-shaped connectors.	 xx1800002500
3	Disconnect the connectors. • J2.C1 • J2.C2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the J2.C2 (for Ethernet cabling).  xx1800002943	 xx1800002501

Disconnecting the SMB connectors

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

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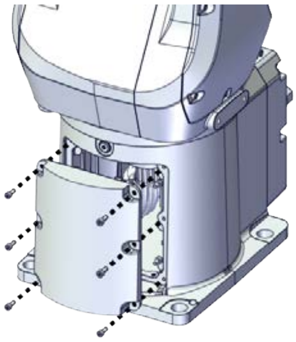
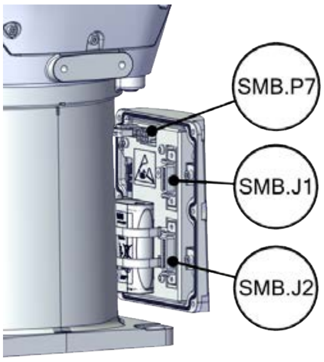
	Action	Note
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Remove the SMB cover attachment screws and carefully open the cover. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures. **CAUTION** There are cabling attached to the cover. The cover cannot be removed completely until the connectors are removed.	 xx1800002467
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002468
5	Remove the SMB cover completely from the base.	

Putting the robot on its side

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** The CRB 1100 robot weighs 21.1 kg and can be lifted by one person.	

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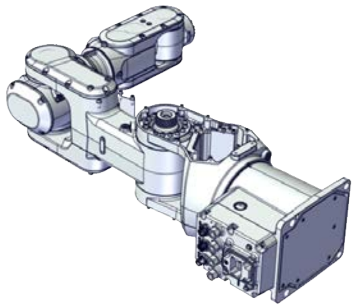
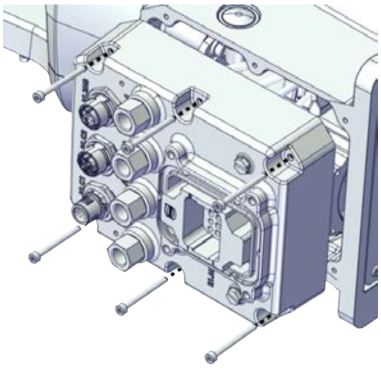
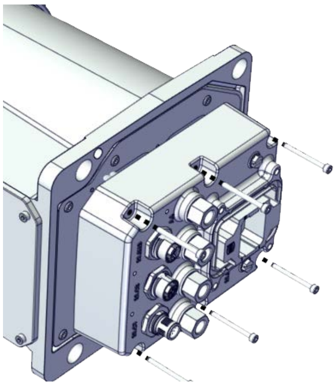
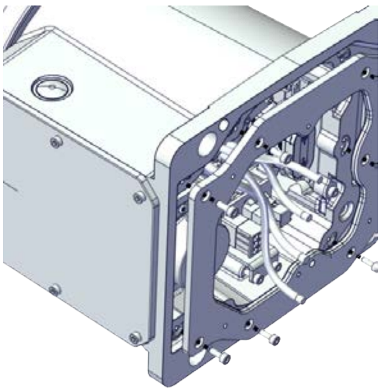
	Action	Note
3	**WARNING** The robot is likely to be mechanically unstable if not secured to the foundation.	
4	Loosen the robot from the foundation by removing the foundation attachment screws and put the robot on its side.	 xx1800003033

Opening the connector interface plate

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

Continues on next page

	Action	Note
2	Remove the connector interface plate attachment screws and carefully open the plate. **CAUTION** There are cabling attached to the cover. The cover cannot be removed completely until the connectors are removed.	**Valid for cabling with rear interface**  xx1800003034 **Valid for cabling with bottom interface (option 3309-1)**  xx1800003055
3	**Valid for cabling with bottom interface (option 3309-1)** Remove the base adapter.	 xx1800003056

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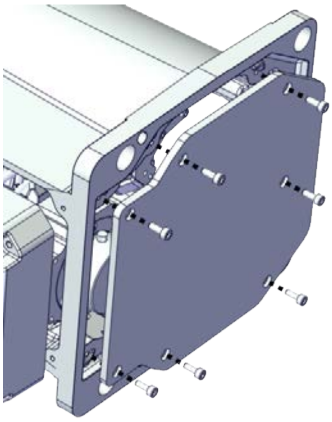
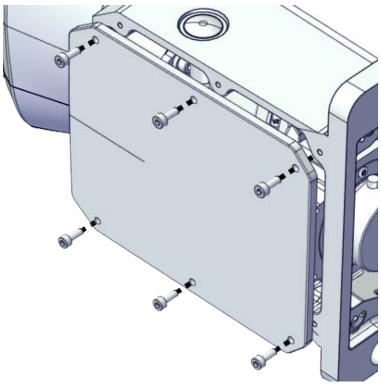
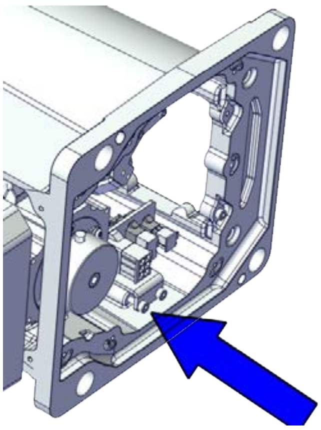
Removing the brake release button

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**Valid for cabling with rear interface** Remove the base bottom cover.	 xx1800003035
3	**Valid for cabling with bottom interface (option 3309-1)** Remove the base rear cover.	 xx1800003057
4	Disconnect the earth cable.	 xx1800003036

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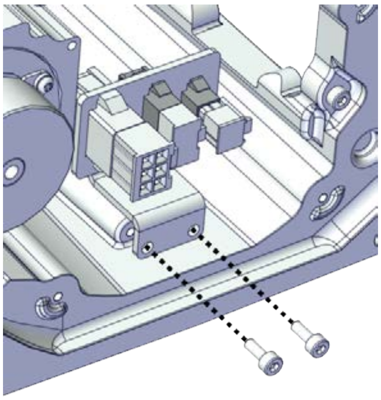
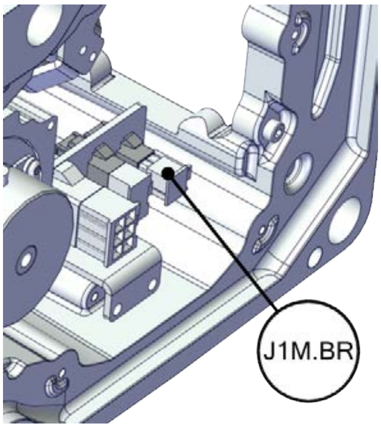
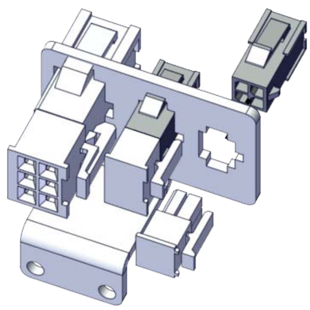
	Action	Note
5	Remove the connector plate.	 xx1800003037
6	Disconnect the connector. • J1M.BR **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003038
7	Remove the female header of the J1M.BR connector from the connector plate.	 xx1800003039

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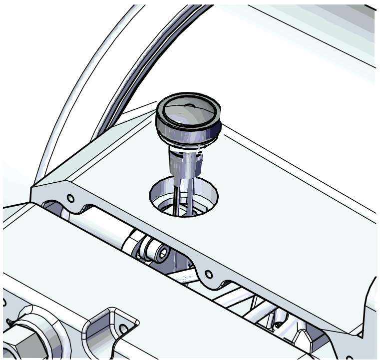
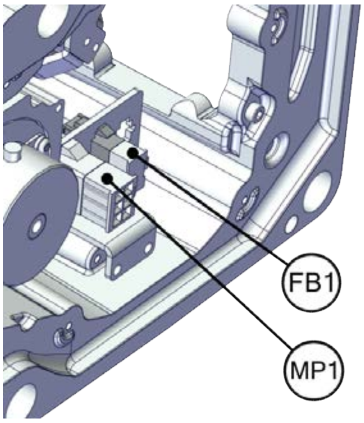
	Action	Note
8	Remove the brake release button from the base using the tool.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

Disconnecting axis-1 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • FB1 • MP1 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003041

Separating the cable package from the base

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

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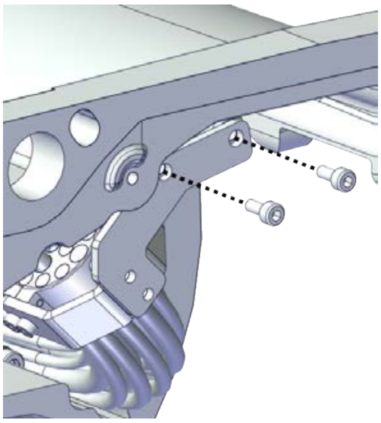
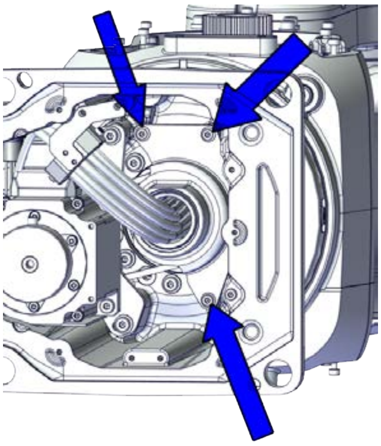
	Action	Note
2	Remove the cable bracket.	 xx1800003042

Separating the cable package from the axis-1 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the pulley cover.	 xx1800003043

Pulling out the cable package

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

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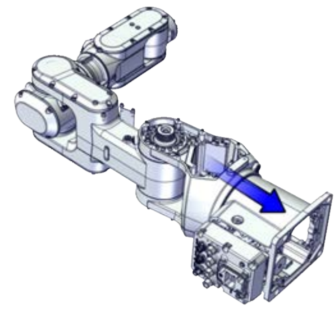
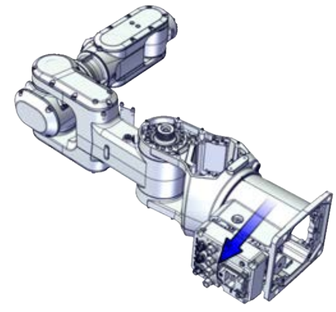
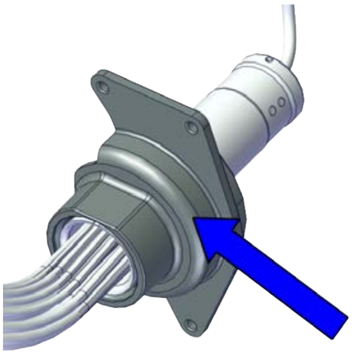
	Action	Note
2	Pull out the lower cable package from the axis-1 gearbox.	 xx1800003044
3	Pull out the lower cable package from the base.	 xx1800003045
4	Remove the pulley cover from the lower cable package.	 xx1800003046

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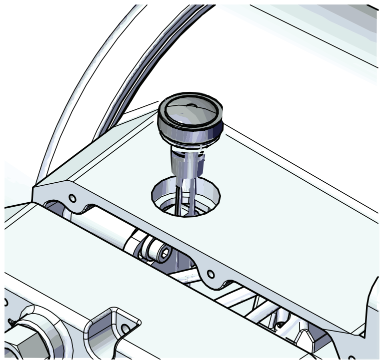
Refitting the lower cable package

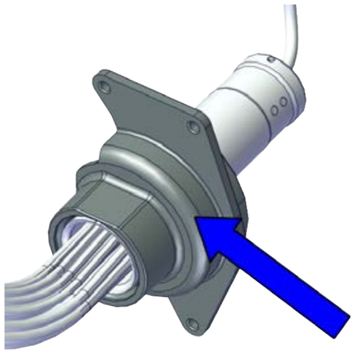
Use these procedures to refit the lower cable package.

Refitting the brake release button

	Action	Note
1	Refit the brake release button. **Note** Do not reconnect the connector yet. Do not tighten the button yet.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

Refitting the lower cable package through the axis-1 gearbox

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	Refit the pulley cover to the lower cable package.	 xx1800003046

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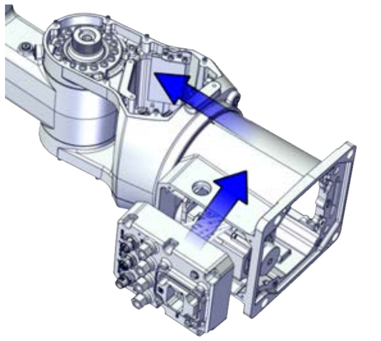
	Action	Note
2	**Valid for cabling with rear interface** Insert the cable package in the base and up through the axis-1 gearbox, through the rear. **Tip** Wrap the connectors with the masking tape. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	 xx1800003047 Cable protection tube orientation: use the encircled notch on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole on the gearbox.  xx1800003048

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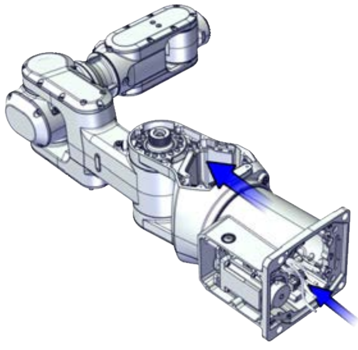
	Action	Note
3	**Valid for cabling with bottom interface (option 3309-1)** Insert the cable package in the base and up through the axis-1 gearbox, through the bottom. **Tip** Wrap the connectors with the masking tape. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	 xx1800003060 Cable protection tube orientation: use the encircled notch on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole on the gearbox.  xx1800003048

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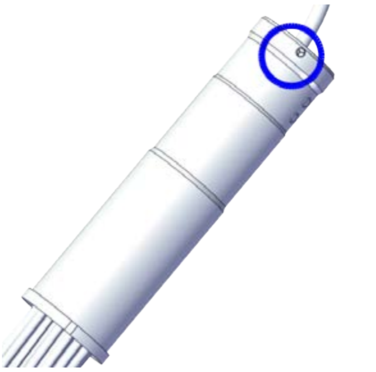
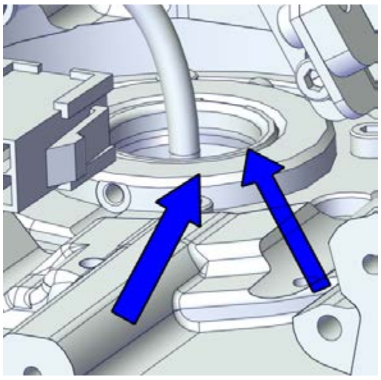
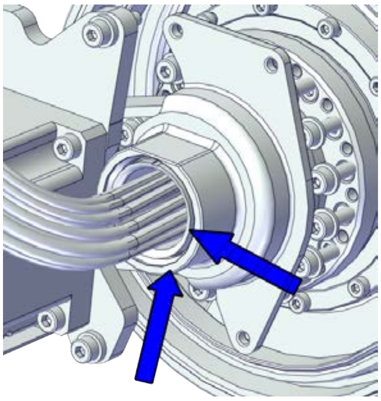
Securing the lower cable package to the axis-1 gearbox

	Action	Note
1	Make sure that: • The hole on the cable protection tube is aligned with the locking screw hole on the gearbox. • The cable protection tube surface is completely parallel with the pulley cover at one side and with the flange at the other side.	 xx1800003063  xx1800003049  xx1800003050

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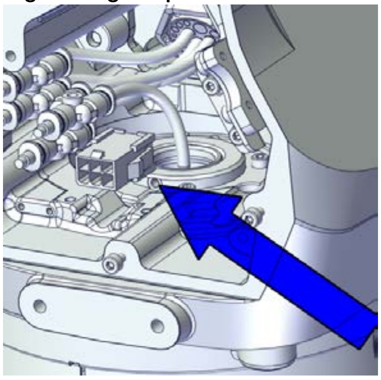
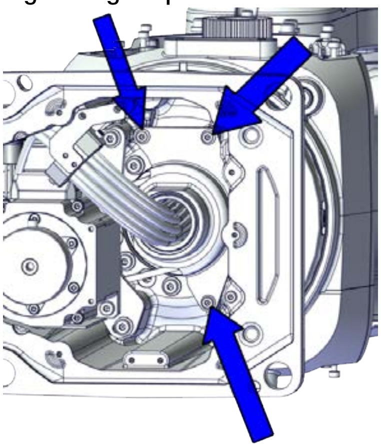
	Action	Note
2	Apply a little Loctite 243 to the locking screw and refit the locking screw. **Note** Make sure the locking screw header is parallel with flange surface. **Note** If there is locking liquid residues on the screw or screw hole, please clean it before refitting. Remove residual locking liquid after refitting.	Screw: M3x8 (1 pcs) Tightening torque: 0.4 Nm  xx1800003032

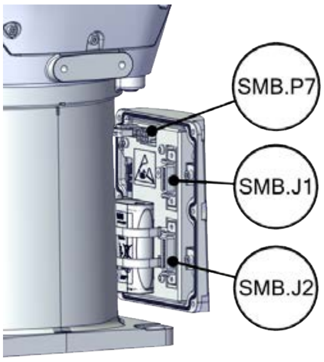
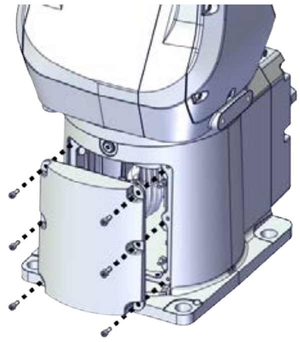
Refitting the pulley cover

	Action	Note
1	Refit the puller cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.2 Nm  xx1800003043

Reconnecting the SMB connectors

	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 48*.	

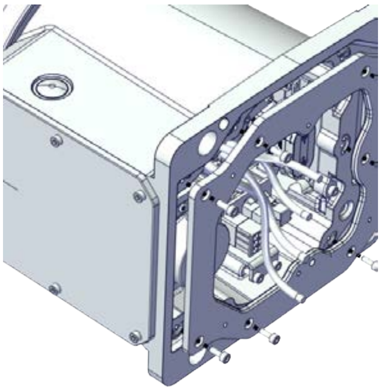
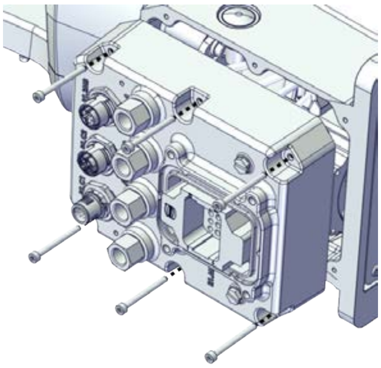
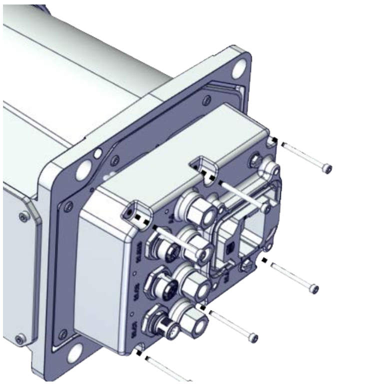
Continues on next page

	Action	Note
2	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	Tightening torque: 0.3 Nm  xx1800002468
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the SMB cover to the base.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm  xx1800002467

Refitting the connector interface plate

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

Continues on next page

	Action	Note
2	**Valid for cabling with bottom interface (option 3309-1)** Refit the base adapter.	Screw: M3x8 Steel 8.8-A2F (7 pcs) Tightening torque: 1.2 Nm  xx1800003056
3	Refit the connector interface plate to the base.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm **Valid for cabling with rear interface**  xx1800003034 **Valid for cabling with bottom interface (option 3309-1)**  xx1800003055

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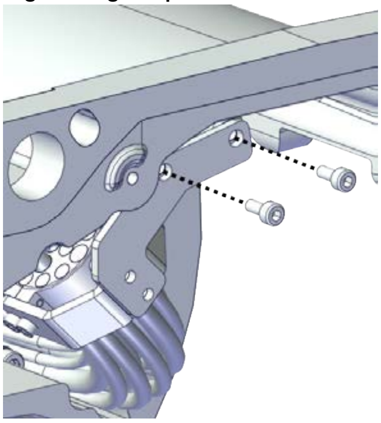
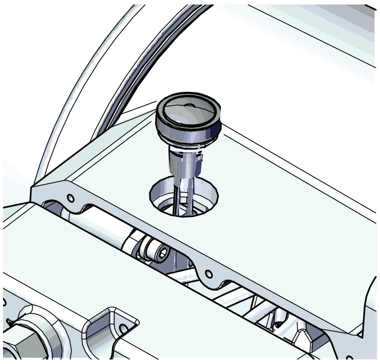
Securing the lower cable package to the base

	Action	Note
1	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003042

Securing the brake release button

	Action	Note
1	Tighten the brake release button using the tool.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

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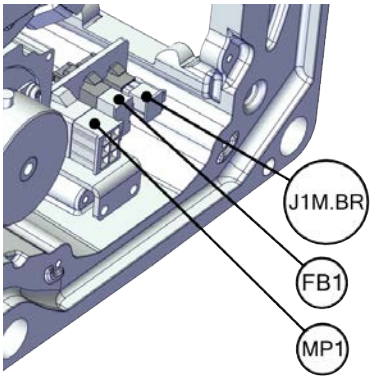
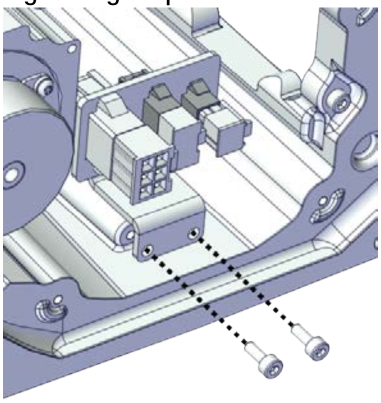
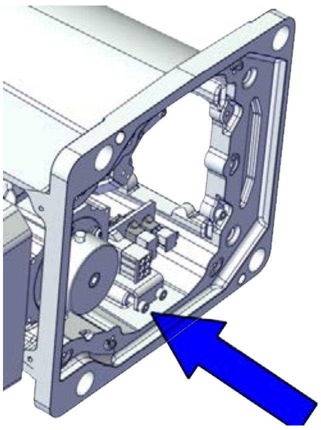
Reconnecting the brake release cabling and axis-1 motor connectors

	Action	Note
1	Reconnect the connectors. • J1M.BR • MP1 • FB1 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003054
2	Reconnect the floor cable together with the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800003037  xx1800003036

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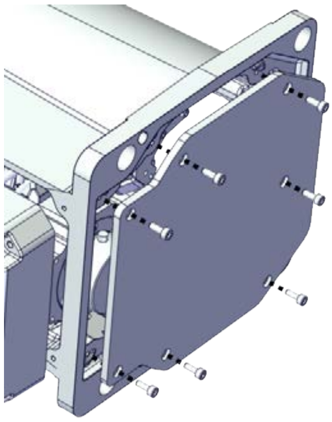
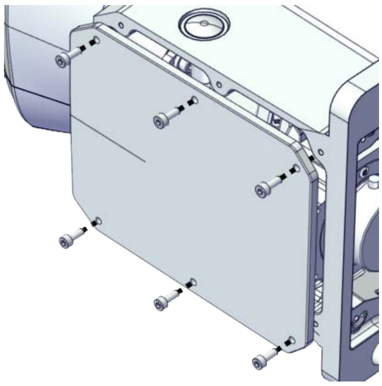
Refitting the base cover

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	**Valid for cabling with rear interface** Refit the bottom cover.	Screw: M3x8 Steel 8.8-A2F (7 pcs) Tightening torque: 1.2 Nm  xx1800003035
5	Refit the rear cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm  xx1800003057

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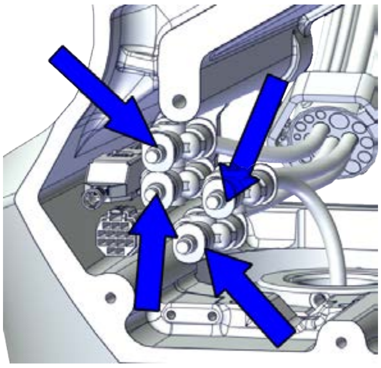
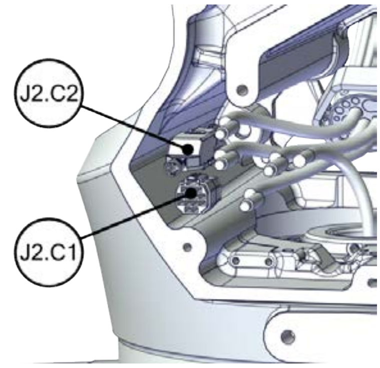
Securing the robot to the foundation

	Action	Note
1	**CAUTION** The CRB 1100 robot weighs 21.1 kg and can be lifted by one person.	
2	Raise the robot to standing and secure to the foundation with the attachment screws and washers.	Attachment screws: M12x25 (robot installation directly on foundation), quality: 8.8. Washers: 4 pcs, 24 x 13 x 2.5. Tightening Torque: 50 Nm±5 Nm.

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

	Action	Note
1	Reconnect the air hoses in a cross pattern to the Y-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	 xx1800002500
2	Reconnect the connectors. • J2.C1 • J2.C2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002501

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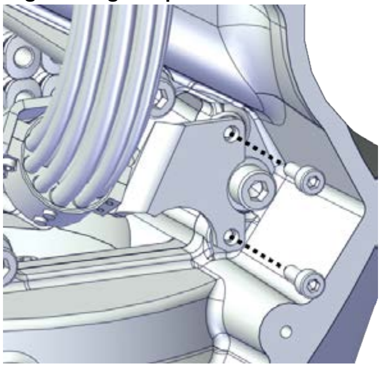
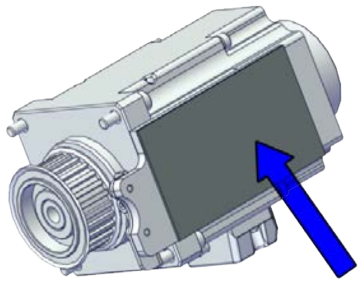
Securing the cable package to the swing

	Action	Note
1	Refit the cable bracket.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002499

Refitting the axis-2 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged, as shown in the following step.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001  xx1800003603

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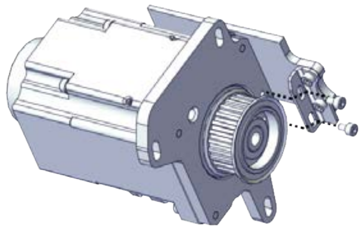
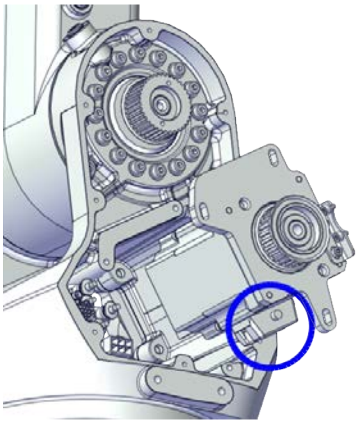
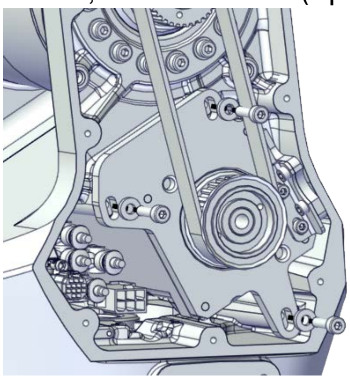
	Action	Note
3	Remove the screws. Replace with a new cooling pad and then refit the screws.	Screw: M3x5 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 1.2 Nm  xx1800003026
4	Orient the motor correctly and fit it into the swing. **Tip** Bend the motor signal cable back towards the swing support.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003027
5	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800002494

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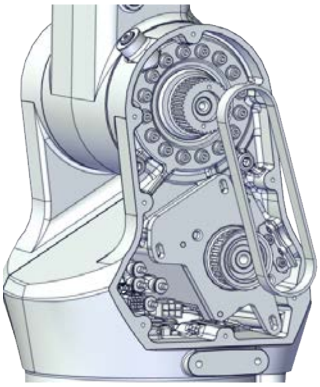
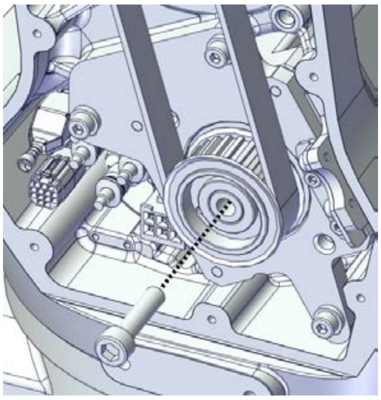
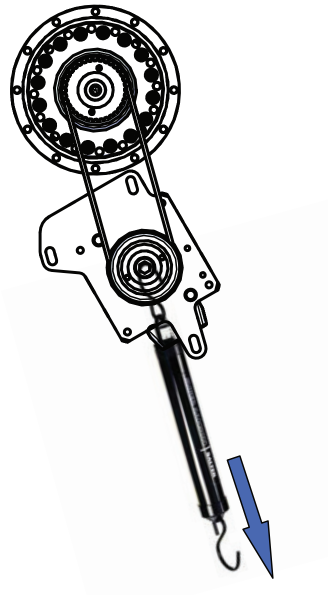
	Action	Note
6	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003028
7	Install an M6x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000010
8	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 68.18-75.04 N (for reference only) Initial referenced force for new belt: 97.4-107.2 N  xx1900000029

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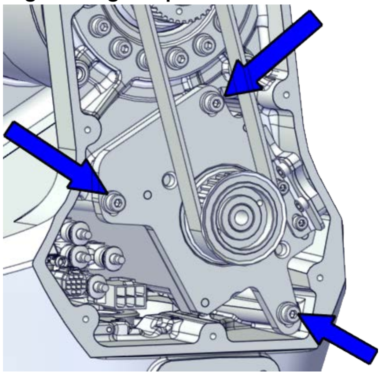
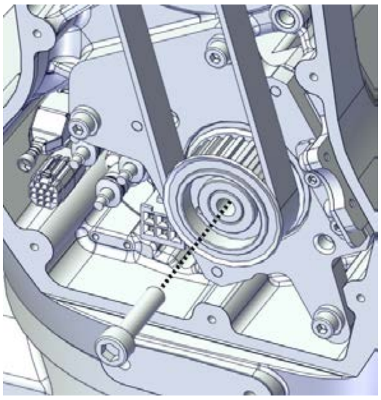
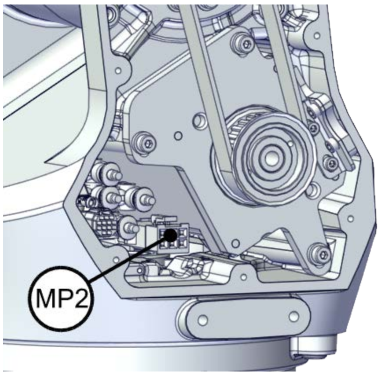
	Action	Note
9	Secure the motor with the screws.	Tightening torque: 3.5 Nm  xx1800002493
10	Use a sonic tension meter to measure the timing belt tension.	Used belt: 163-174 Hz New belt:180-229 Hz (for reference only)
11	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	
12	Remove the adjustment screw from the motor.	 xx1900000010
13	Reconnect the connector. • MP2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002495

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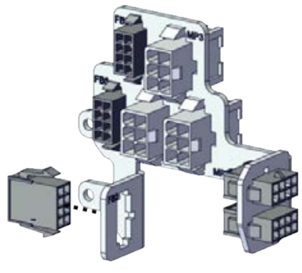
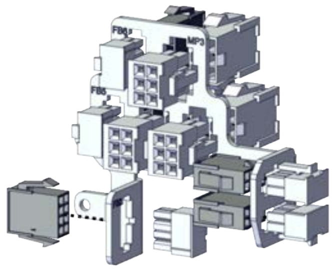
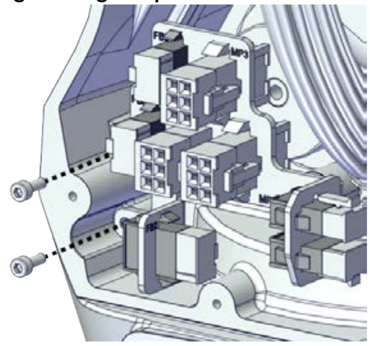
Reconnecting the connectors at the division point

	Action	Note
1	Insert the female header of the connectors to the connector plate.	 xx1800003029
2	Reconnect the connectors. • J2.FB2,3,4,5,6 • J2.MP3,4,5/6 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003030
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002489

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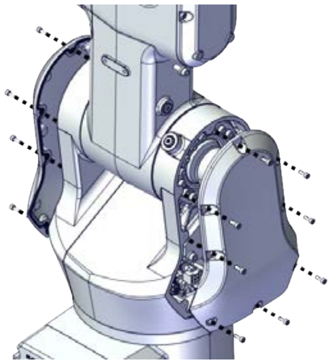
Refitting the swing covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	
3	Refit the covers. • Swing cover • Swing support cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003607

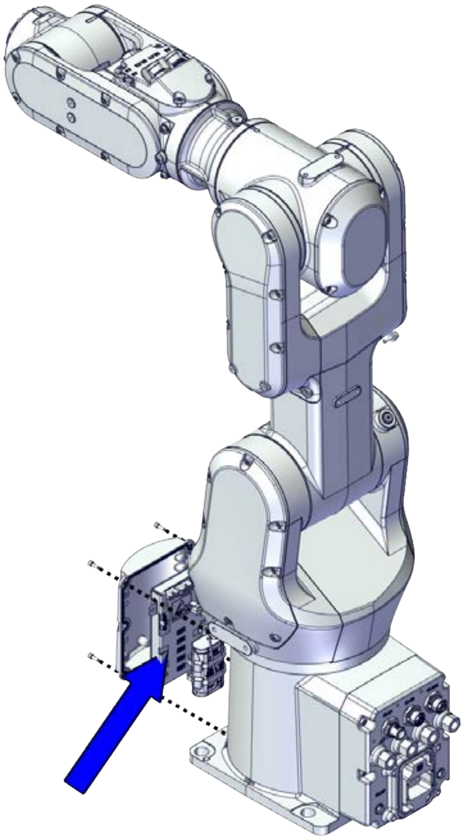
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

5.3.3 Replacing the SMB unit

Location of the SMB unit

The SMB unit is located as shown in the figure.



xx1800002464

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 1100 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Serial measurement unit	3HAC063968-001	
SMB cover	3HAC069060-001	
Battery pack	3HAC044075-001	Battery includes protection circuits. Only replace with the specified spare part or an ABB-approved equivalent.

Continues on next page

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.

Required consumables and wear parts

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)

Deciding calibration routine

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

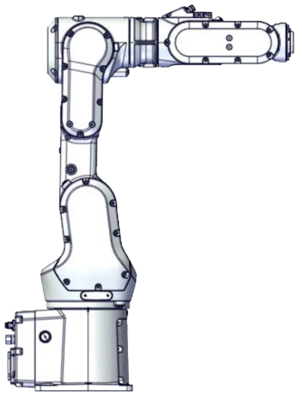
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removing the SMB unit

Use these procedures to remove the SMB unit.

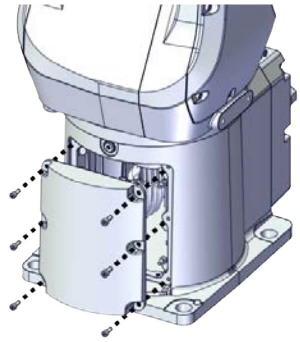
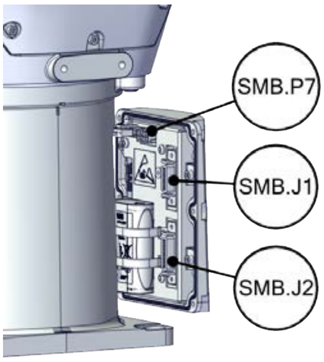
Preparations before removing the SMB unit

	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 synchronization position.	 xx1800003288
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Disconnecting the SMB connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	

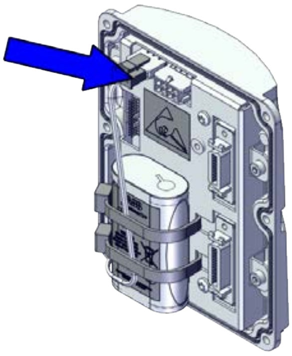
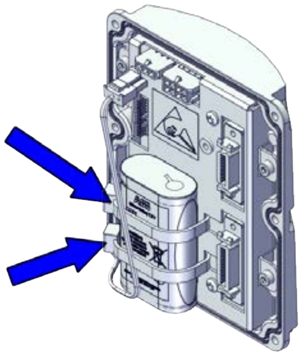
Continues on next page

	Action	Note
3	Remove the SMB cover attachment screws and carefully open the cover. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures. **CAUTION** There are cabling attached to the cover. The cover cannot be removed completely until the connectors are removed.	 xx1800002467
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002468
5	Remove the SMB cover completely from the base.	

Removing the battery pack

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	

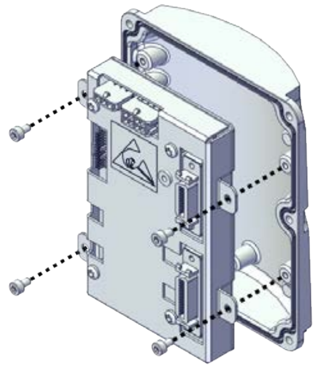
Continues on next page

	Action	Note
3	Disconnect the battery cable.	 xx1800002469
4	Remove the battery pack by cutting the cable strap.	 xx1800002470

Removing the SMB unit

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	 **ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	

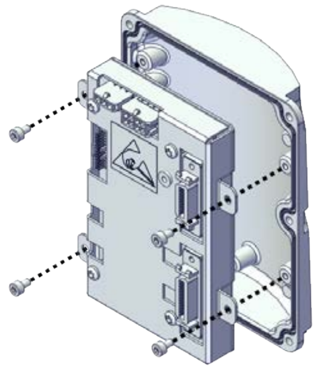
Continues on next page

	Action	Note
3	Remove the screws.	 xx1800002471

Refitting the SMB unit

Use these procedures to refit the SMB unit.

Refitting the SMB unit

	Action	Note
1	 **ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
2	Refit the screws.	Screw: M3x5 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 0.8 Nm  xx1800002471

Refitting the battery pack

	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 48*.	

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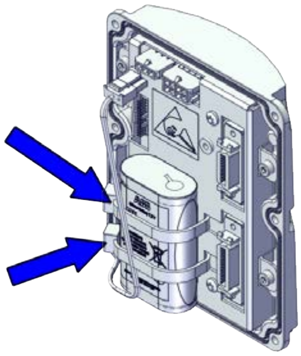
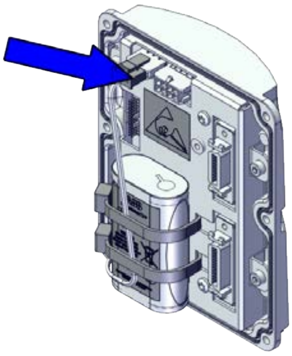
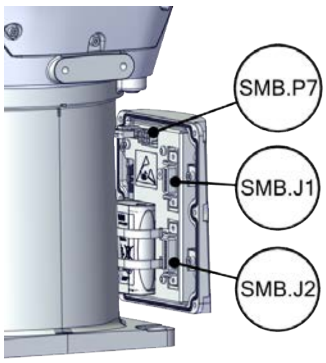
	Action	Note
2	Secure the battery pack using the cable strap.	 xx1800002470
3	Reconnect the battery cable.	 xx1800002469

Reconnecting the SMB connectors

	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 48*.	
2	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	Tightening torque: 0.3 Nm  xx1800002468

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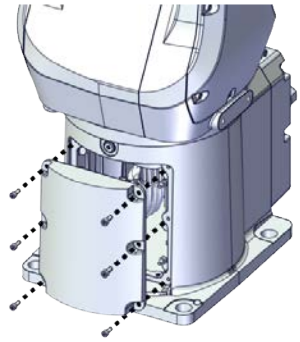
	Action	Note
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the SMB cover to the base.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm  xx1800002467

Concluding procedure

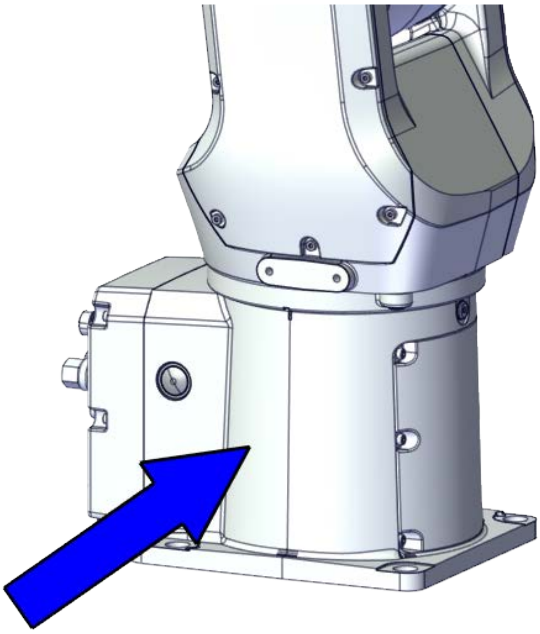
	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 163*.	

5.4 Swing and base

5.4.1 Replacing the base

Location of the base

The base is located as shown in the figure.



xx1800002472

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 1100 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Lower cable harness (CP/CS and air hose, with Ethernet)	3HAC075523-001	
Base	3HAC069048-001	
Motor with flange, axis 1	3HAC083589-001	
Timing belt, axis 1	3HAC061934-001	
Motor with flange, axis 2	3HAC083588-001	.
Timing belt, axis 2	3HAC061935-001	
Mechanical stop, axis 1	3HAC061947-001	Replace if damaged.

Continues on next page

Spare part	Article number	Note
Base bottom cover	3HAC060463-001	Standard configuration, used for robots with rear connector interface.
Base rear cover	3HAC070312-001	Used for robots with bottom connector interface.
Base adapter	3HAC070313-001	Used for robots with bottom connector interface.
Swing cover	3HAC069051-001	
Swing support cover	3HAC069052-001	
SMB cover	3HAC069060-001	
Cooling pad for axis-1 and -2 motors	3HAC071020-001	Cooling pads are wear parts. One cooling pad sheet contains 6 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.
brake release button assembly tool	-	Included in the special toolkit 3HAC071022-001. Used to remove and refit the brake release button.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)

Continues on next page

Deciding calibration routine

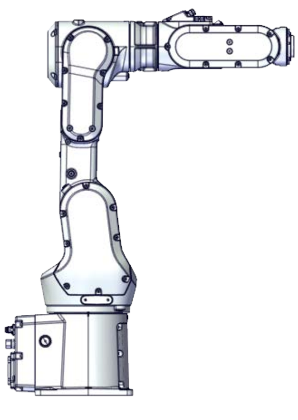
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the base

Use these procedures to remove the base.

Preparations before removing the base

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx1800003288

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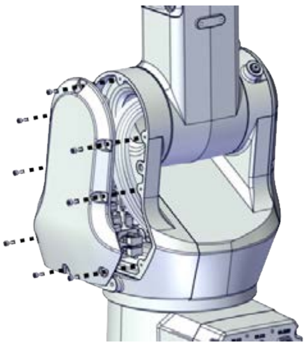
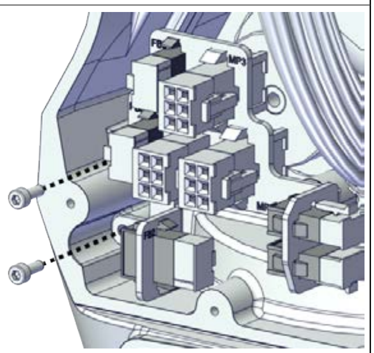
	Action	Note
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Remove the swing support cover.	 xx1800002488
4	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate.	 xx1800002489

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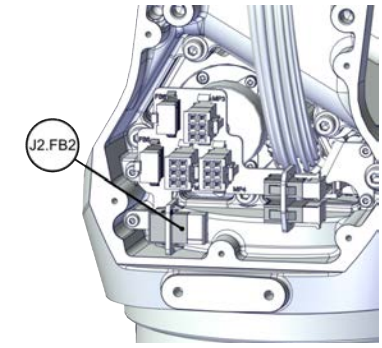
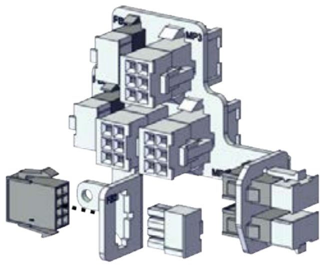
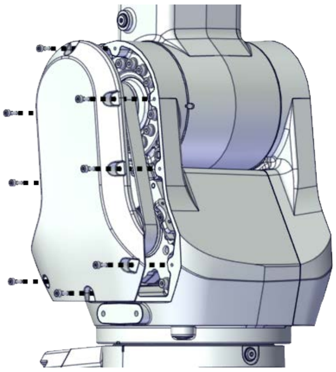
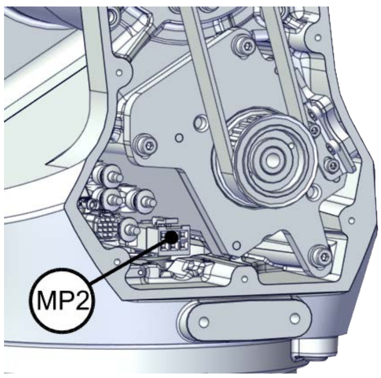
	Action	Note
5	Disconnect the connector. • J2.FB2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002490
6	Snap loose and remove the female head of the connector from the connector plate.	 xx1800002491
7	Remove the swing cover.	 xx1800002492
8	Disconnect the connector. • MP2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002495

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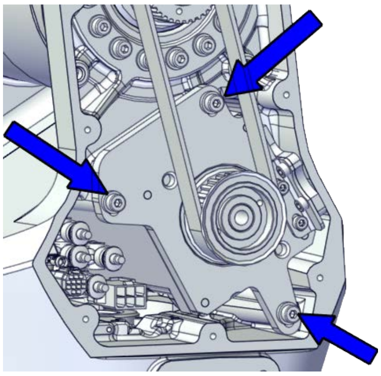
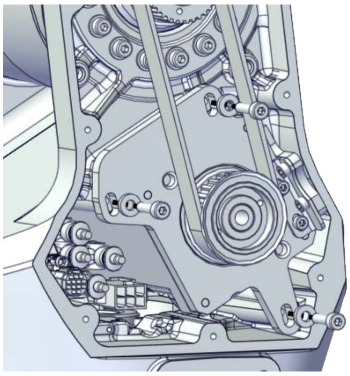
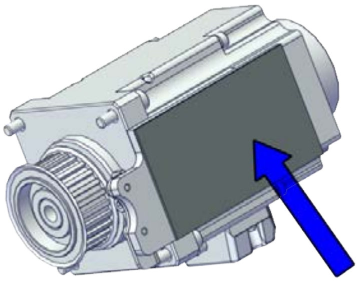
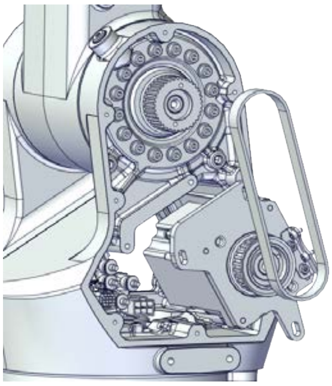
	Action	Note
9	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002493
10	Remove the screws and washers.	 xx1800002494
11	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad. **CAUTION** Be aware of the motor cabling. The motor cannot be removed completely until the connector is disconnected, as shown in following step.	Cooling pad location  xx1800003603
12	Remove the timing belt from its groove on the motor.	 xx1800002496

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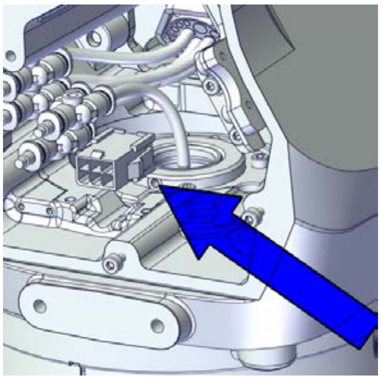
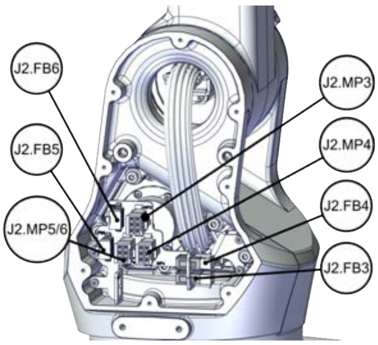
Loosening the cable package from axis-1 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Access the cable package locking screw on the axis-1 gearbox from the swing and then loosen the locking screw.	 xx1800003032
3	Remove the locking screw.	

Disconnecting the connectors at the division point

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • J2.FB3,4,5,6 • J2.MP3,4,5/6 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002497

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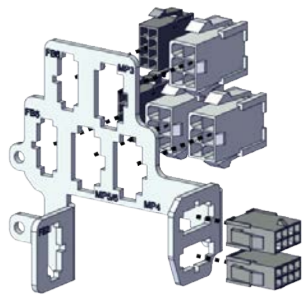
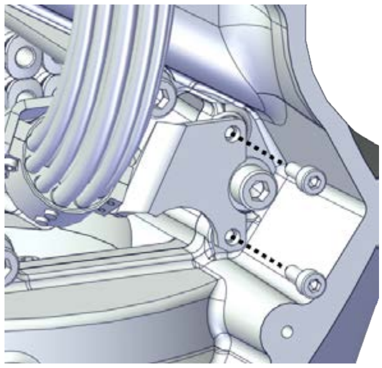
	Action	Note
3	Snap loose and remove the female head of the connectors from the connector plate.	 xx1800002498

Separating the cable package from the swing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable bracket.	 xx1800002499

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

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

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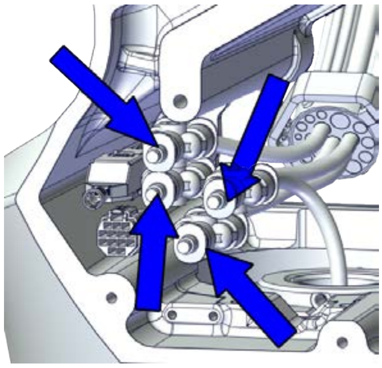
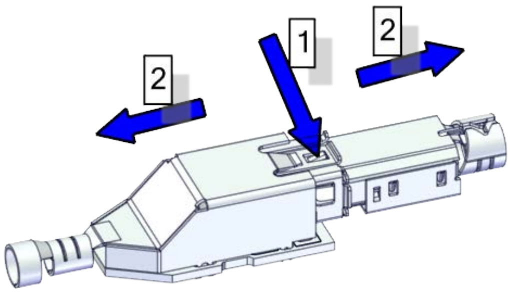
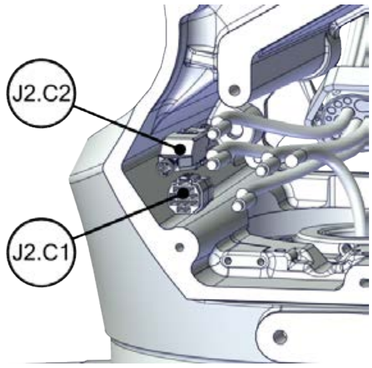
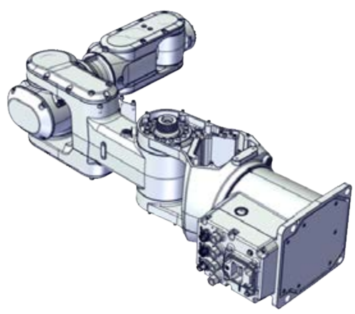
	Action	Note
2	Disconnect the air hoses from the Y-shaped connectors.	 xx1800002500
3	Disconnect the connectors. • J2.C1 • J2.C2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the J2.C2 (for Ethernet cabling).  xx1800002943	 xx1800002501

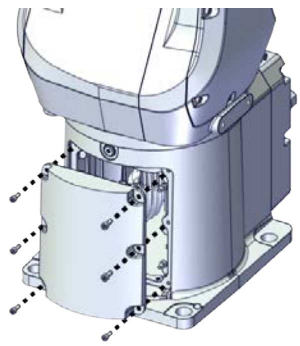
Putting the robot on its side

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

Continues on next page

	Action	Note
2	**CAUTION** The CRB 1100 robot weighs 21.1 kg and can be lifted by one person.	
3	**WARNING** The robot is likely to be mechanically unstable if not secured to the foundation.	
4	Loosen the robot from the foundation by removing the foundation attachment screws and put the robot on its side.	 xx1800003033

Disconnecting the SMB connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Remove the SMB cover attachment screws and carefully open the cover. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures. **CAUTION** There are cabling attached to the cover. The cover cannot be removed completely until the connectors are removed.	 xx1800002467

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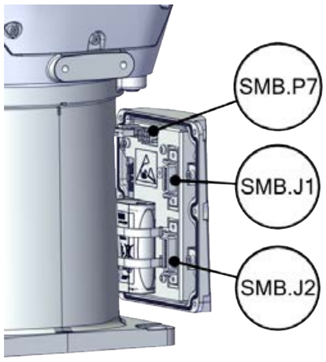
	Action	Note
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002468
5	Remove the SMB cover completely from the base.	

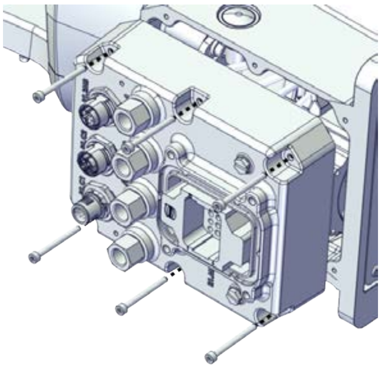
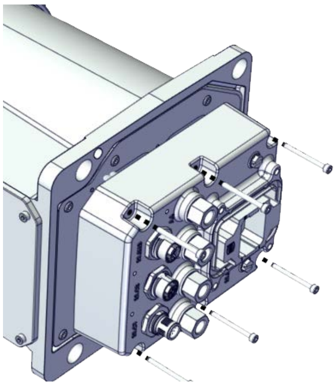
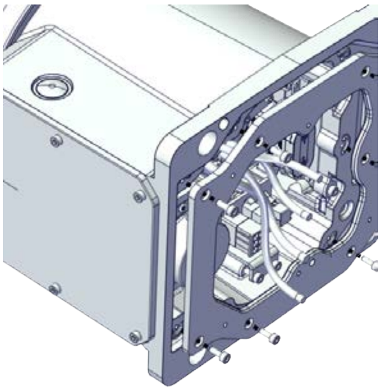
Opening the connector interface plate

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

Continues on next page

<table>
<tr><th></th><th>Action</th><th>Note</th></tr>
<tr><td>2</td><td>Remove the connector interface plate attachment screws and carefully open the plate.

 **CAUTION**

There are cabling attached to the cover. The cover cannot be removed completely until the connectors are removed.</td><td>**Valid for cabling with rear interface**

xx1800003034
Valid for cabling with bottom interface (option 3309-1)

xx1800003055</td></tr>
<tr><td>3</td><td>**Valid for cabling with bottom interface (option 3309-1)**
Remove the base adapter.</td><td>
xx1800003056</td></tr>
</table>

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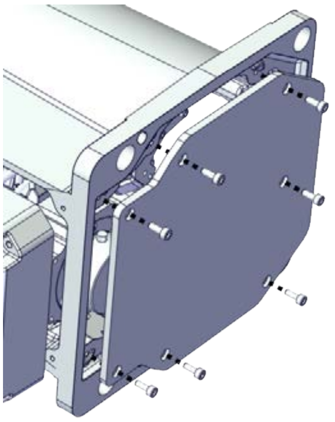
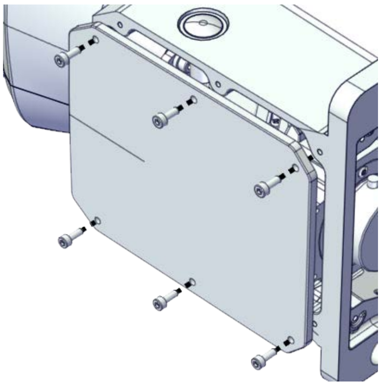
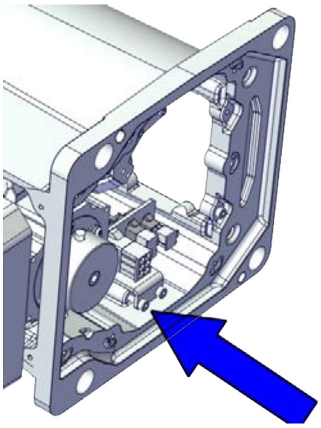
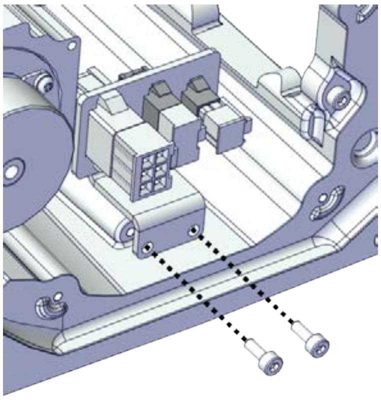
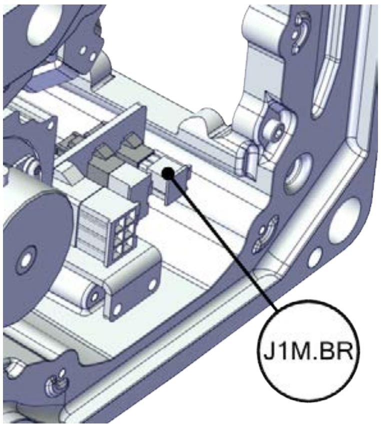
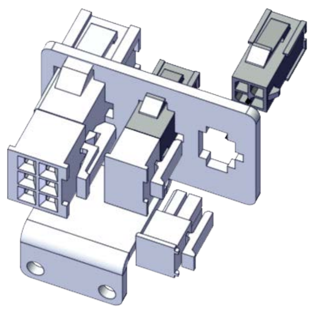
Removing the brake release button

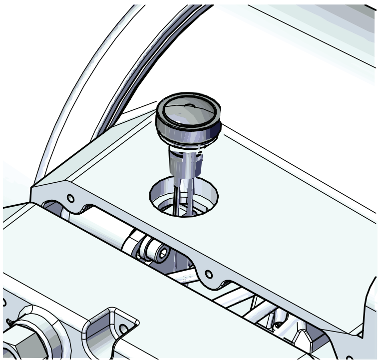
Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**Valid for cabling with rear interface** Remove the base bottom cover.	 xx1800003035
3	**Valid for cabling with bottom interface (option 3309-1)** Remove the base rear cover.	 xx1800003057
4	Disconnect the earth cable.	 xx1800003036

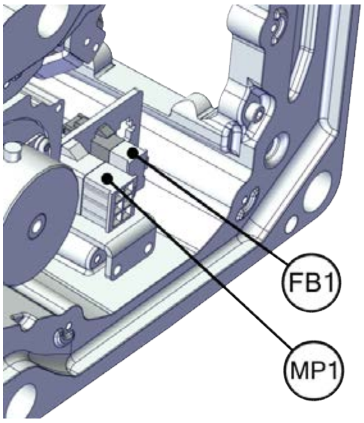
Continues on next page

	Action	Note
5	Remove the connector plate.	 xx1800003037
6	Disconnect the connector. • J1M.BR **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003038
7	Remove the female header of the J1M.BR connector from the connector plate.	 xx1800003039

Continues on next page

	Action	Note
8	Remove the brake release button from the base using the tool.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

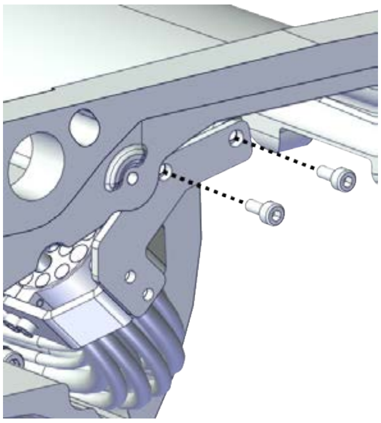
Disconnecting axis-1 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • FB1 • MP1 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003041

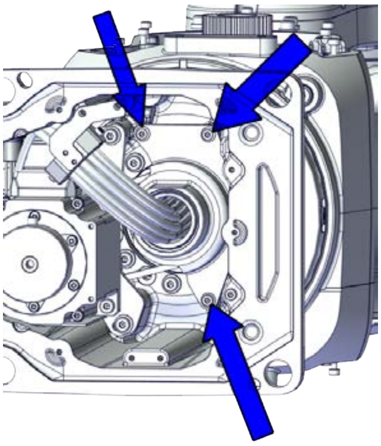
Separating the cable package from the base

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

Continues on next page

	Action	Note
2	Remove the cable bracket.	 xx1800003042

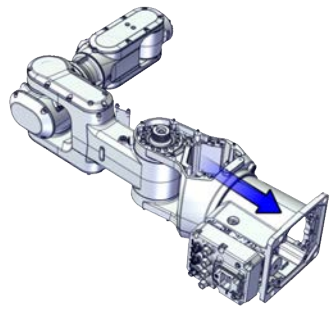
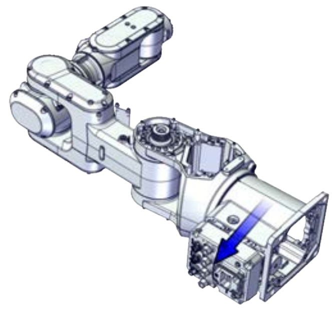
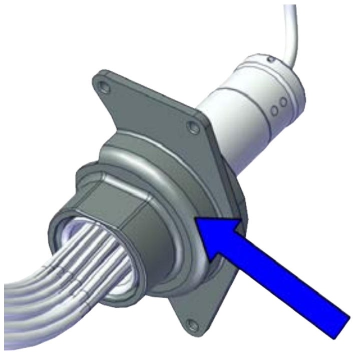
Separating the cable package from the axis-1 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the pulley cover.	 xx1800003043

Pulling out the cable package

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

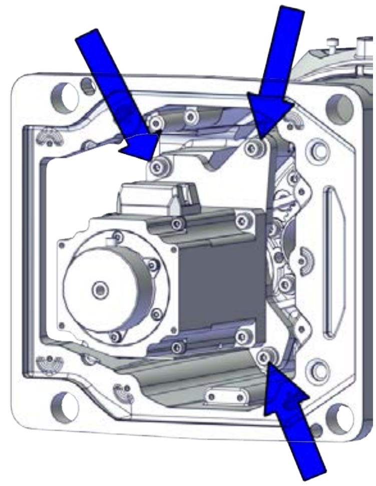
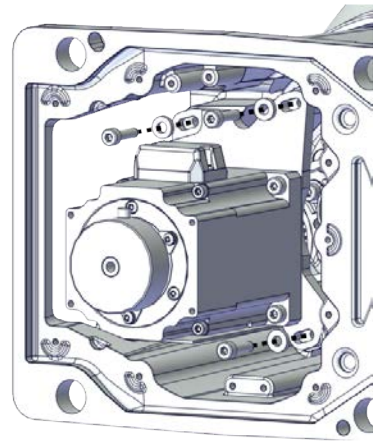
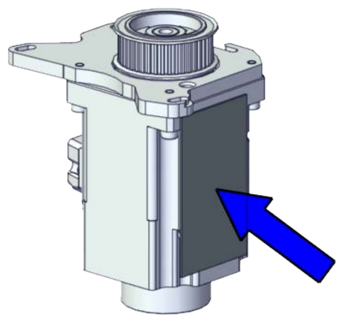
Continues on next page

	Action	Note
2	Pull out the lower cable package from the axis-1 gearbox.	 xx1800003044
3	Pull out the lower cable package from the base.	 xx1800003045
4	Remove the pulley cover from the lower cable package.	 xx1800003046

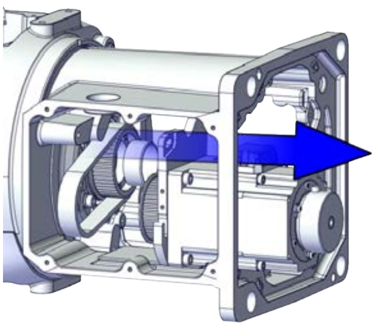
Removing the axis-1 motor

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

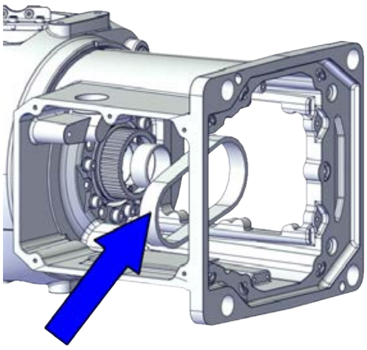
Continues on next page

	Action	Note
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003064
4	Remove the screws and washers.	 xx1800003065
5	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad.	Cooling pad location  xx1800003602

Continues on next page

	Action	Note
6	Remove the timing belt from its groove on the motor.	 xx1800003066

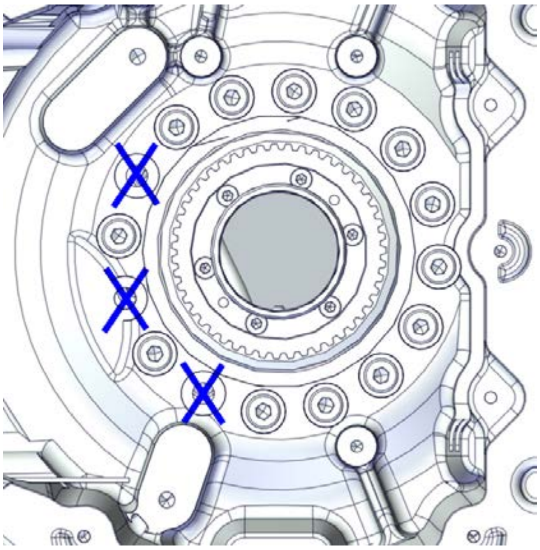
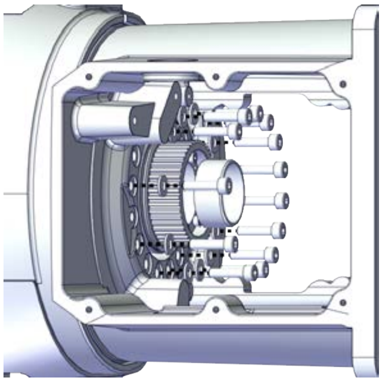
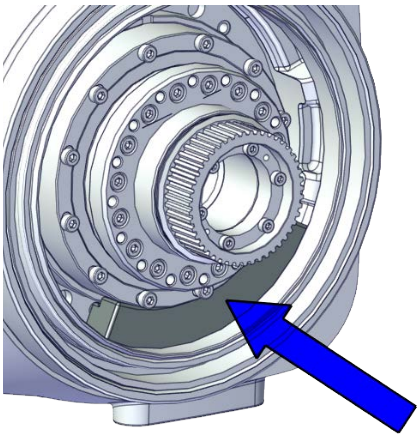
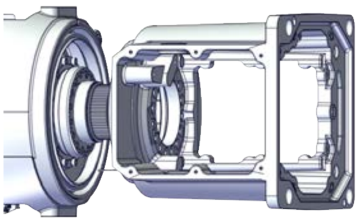
Removing the axis-1 timing belt

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Loosening timing belts will release axes. This means the axes can fall down. Make sure axes are well supported before loosening timing belts.	
3	Remove the timing belt from its groove on the gearbox.	 xx1800003067

Separating the base from the swing

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

Continues on next page

	Action	Note
2	Remove the screws and washers. **Tip** Three screw holes have no screws fitted in. Take photos of the screw and washer position before removing them, to have as a reference when refitting.  xx1800003068	 xx1800003069
3	Separate the base from the swing. **CAUTION** The axis-1 mechanical stop is accessible now. Put it aside for later refitting.  xx1800003071	 xx1800003070

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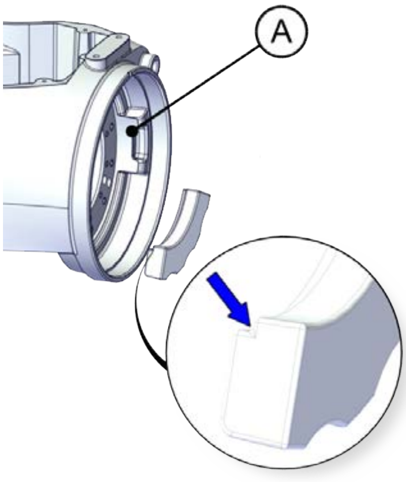
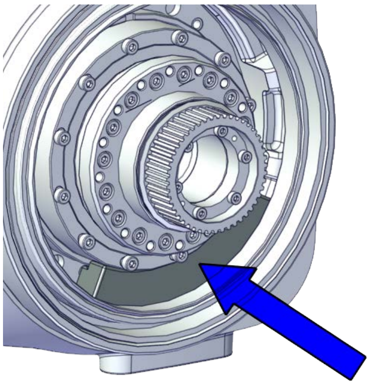
Refitting the base

Use these procedures to refit the base.

Placing the axis-1 mechanical stop

	Action	Note
1	Check the axis-1 mechanical stop. Replace if damaged.	Mechanical stop, axis 1: 3HAC061947-001
2	Put the axis-1 mechanical stop in place in the swing. **Note** The mechanical stop can be placed in any place except the block (A) on the swing. Make sure the mechanical stop step pointed in the figure is facing the swing when putting.  xx1800003619	 xx1800003071

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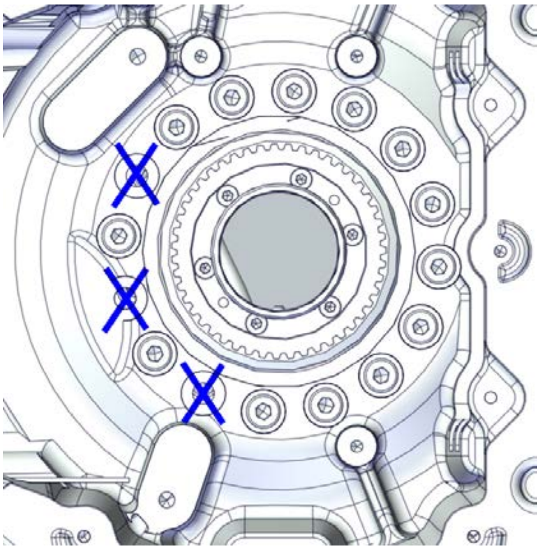
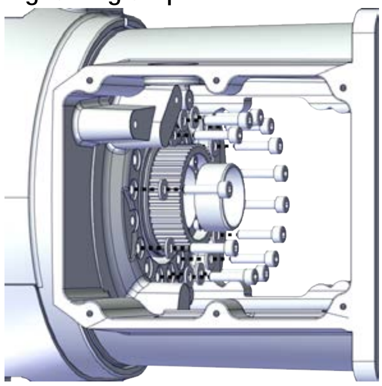
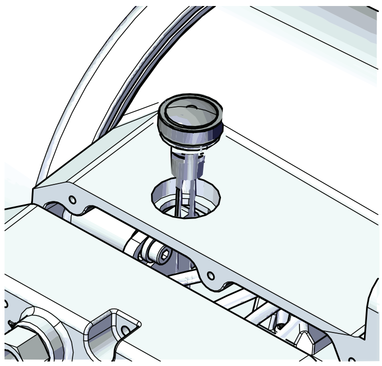
Refitting the base to the swing

	Action	Note
1	Refit the base to the swing. **Note** Pay attention to the screw and washer location.  xx1800003068	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (13 pcs) Tightening torque: 4.4 Nm  xx1800003069

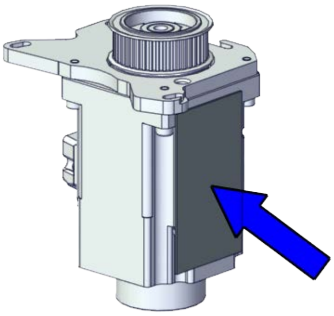
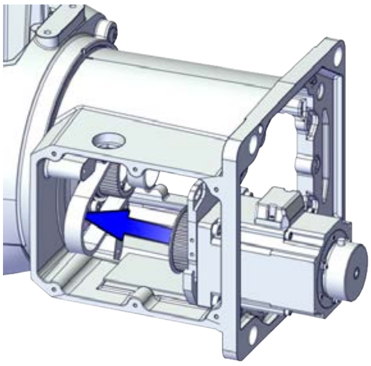
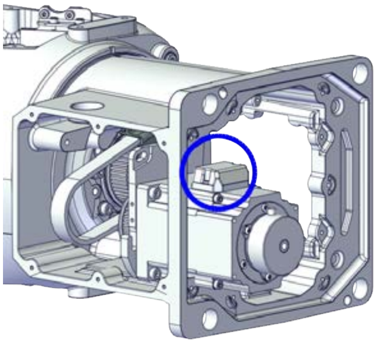
Refitting the brake release button

	Action	Note
1	Refit the brake release button. **Note** Do not reconnect the connector yet. Do not tighten the button yet.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

Refitting the axis-1 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	

Continues on next page

	Action	Note
2	Check the cooling pad. Replace if damaged.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001  xx1800003602
3	Install the timing belt to the motor pulley and verify that the belt runs correctly in the groove of the pulley.	 xx1800003085
4	Orient the motor correctly and fit it into the base. At the same time, install the timing belt to the gearbox pulley and verify that the belt runs correctly in the groove of the pulley.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003072

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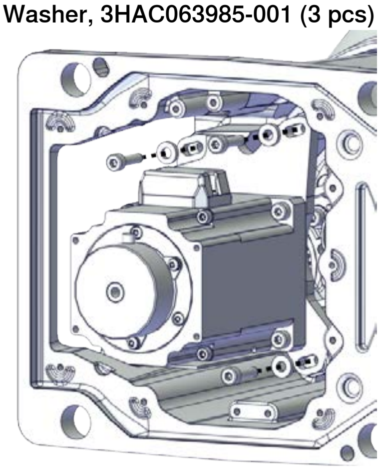
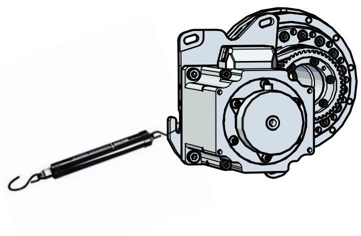
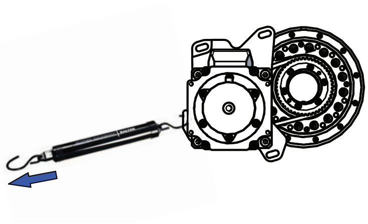
	Action	Note
5	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800003065

Adjusting the axis-1 timing belt tension

	Action	Note
1	Use a handheld dynamometer hooking to the motor.	 xx1900000040
2	Pull the dynamometer to make the tension falling in the allowed force range. **Note** During the measurement, make sure that all interferences that may affect the force are removed. Pay attention to the force application direction.	Used belt: 58.24-63.56 N New belt:83.2-90.8 N (for reference only)  xx1900000041
3	Secure the motor with the screws.	Tightening torque: 3 Nm

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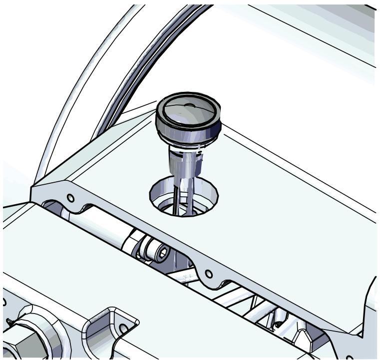
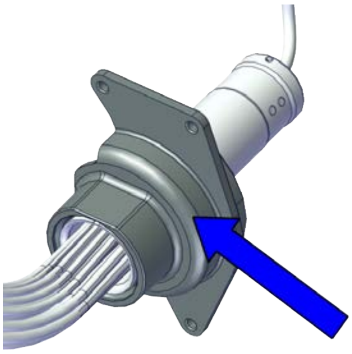
Securing the brake release button

	Action	Note
1	Tighten the brake release button using the tool.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

Refitting the lower cable package through the axis-1 gearbox

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	Refit the pulley cover to the lower cable package.	 xx1800003046

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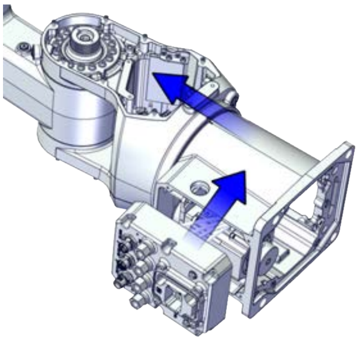
<table>
<tr><th></th><th>Action</th><th>Note</th></tr>
<tr><td>2</td><td>Valid for cabling with rear interface
Insert the cable package in the base and up through the axis-1 gearbox, through the rear.

Tip

Wrap the connectors with the masking tape.

CAUTION

Make sure that no cables or hoses are twisted or strained. Reroute if necessary.</td><td>
xx1800003047

Cable protection tube orientation: use the encircled notch on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole on the gearbox.

xx1800003048</td></tr>
</table>

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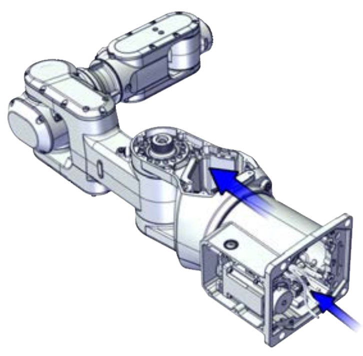
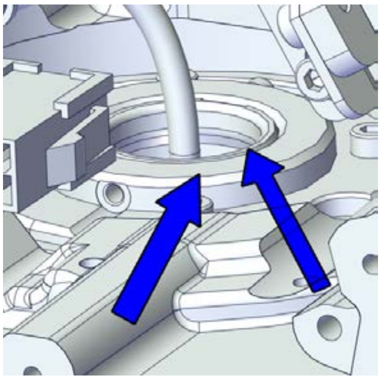
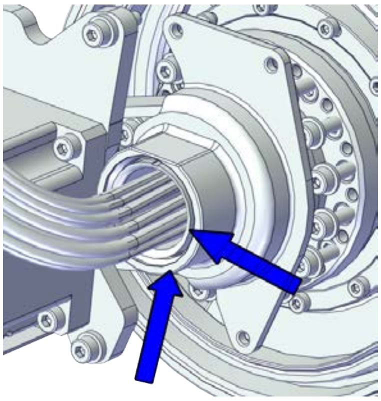
	Action	Note
3	**Valid for cabling with bottom interface (option 3309-1)** Insert the cable package in the base and up through the axis-1 gearbox, through the bottom. **Tip** Wrap the connectors with the masking tape. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	 xx1800003060 Cable protection tube orientation: use the encircled notch on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole on the gearbox.  xx1800003048

Continues on next page

Securing the lower cable package to the axis-1 gearbox

	Action	Note
1	Make sure that: • The hole on the cable protection tube is aligned with the locking screw hole on the gearbox. • The cable protection tube surface is completely parallel with the pulley cover at one side and with the flange at the other side.	 xx1800003063  xx1800003049  xx1800003050

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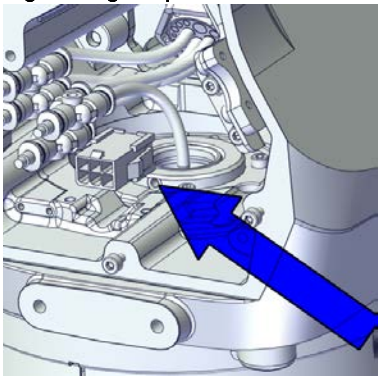
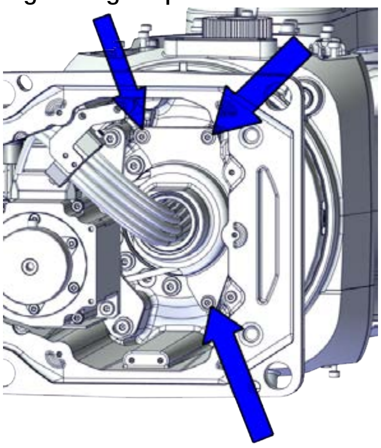
	Action	Note
2	Apply a little Loctite 243 to the locking screw and refit the locking screw. **Note** Make sure the locking screw header is parallel with flange surface. **Note** If there is locking liquid residues on the screw or screw hole, please clean it before refitting. Remove residual locking liquid after refitting.	Screw: M3x8 (1 pcs) Tightening torque: 0.4 Nm  xx1800003032

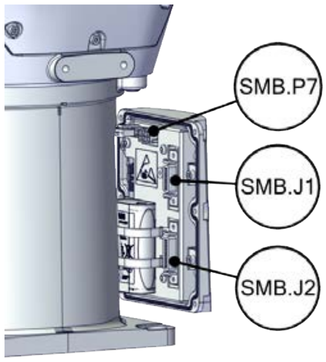
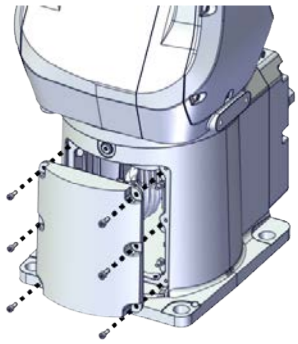
Refitting the pulley cover

	Action	Note
1	Refit the puller cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.2 Nm  xx1800003043

Reconnecting the SMB connectors

	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 48*.	

Continues on next page

	Action	Note
2	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	Tightening torque: 0.3 Nm  xx1800002468
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the SMB cover to the base.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm  xx1800002467

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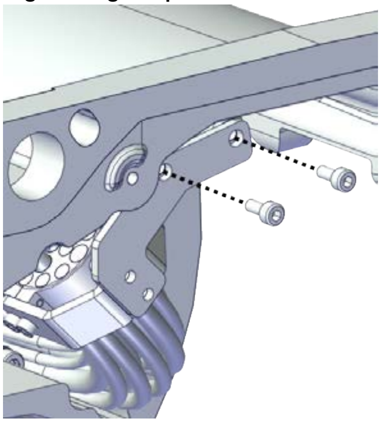
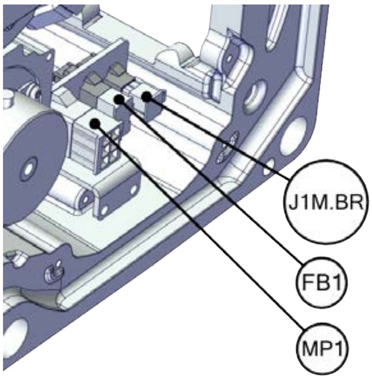
Securing the lower cable package to the base

	Action	Note
1	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003042

Reconnecting the brake release cabling and axis-1 motor connectors

	Action	Note
1	Reconnect the connectors. • J1M.BR • MP1 • FB1  **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003054

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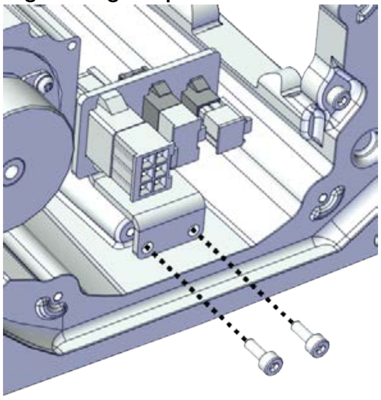
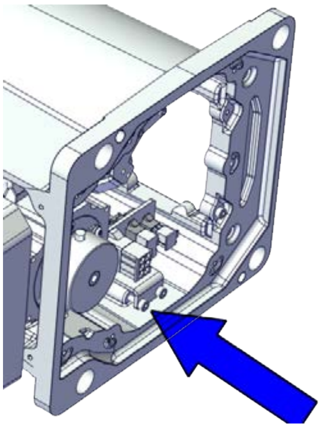
	Action	Note
2	Reconnect the floor cable together with the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800003037  xx1800003036

Refitting the base cover

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

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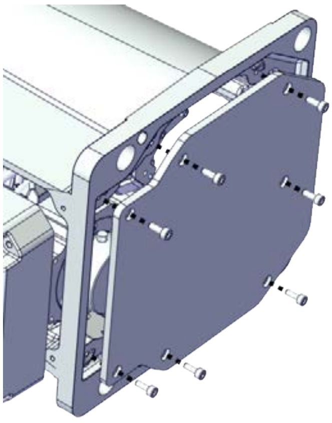
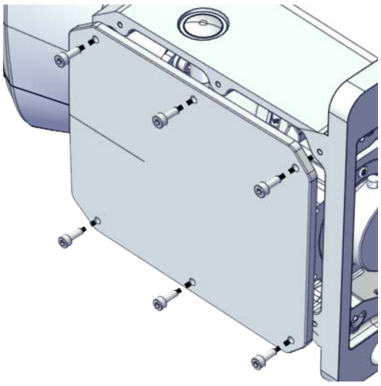
	Action	Note
4	**Valid for cabling with rear interface** Refit the bottom cover.	Screw: M3x8 Steel 8.8-A2F (7 pcs) Tightening torque: 1.2 Nm  xx1800003035
5	Refit the rear cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm  xx1800003057

Refitting the connector interface plate

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

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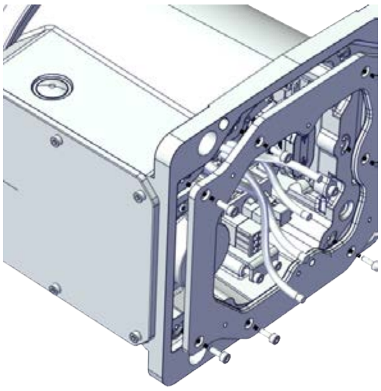
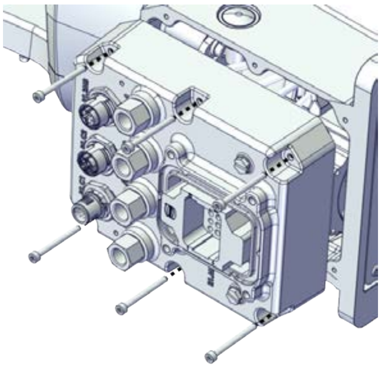
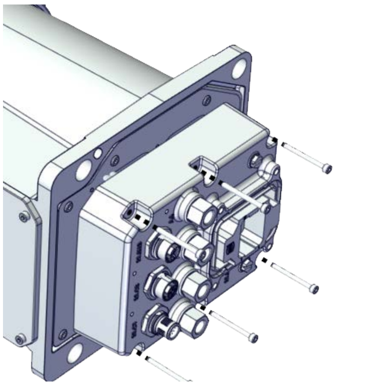
	Action	Note
2	**Valid for cabling with bottom interface (option 3309-1)** Refit the base adapter.	Screw: M3x8 Steel 8.8-A2F (7 pcs) Tightening torque: 1.2 Nm  xx1800003056
3	Refit the connector interface plate to the base.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm **Valid for cabling with rear interface**  xx1800003034 **Valid for cabling with bottom interface (option 3309-1)**  xx1800003055

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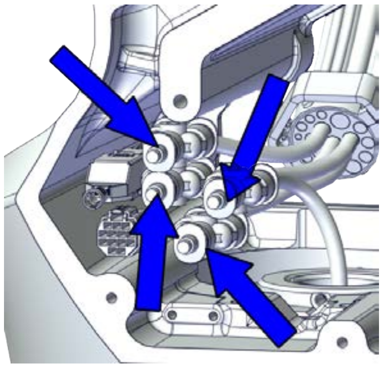
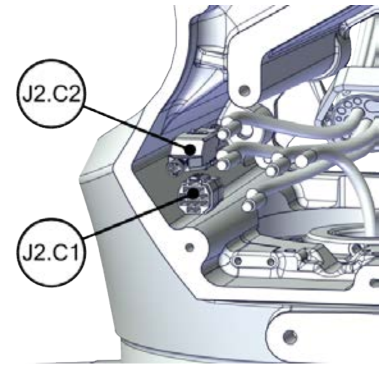
Securing the robot to the foundation

	Action	Note
1	**CAUTION** The CRB 1100 robot weighs 21.1 kg and can be lifted by one person.	
2	Raise the robot to standing and secure to the foundation with the attachment screws and washers.	Attachment screws: M12x25 (robot installation directly on foundation), quality: 8.8. Washers: 4 pcs, 24 x 13 x 2.5. Tightening Torque: 50 Nm±5 Nm.

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

	Action	Note
1	Reconnect the air hoses in a cross pattern to the Y-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	 xx1800002500
2	Reconnect the connectors. • J2.C1 • J2.C2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002501

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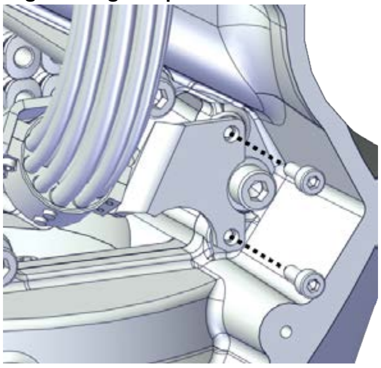
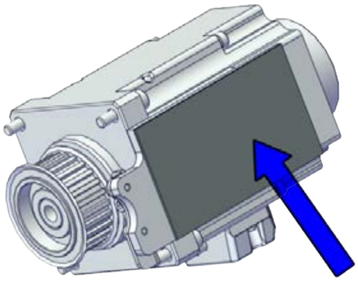
Securing the cable package to the swing

	Action	Note
1	Refit the cable bracket.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002499

Refitting the axis-2 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged, as shown in the following step.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001  xx1800003603

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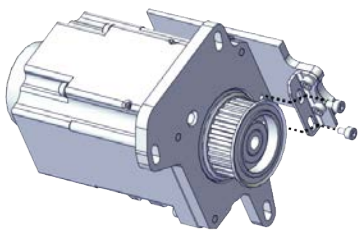
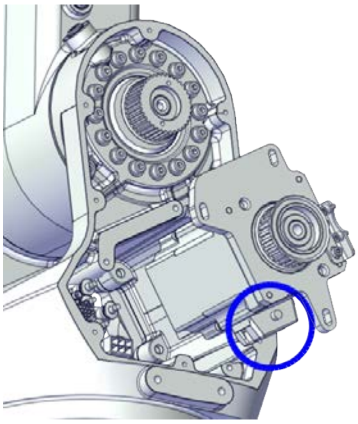
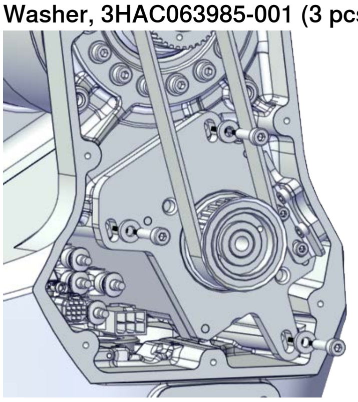
	Action	Note
3	Remove the screws. Replace with a new cooling pad and then refit the screws.	Screw: M3x5 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 1.2 Nm  xx1800003026
4	Orient the motor correctly and fit it into the swing. **Tip** Bend the motor signal cable back towards the swing support.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003027
5	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800002494

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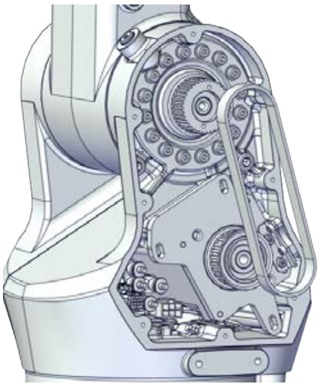
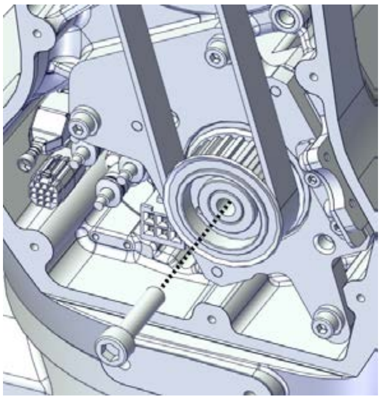
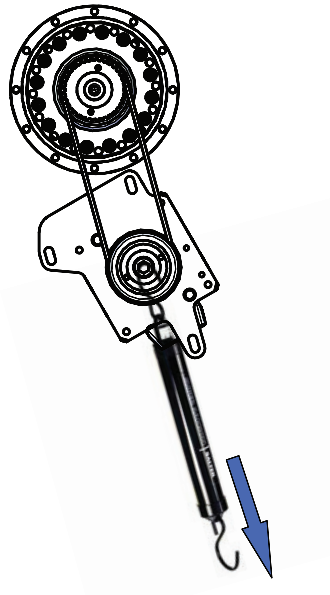
	Action	Note
6	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003028
7	Install an M6x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000010
8	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 68.18-75.04 N (for reference only) Initial referenced force for new belt: 97.4-107.2 N  xx1900000029

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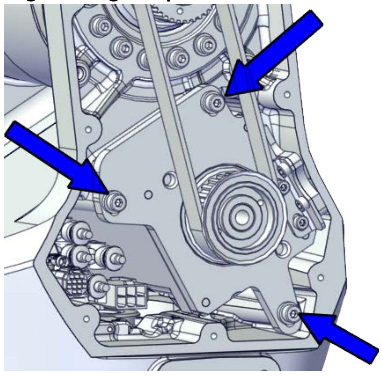
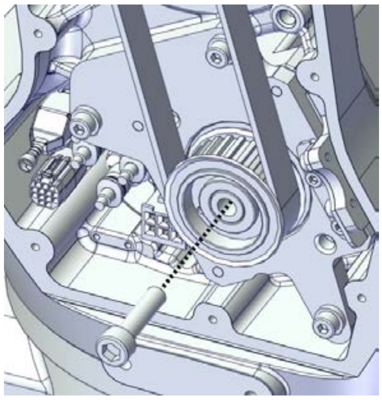
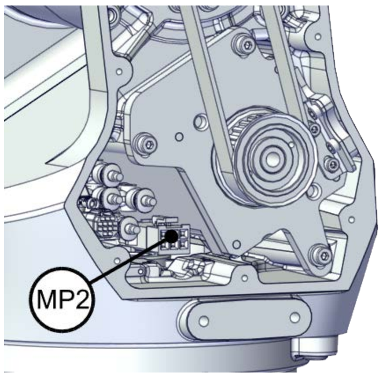
	Action	Note
9	Secure the motor with the screws.	Tightening torque: 3.5 Nm  xx1800002493
10	Use a sonic tension meter to measure the timing belt tension.	Used belt: 163-174 Hz New belt:180-229 Hz (for reference only)
11	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	
12	Remove the adjustment screw from the motor.	 xx1900000010
13	Reconnect the connector. • MP2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002495

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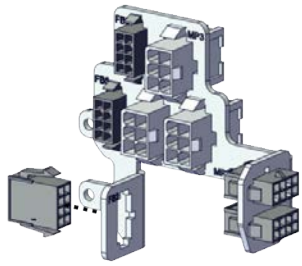
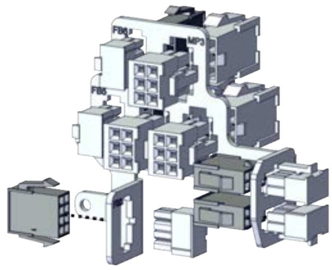
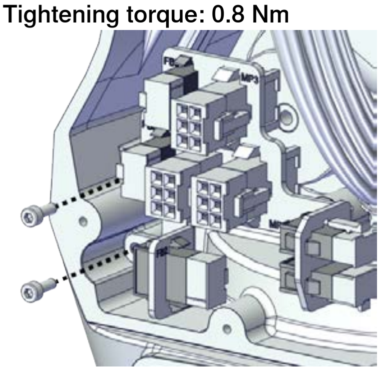
Reconnecting the connectors at the division point

	Action	Note
1	Insert the female header of the connectors to the connector plate.	 xx1800003029
2	Reconnect the connectors. • J2.FB2,3,4,5,6 • J2.MP3,4,5/6 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003030
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002489

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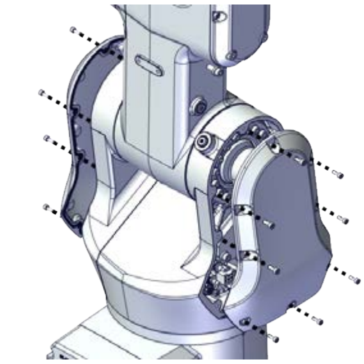
Refitting the swing covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	
3	Refit the covers. • Swing cover • Swing support cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003607

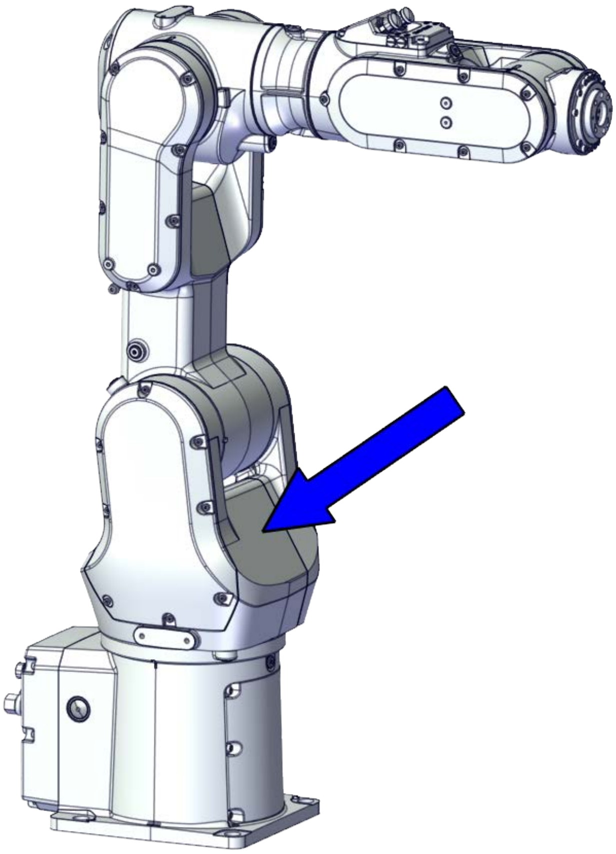
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

5.4.2 Replacing the swing

Location of the swing

The swing is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 1100 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Lower cable harness (CP/CS and air hose, with Ethernet)	3HAC075523-001	
Swing	3HAC069050-001	
Swing support	3HAC069039-001	
Base	3HAC069048-001	
Gear unit with pulley, axis 1	3HAC069062-001	
Motor with flange, axis 1	3HAC083589-001	

Continues on next page

Spare part	Article number	Note
Timing belt, axis 1	3HAC061934-001	
Motor with flange, axis 2	3HAC083588-001	.
Timing belt, axis 2	3HAC061935-001	
Mechanical stop, axis 1	3HAC061947-001	Replace if damaged.
Base bottom cover	3HAC060463-001	Standard configuration, used for robots with rear connector interface.
Base rear cover	3HAC070312-001	Used for robots with bottom connector interface.
Base adapter	3HAC070313-001	Used for robots with bottom connector interface.
Swing cover	3HAC069051-001	
Swing support cover	3HAC069052-001	
Cooling pad for axis-1 and -2 motors	3HAC071020-001	Cooling pads are wear parts. One cooling pad sheet contains 6 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.
brake release button assembly tool	-	Included in the special toolkit 3HAC071022-001. Used to remove and refit the brake release button.

Required consumables

Consumable	Article number	Note
Cable straps	-	

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Consumable	Article number	Note
Grease	3HAC029132-001	FM 222
Grease	-	Castrol Molub. Alloy 777-1 NG Used to lubricate bearings on the swing support and lower arm support.
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)
Sealing compound	3HAC026759-002	Sikaflex 521 FC

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the swing

Use these procedures to remove the swing.

Preparations before removing the swing

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

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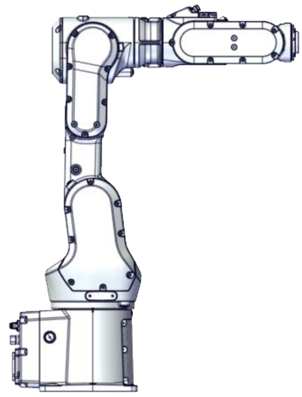
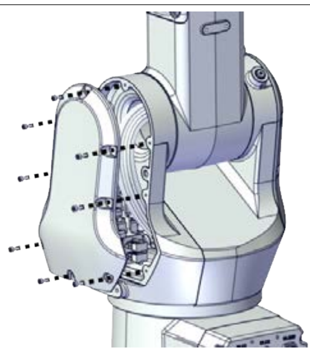
	Action	Note
2	Jog all axes to zero position.	 xx1800003288
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Remove the swing support cover.	 xx1800002488

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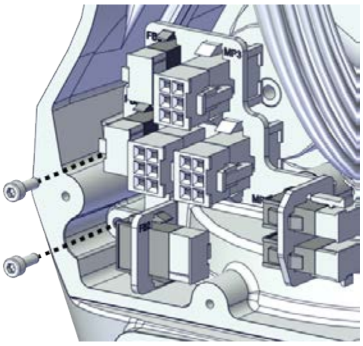
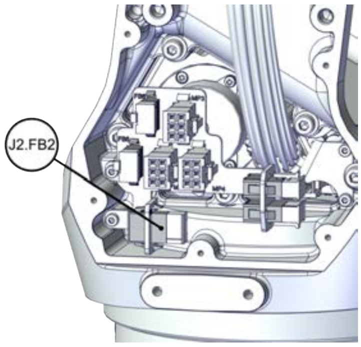
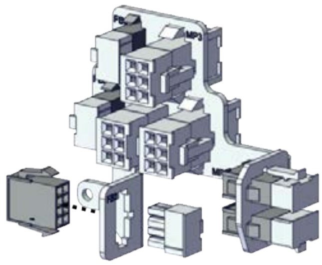
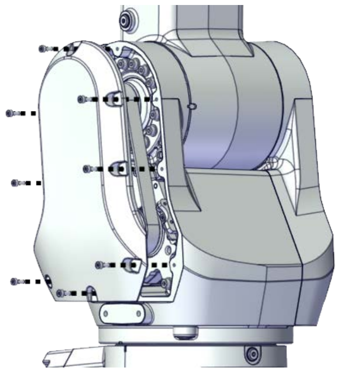
	Action	Note
4	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate.	 xx1800002489
5	Disconnect the connector. • J2.FB2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002490
6	Snap loose and remove the female head of the connector from the connector plate.	 xx1800002491
7	Remove the swing cover.	 xx1800002492

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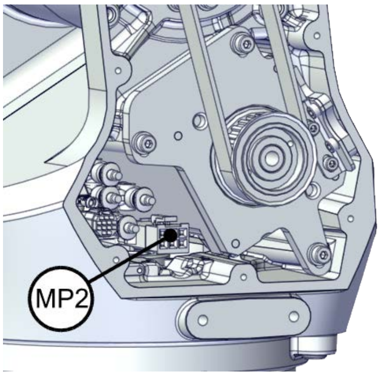
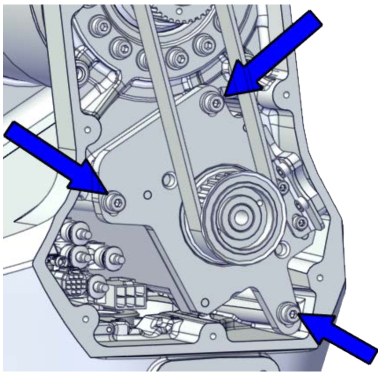
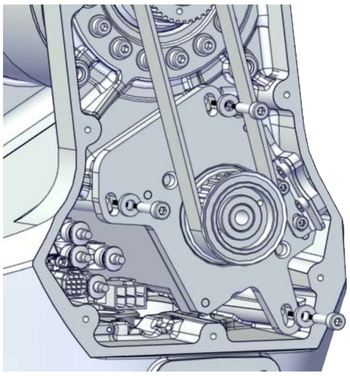
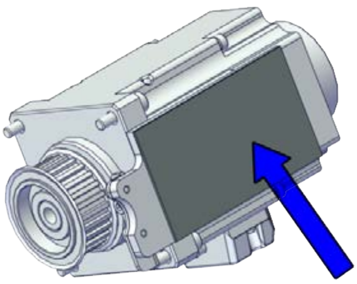
	Action	Note
8	Disconnect the connector. • MP2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002495
9	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002493
10	Remove the screws and washers.	 xx1800002494
11	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad. **CAUTION** Be aware of the motor cabling. The motor cannot be removed completely until the connector is disconnected, as shown in following step.	Cooling pad location  xx1800003603

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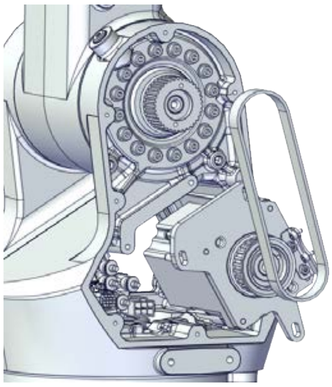
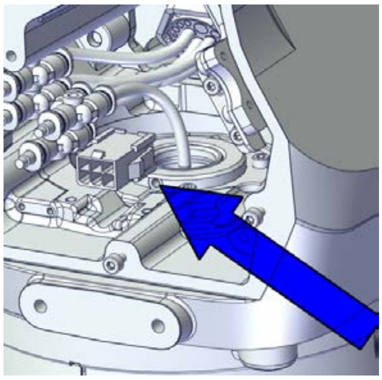
	Action	Note
12	Remove the timing belt from its groove on the motor.	 xx1800002496

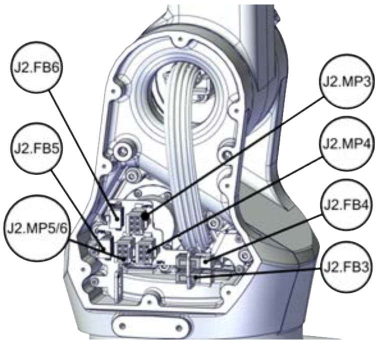
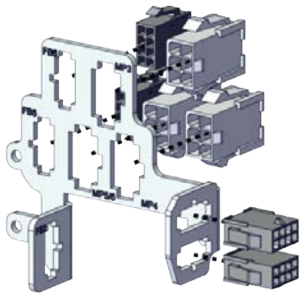
Loosening the cable package from axis-1 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Access the cable package locking screw on the axis-1 gearbox from the swing and then loosen the locking screw.	 xx1800003032
3	Remove the locking screw.	

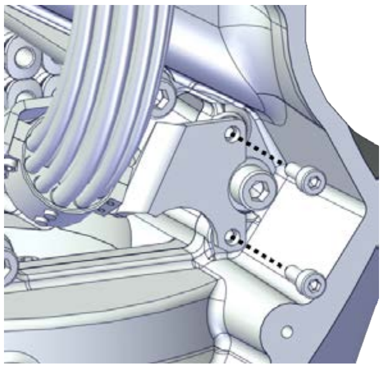
Disconnecting the connectors at the division point

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

Continues on next page

	Action	Note
2	Disconnect the connectors. • J2.FB3,4,5,6 • J2.MP3,4,5/6 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002497
3	Snap loose and remove the female head of the connectors from the connector plate.	 xx1800002498

Separating the cable package from the swing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable bracket.	 xx1800002499

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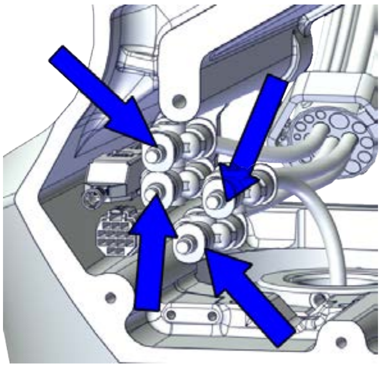
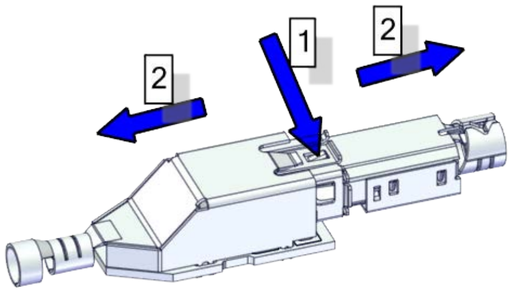
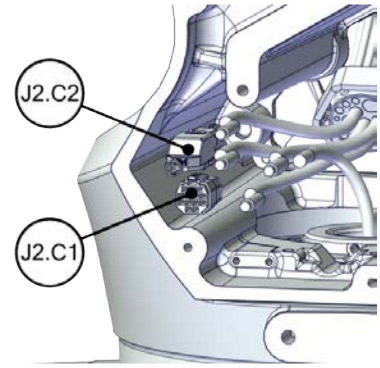
Disconnecting the air hoses, CP/CS cabling and Ethernet cabling (if equipped)

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the air hoses from the Y-shaped connectors.	 xx1800002500
3	Disconnect the connectors. • J2.C1 • J2.C2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the J2.C2 (for Ethernet cabling).  xx1800002943	 xx1800002501

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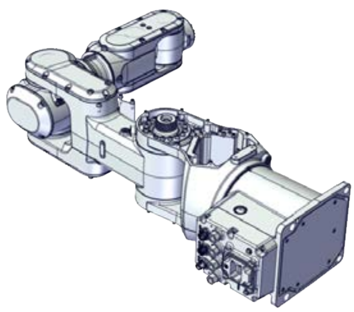
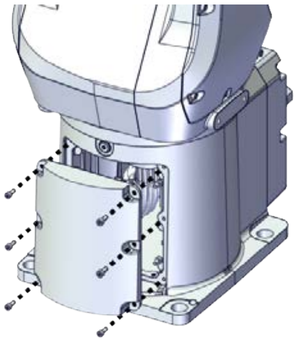
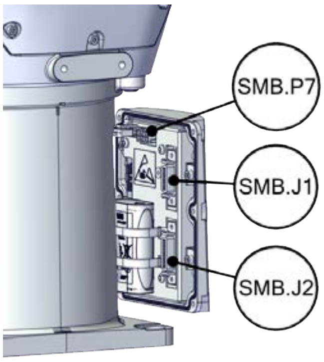
Putting the robot on its side

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** The CRB 1100 robot weighs 21.1 kg and can be lifted by one person.	
3	**WARNING** The robot is likely to be mechanically unstable if not secured to the foundation.	
4	Loosen the robot from the foundation by removing the foundation attachment screws and put the robot on its side.	 xx1800003033

Disconnecting the SMB connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	

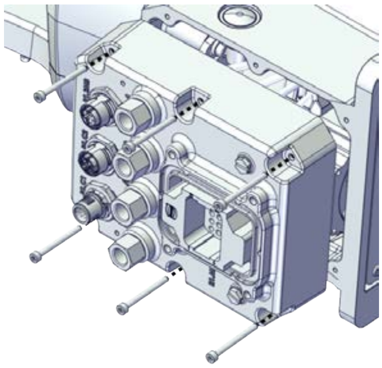
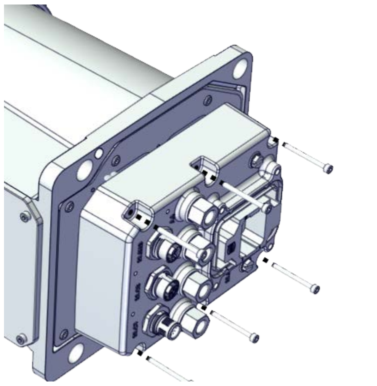
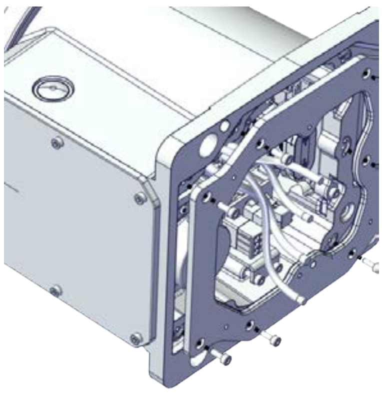
Continues on next page

	Action	Note
3	Remove the SMB cover attachment screws and carefully open the cover. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures. **CAUTION** There are cabling attached to the cover. The cover cannot be removed completely until the connectors are removed.	 xx1800002467
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002468
5	Remove the SMB cover completely from the base.	

Opening the connector interface plate

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

Continues on next page

	Action	Note
2	Remove the connector interface plate attachment screws and carefully open the plate. **CAUTION** There are cabling attached to the cover. The cover cannot be removed completely until the connectors are removed.	**Valid for cabling with rear interface**  xx1800003034 **Valid for cabling with bottom interface (option 3309-1)**  xx1800003055
3	**Valid for cabling with bottom interface (option 3309-1)** Remove the base adapter.	 xx1800003056

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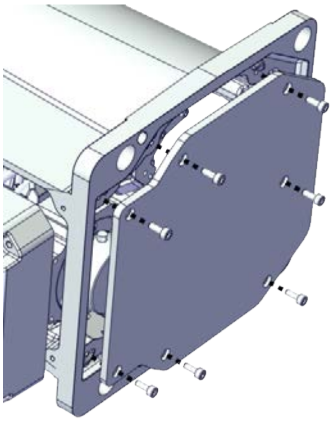
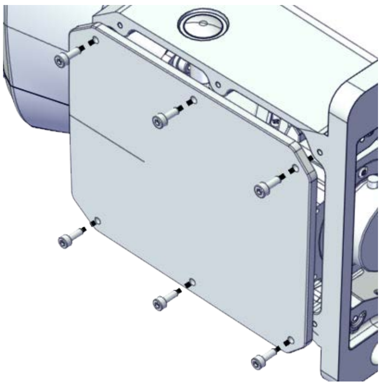
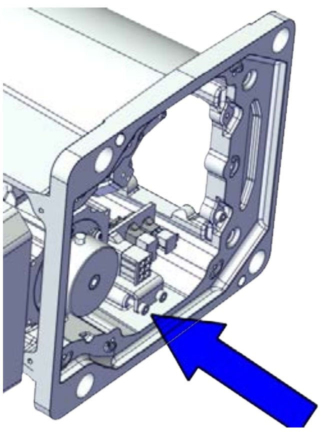
Removing the brake release button

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**Valid for cabling with rear interface** Remove the base bottom cover.	 xx1800003035
3	**Valid for cabling with bottom interface (option 3309-1)** Remove the base rear cover.	 xx1800003057
4	Disconnect the earth cable.	 xx1800003036

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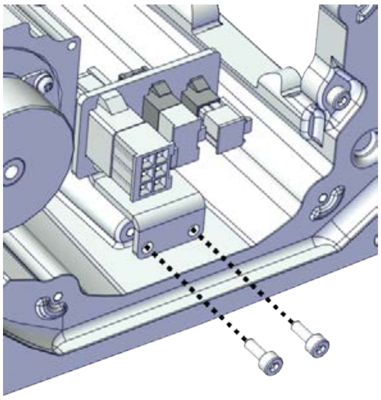
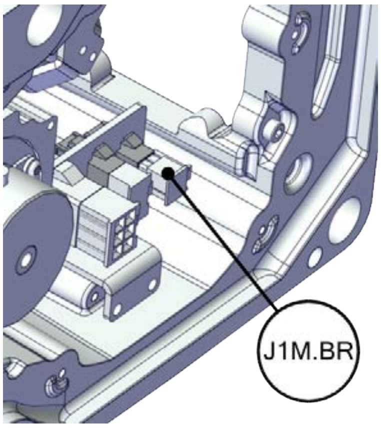
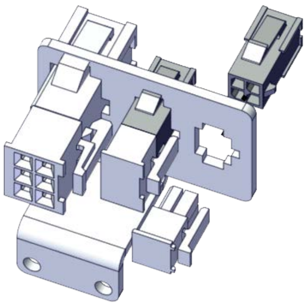
	Action	Note
5	Remove the connector plate.	 xx1800003037
6	Disconnect the connector. • J1M.BR **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003038
7	Remove the female header of the J1M.BR connector from the connector plate.	 xx1800003039

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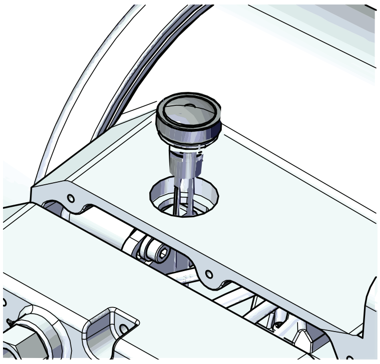
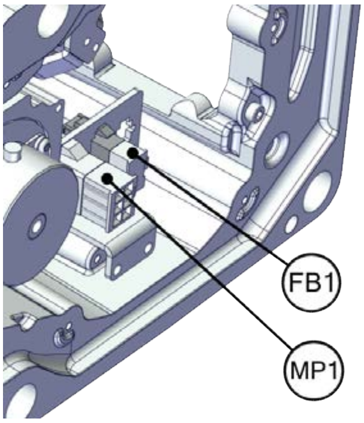
	Action	Note
8	Remove the brake release button from the base using the tool.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

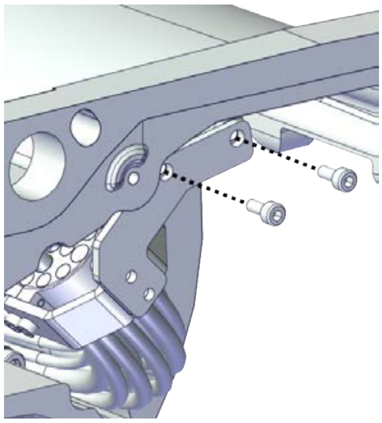
Disconnecting axis-1 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • FB1 • MP1 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003041

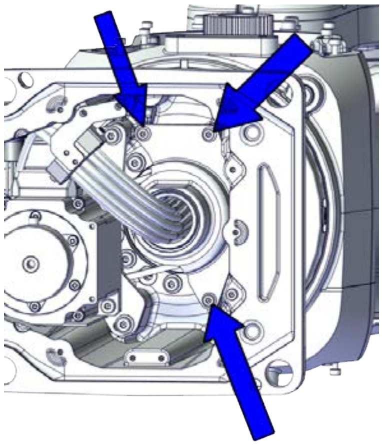
Separating the cable package from the base

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

Continues on next page

	Action	Note
2	Remove the cable bracket.	 xx1800003042

Separating the cable package from the axis-1 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the pulley cover.	 xx1800003043

Pulling out the cable package

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

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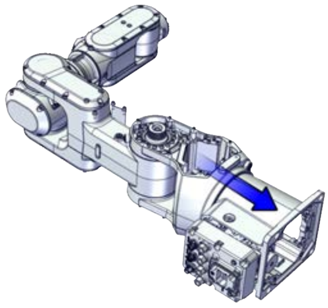
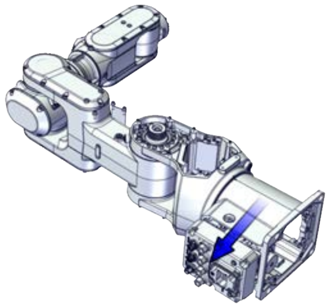
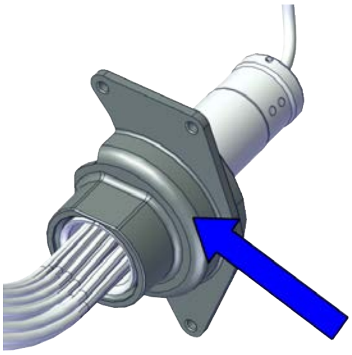
	Action	Note
2	Pull out the lower cable package from the axis-1 gearbox.	 xx1800003044
3	Pull out the lower cable package from the base.	 xx1800003045
4	Remove the pulley cover from the lower cable package.	 xx1800003046

Removing the axis-1 motor

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

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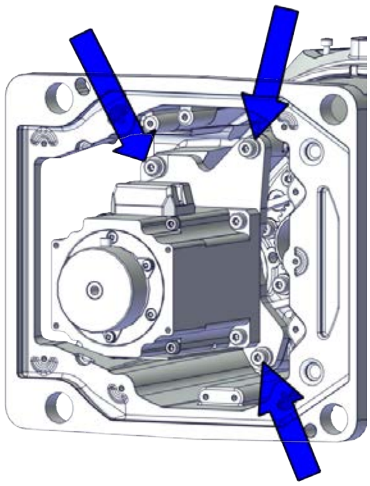
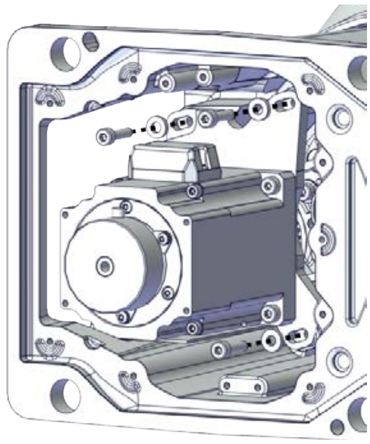
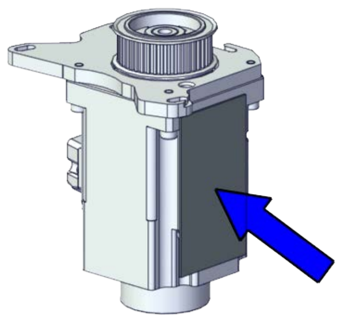
	Action	Note
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003064
4	Remove the screws and washers.	 xx1800003065
5	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad.	Cooling pad location  xx1800003602

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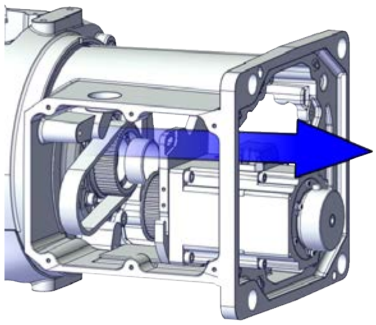
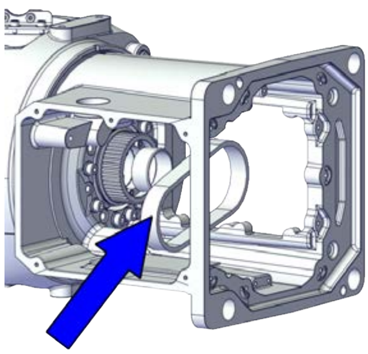
	Action	Note
6	Remove the timing belt from its groove on the motor.	 xx1800003066

Removing the axis-1 timing belt

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Loosening timing belts will release axes. This means the axes can fall down. Make sure axes are well supported before loosening timing belts.	
3	Remove the timing belt from its groove on the gearbox.	 xx1800003067

Separating the base from the swing

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

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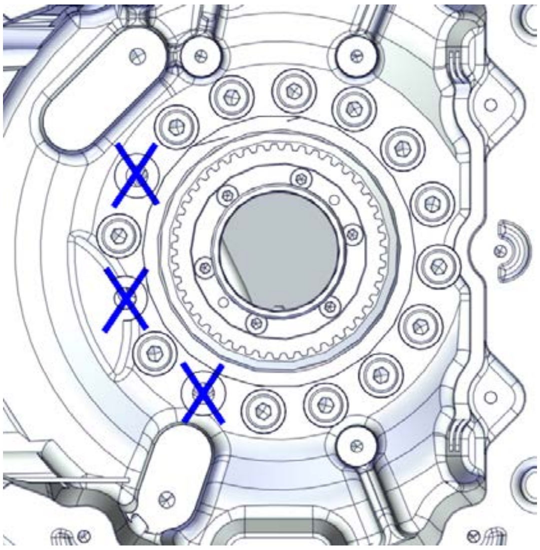
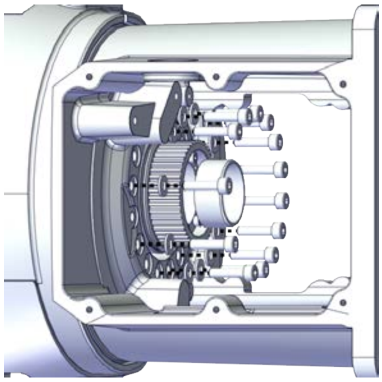
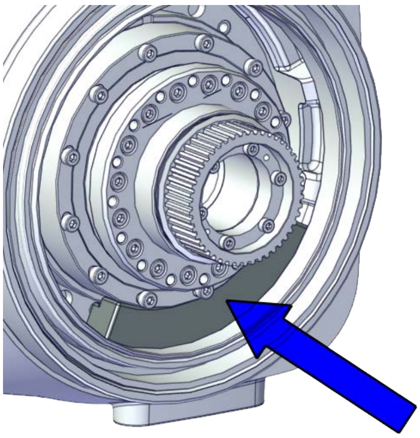
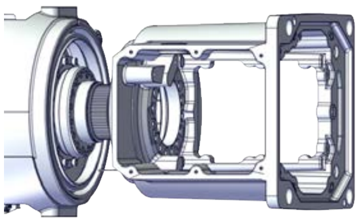
	Action	Note
2	Remove the screws and washers. **Tip** Three screw holes have no screws fitted in. Take photos of the screw and washer position before removing them, to have as a reference when refitting.  xx1800003068	 xx1800003069
3	Separate the base from the swing. **CAUTION** The axis-1 mechanical stop is accessible now. Put it aside for later refitting.  xx1800003071	 xx1800003070

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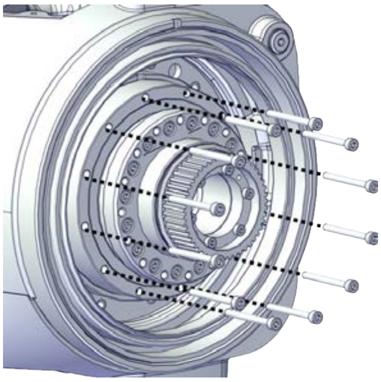
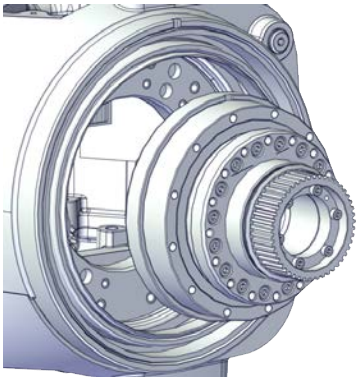
Removing the axis-1 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing gearboxes will release axes. This means the axes can fall down. Make sure axes are well supported before removing gearboxes.	
3	Remove the screws.	 xx1800003073
4	Pull out the gearbox.	 xx1800003074

Separating the swing from the lower arm

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

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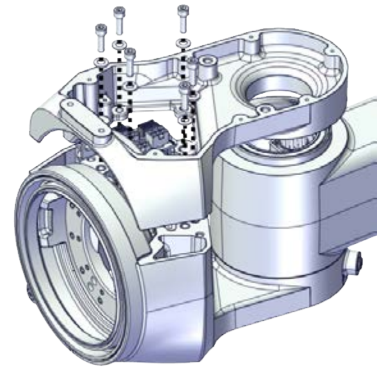
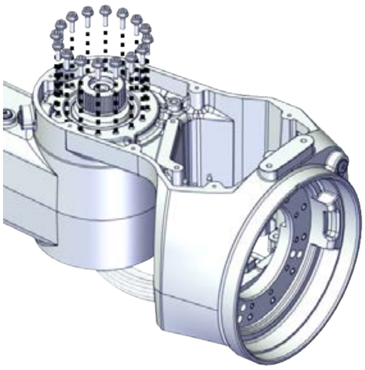
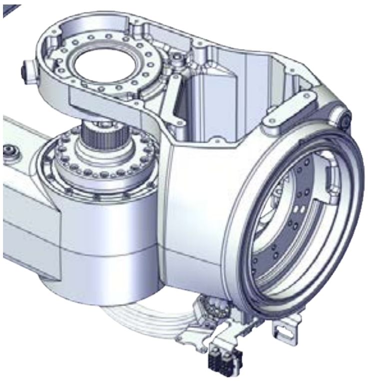
	Action	Note
2	Remove the swing support. **Tip** If the swing support is hard to loosen from the lower arm, use a plastic hammer to knock on the swing support lightly.	 xx1800003076
3	Route the upper cable package out of the swing support.	
4	Remove the screws. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	 xx1900002192
5	Separate the swing from the lower arm.	 xx1800003078

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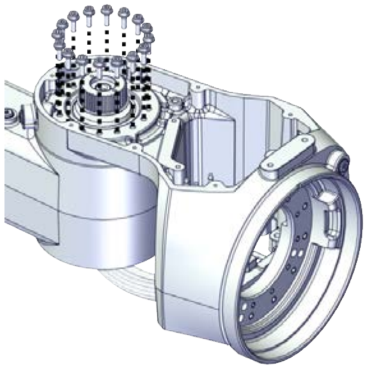
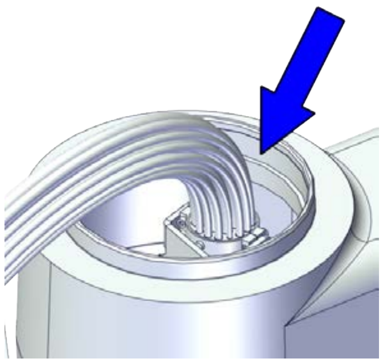
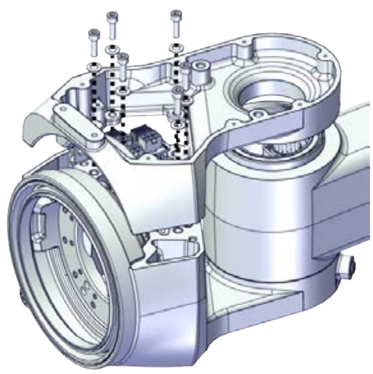
Refitting the swing

Use these procedures to refit the swing.

Refitting the swing to the lower arm

	Action	Note
1	Refit the swing to the lower arm. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	Flange screws (16 pcs) Tightening torque: 4.2 Nm  xx1900002192
2	Route the cable package through the swing support.	
3	Apply grease Castrol Molub-Alloy 777-1 NG to the inner surface of the lower arm, where contacts the bearing on the swing support.	 xx2000000058
4	Refit the swing support. **Tip** If the swing support is hard to closely fit to the lower arm, use a plastic hammer to knock on the swing support lightly.	Screw: M5x16 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 6 Nm  xx1800003076

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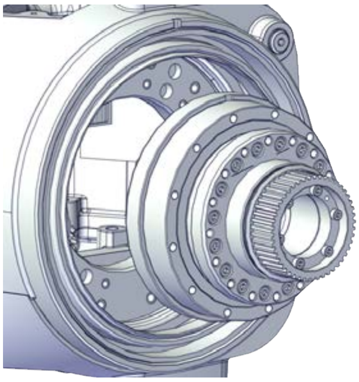
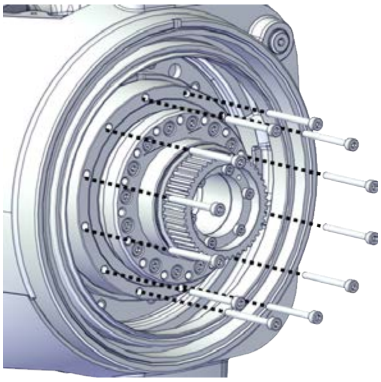
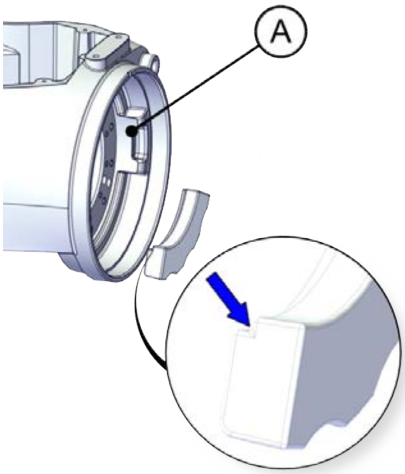
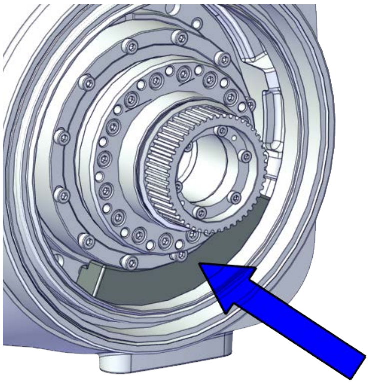
Refitting the axis-1 gearbox

	Action	Note
1	Refit the axis-1 gearbox. Make sure the locking screw hole on the gearbox is aligned with the notch on the swing casting.	 xx1800003074
2	Secure with screws.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (12 pcs) Tightening torque: 1.6 Nm  xx1800003073

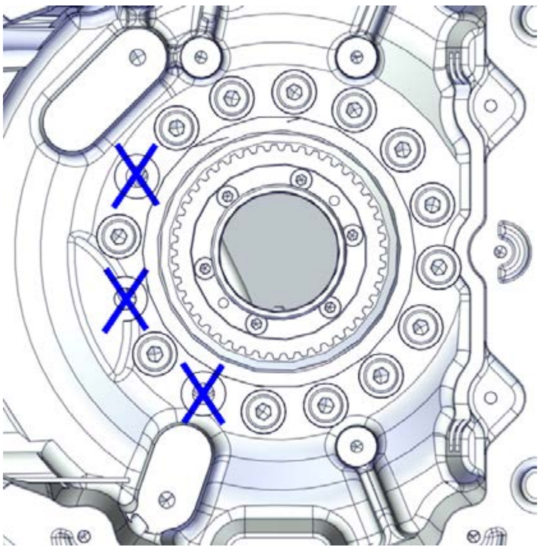
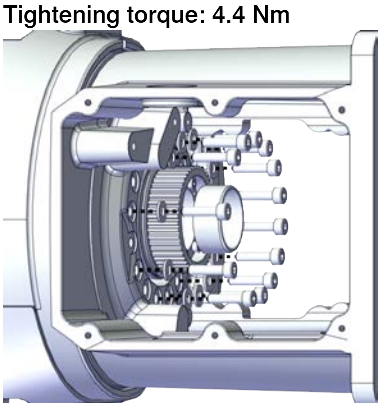
Placing the axis-1 mechanical stop

	Action	Note
1	Check the axis-1 mechanical stop. Replace if damaged.	Mechanical stop, axis 1: 3HAC061947-001

Continues on next page

	Action	Note
2	Put the axis-1 mechanical stop in place in the swing. **Note** The mechanical stop can be placed in any place except the block (A) on the swing. Make sure the mechanical stop step pointed in the figure is facing the swing when putting.  xx1800003619	 xx1800003071

Refitting the base to the swing

	Action	Note
1	Refit the base to the swing. **Note** Pay attention to the screw and washer location.  xx1800003068	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (13 pcs) Tightening torque: 4.4 Nm  xx1800003069

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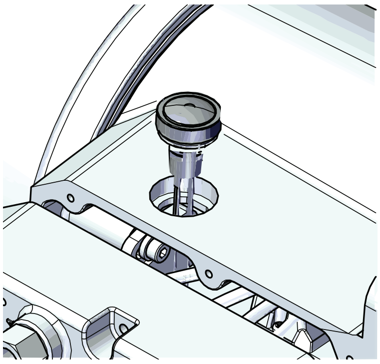
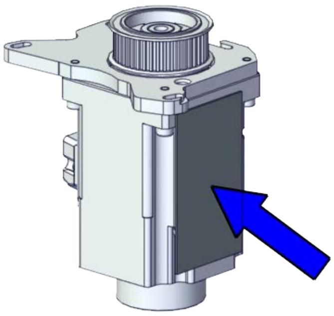
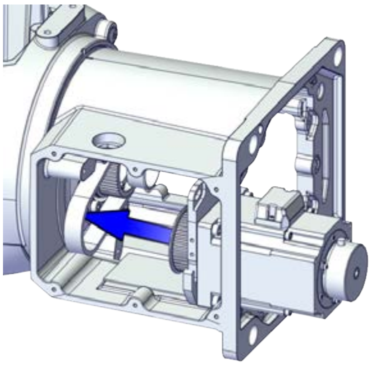
Refitting the brake release button

	Action	Note
1	Refit the brake release button. **Note** Do not reconnect the connector yet. Do not tighten the button yet.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

Refitting the axis-1 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001  xx1800003602
3	Install the timing belt to the motor pulley and verify that the belt runs correctly in the groove of the pulley.	 xx1800003085

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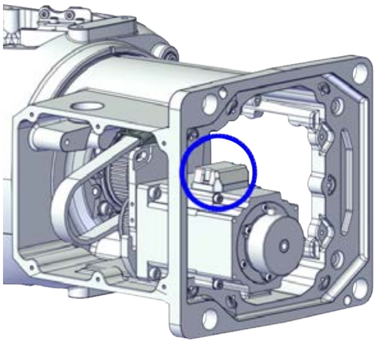
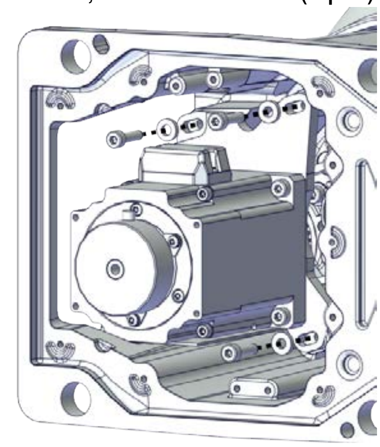
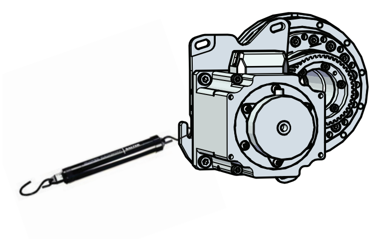
	Action	Note
4	Orient the motor correctly and fit it into the base. At the same time, install the timing belt to the gearbox pulley and verify that the belt runs correctly in the groove of the pulley.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003072
5	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800003065

Adjusting the axis-1 timing belt tension

	Action	Note
1	Use a handheld dynamometer hooking to the motor.	 xx1900000040

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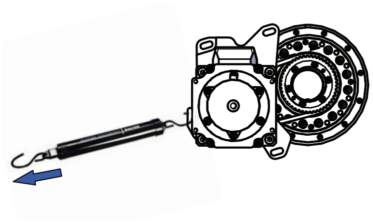
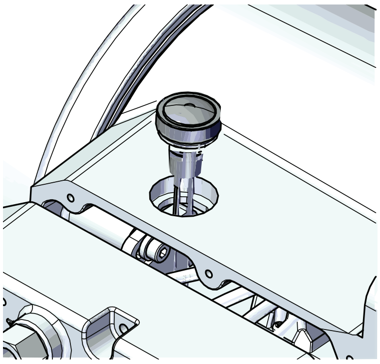
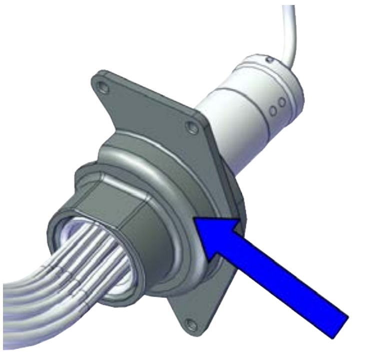
	Action	Note
2	Pull the dynamometer to make the tension falling in the allowed force range. **Note** During the measurement, make sure that all interferences that may affect the force are removed. Pay attention to the force application direction.	Used belt: 58.24-63.56 N New belt:83.2-90.8 N (for reference only)  xx1900000041
3	Secure the motor with the screws.	Tightening torque: 3 Nm

Securing the brake release button

	Action	Note
1	Tighten the brake release button using the tool.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

Refitting the lower cable package through the axis-1 gearbox

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	Refit the pulley cover to the lower cable package.	 xx1800003046

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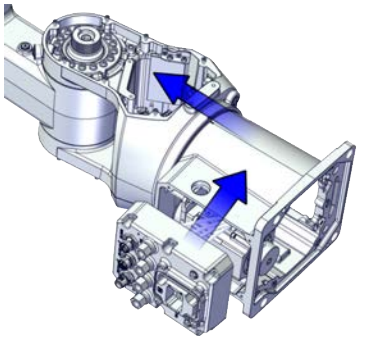
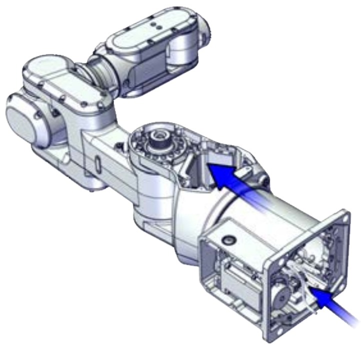
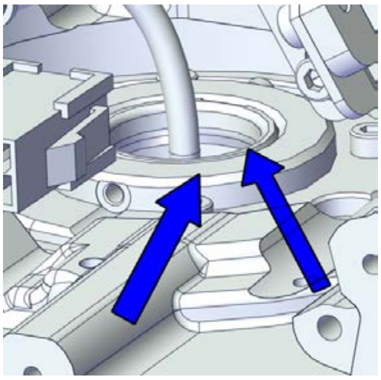
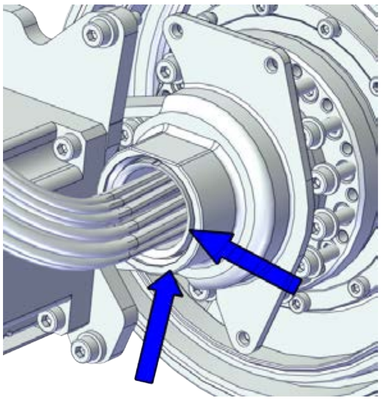
	Action	Note
2	**Valid for cabling with rear interface** Insert the cable package in the base and up through the axis-1 gearbox, through the rear. **Tip** Wrap the connectors with the masking tape. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	 xx1800003047 Cable protection tube orientation: use the encircled notch on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole on the gearbox.  xx1800003048

Continues on next page

	Action	Note
3	**Valid for cabling with bottom interface (option 3309-1)** Insert the cable package in the base and up through the axis-1 gearbox, through the bottom. **Tip** Wrap the connectors with the masking tape. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	 xx1800003060 Cable protection tube orientation: use the encircled notch on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole on the gearbox.  xx1800003048

Continues on next page

Securing the lower cable package to the axis-1 gearbox

	Action	Note
1	Make sure that: • The hole on the cable protection tube is aligned with the locking screw hole on the gearbox. • The cable protection tube surface is completely parallel with the pulley cover at one side and with the flange at the other side.	 xx1800003063  xx1800003049  xx1800003050

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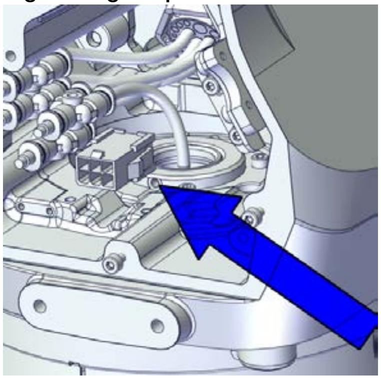
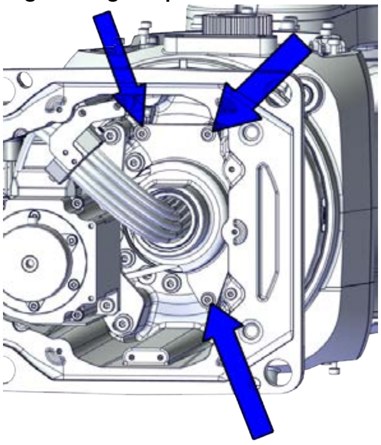
	Action	Note
2	Apply a little Loctite 243 to the locking screw and refit the locking screw. **Note** Make sure the locking screw header is parallel with flange surface. **Note** If there is locking liquid residues on the screw or screw hole, please clean it before refitting. Remove residual locking liquid after refitting.	Screw: M3x8 (1 pcs) Tightening torque: 0.4 Nm  xx1800003032

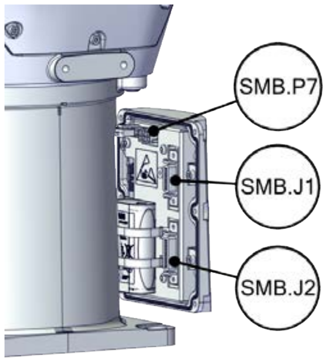
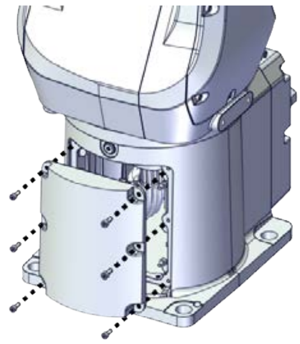
Refitting the pulley cover

	Action	Note
1	Refit the puller cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.2 Nm  xx1800003043

Reconnecting the SMB connectors

	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 48*.	

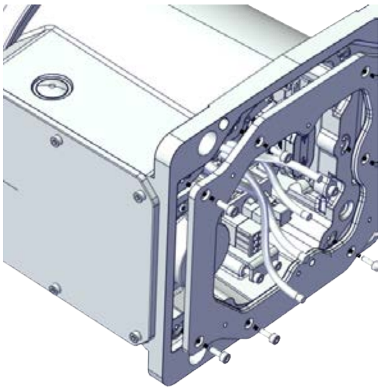
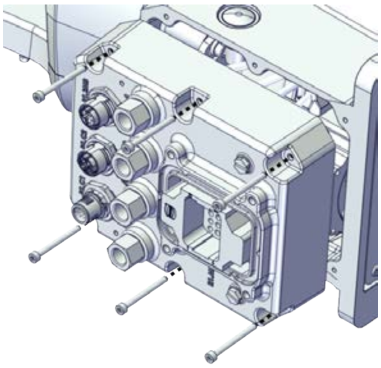
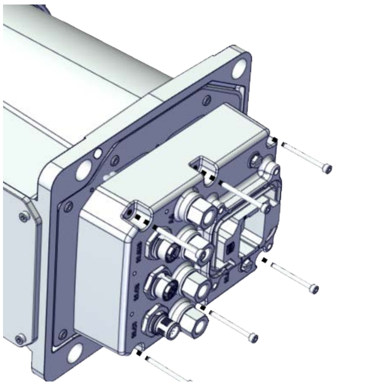
Continues on next page

	Action	Note
2	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	Tightening torque: 0.3 Nm  xx1800002468
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the SMB cover to the base.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm  xx1800002467

Refitting the connector interface plate

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

Continues on next page

	Action	Note
2	**Valid for cabling with bottom interface (option 3309-1)** Refit the base adapter.	Screw: M3x8 Steel 8.8-A2F (7 pcs) Tightening torque: 1.2 Nm  xx1800003056
3	Refit the connector interface plate to the base.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm **Valid for cabling with rear interface**  xx1800003034 **Valid for cabling with bottom interface (option 3309-1)**  xx1800003055

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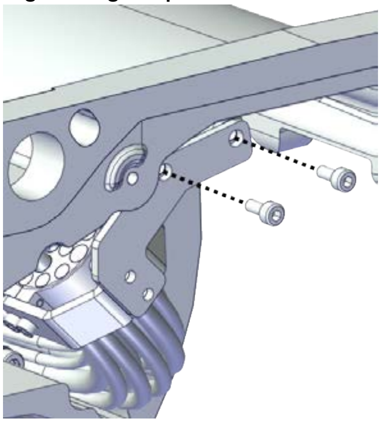
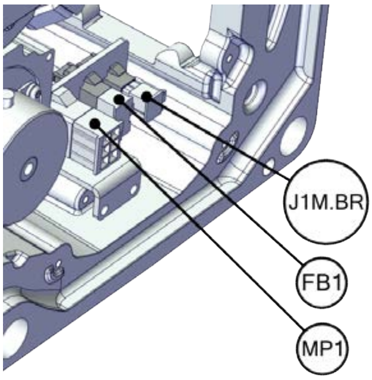
Securing the lower cable package to the base

	Action	Note
1	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003042

Reconnecting the brake release cabling and axis-1 motor connectors

	Action	Note
1	Reconnect the connectors. • J1M.BR • MP1 • FB1  **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003054

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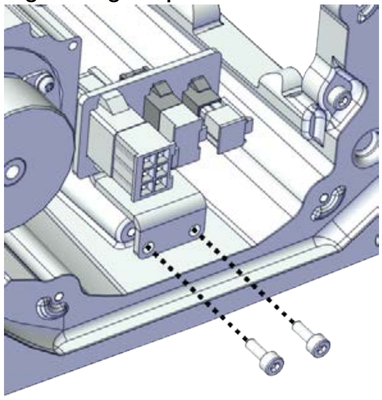
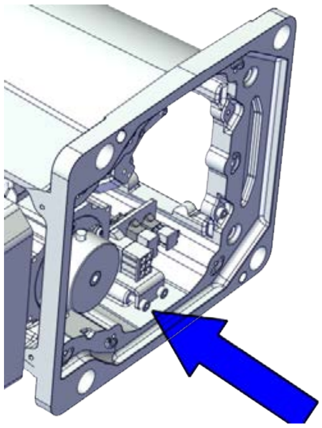
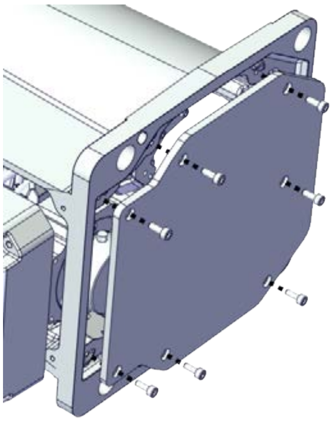
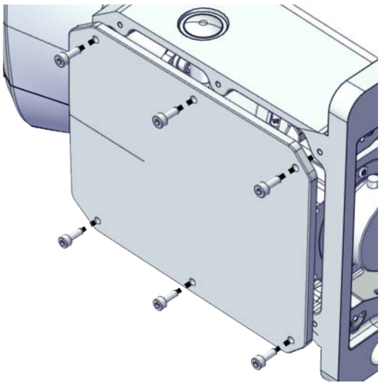
	Action	Note
2	Reconnect the floor cable together with the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800003037  xx1800003036

Refitting the base cover

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

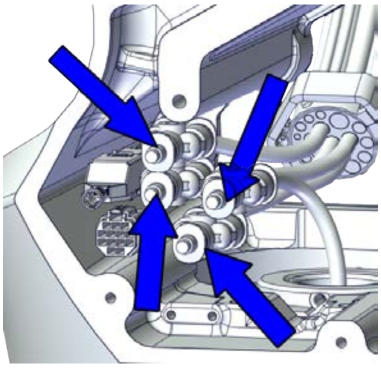
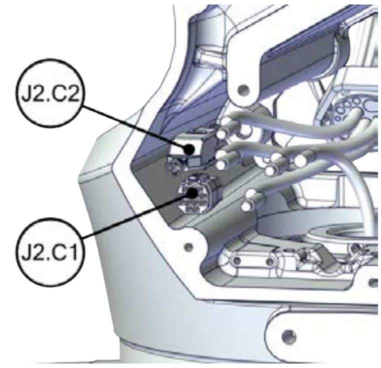
	Action	Note
4	**Valid for cabling with rear interface** Refit the bottom cover.	Screw: M3x8 Steel 8.8-A2F (7 pcs) Tightening torque: 1.2 Nm  xx1800003035
5	Refit the rear cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm  xx1800003057

Securing the robot to the foundation

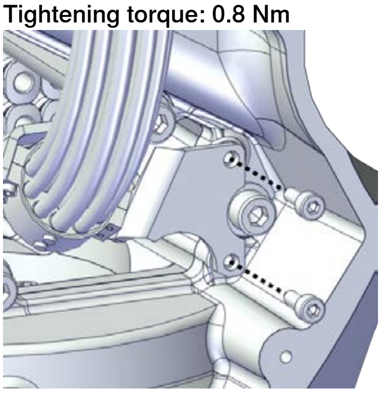
	Action	Note
1	**CAUTION** The CRB 1100 robot weighs 21.1 kg and can be lifted by one person.	
2	Raise the robot to standing and secure to the foundation with the attachment screws and washers.	Attachment screws: M12x25 (robot installation directly on foundation), quality: 8.8. Washers: 4 pcs, 24 x 13 x 2.5. Tightening Torque: 50 Nm±5 Nm.

Continues on next page

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

	Action	Note
1	Reconnect the air hoses in a cross pattern to the Y-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	 xx1800002500
2	Reconnect the connectors. • J2.C1 • J2.C2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002501

Securing the cable package to the swing

	Action	Note
1	Refit the cable bracket.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002499

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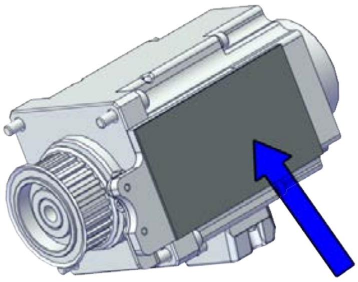
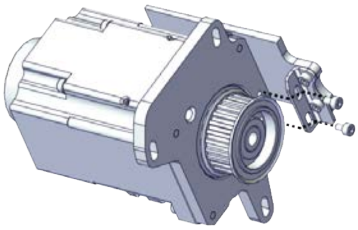
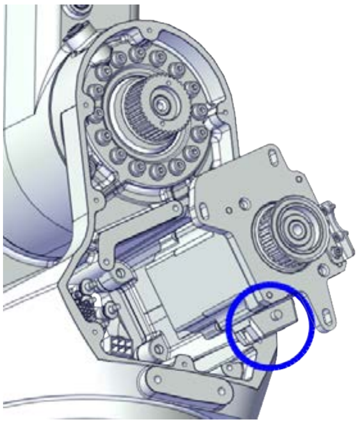
Refitting the axis-2 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged, as shown in the following step.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001  xx1800003603
3	Remove the screws. Replace with a new cooling pad and then refit the screws.	Screw: M3x5 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 1.2 Nm  xx1800003026
4	Orient the motor correctly and fit it into the swing. **Tip** Bend the motor signal cable back towards the swing support.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003027

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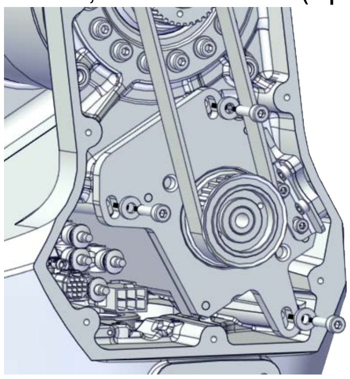
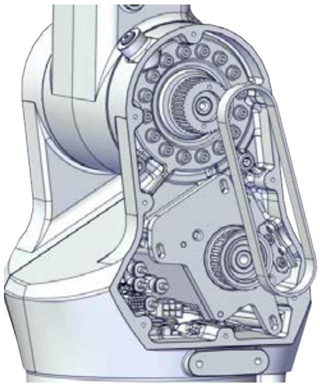
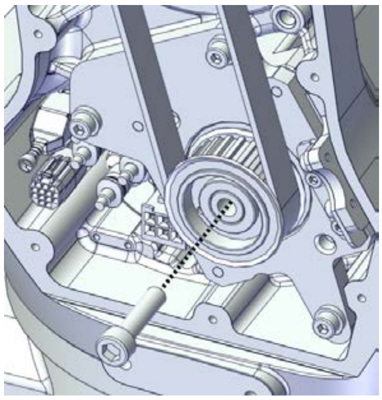
	Action	Note
5	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800002494
6	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003028
7	Install an M6x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000010

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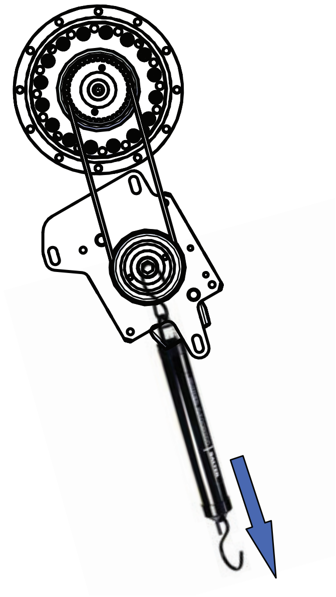
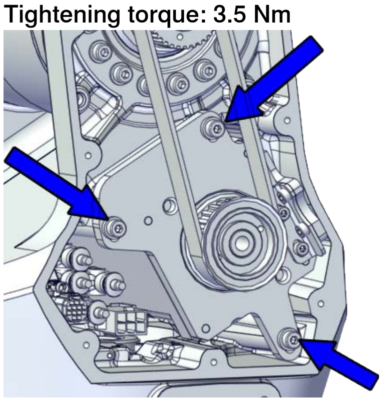
	Action	Note
8	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 68.18-75.04 N (for reference only) Initial referenced force for new belt: 97.4-107.2 N  xx1900000029
9	Secure the motor with the screws.	Tightening torque: 3.5 Nm  xx1800002493
10	Use a sonic tension meter to measure the timing belt tension.	Used belt: 163-174 Hz New belt:180-229 Hz (for reference only)
11	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	

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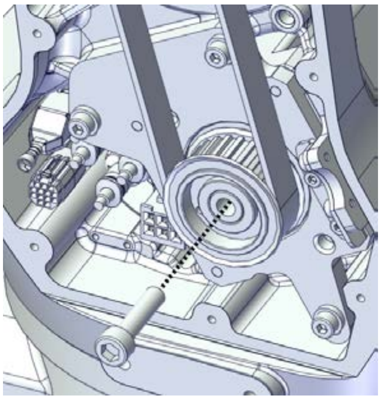
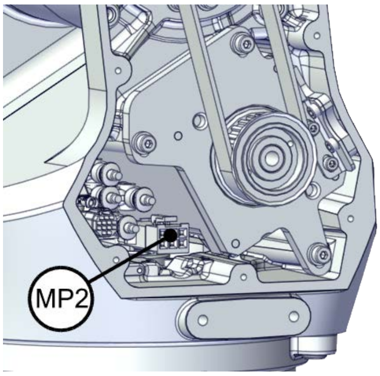
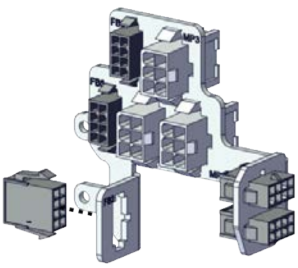
	Action	Note
12	Remove the adjustment screw from the motor.	 xx1900000010
13	Reconnect the connector. • MP2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002495

Reconnecting the connectors at the division point

	Action	Note
1	Insert the female header of the connectors to the connector plate.	 xx1800003029

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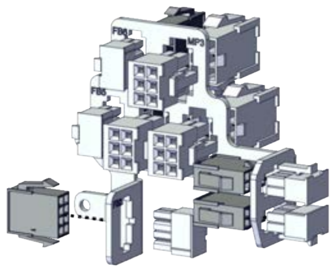
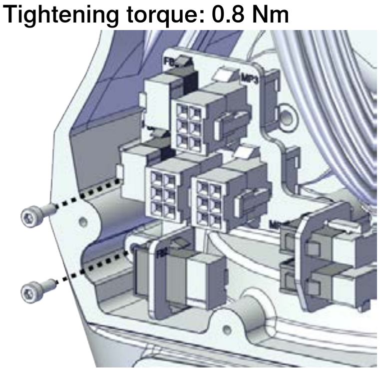
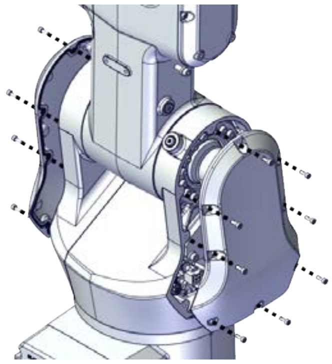
	Action	Note
2	Reconnect the connectors. • J2.FB2,3,4,5,6 • J2.MP3,4,5/6 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003030
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002489

Refitting the swing covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	

Continues on next page

	Action	Note
3	Refit the covers. • Swing cover • Swing support cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003607

Concluding procedure

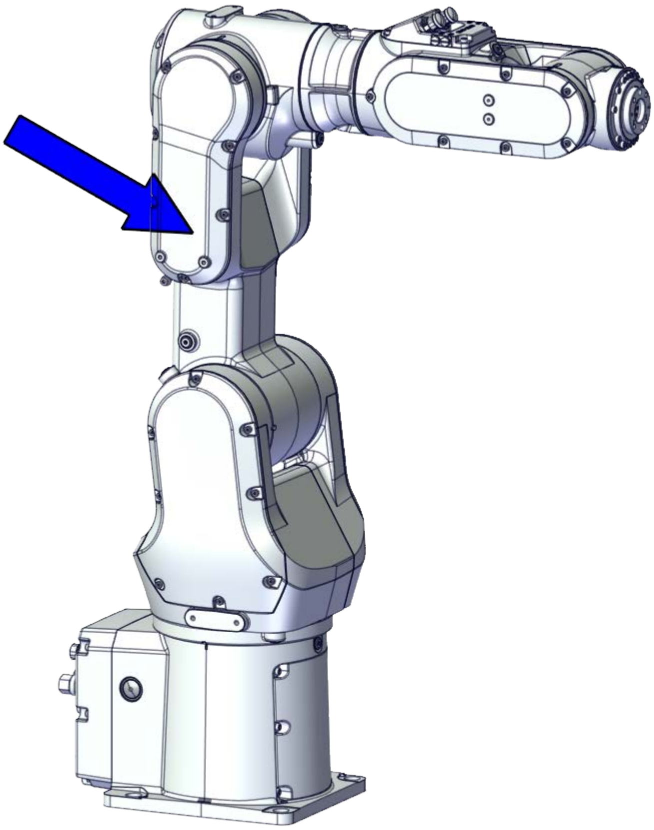
	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 163*.	

5.5 Lower arm

5.5.1 Replacing the lower arm

Location of the lower arm

The lower arm is located as shown in the figure.



xx1800002474

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 1100 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Lower arm (CRB 1100-4/0.58)	3HAC069056-001	
Lower arm (CRB 1100-4/0.475)	3HAC069055-001	
Lower arm support	3HAC069058-001	
Motor with flange, axis 2	3HAC083588-001	.

Continues on next page

Spare part	Article number	Note
Timing belt, axis 2	3HAC061935-001	
Motor with flange, axis 3	3HAC083587-001	
Timing belt, axis 3	3HAC061936-001	
Gear unit with pulley, axis 2	3HAC073517-001	
Swing cover	3HAC069051-001	
Swing support cover	3HAC069052-001	
Lower arm cover	3HAC069057-001	
Lower arm support cover	3HAC069059-001	
Cooling pad for axis-1 and -2 motors	3HAC071020-001	Cooling pads are wear parts. One cooling pad sheet contains 6 pieces of small pad. Replace if damaged with one piece each time.
Cooling pad for axis-3 and -4 motors	3HAC071021-001	Cooling pads are wear parts. One cooling pad sheet includes 10 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.

Required consumables

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

Continues on next page

Consumable	Article number	Note
Grease	-	Castrol Molub. Alloy 777-1 NG Used to lubricate bearings on the swing support and lower arm support.
Sealing compound	3HAC026759-002	Sikaflex 521 FC

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

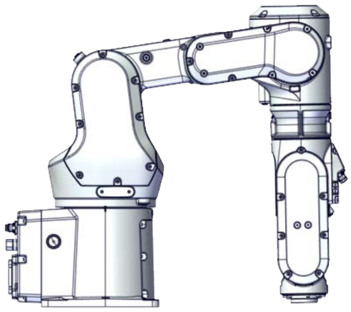
Removing the lower arm

Use these procedures to remove the lower arm.

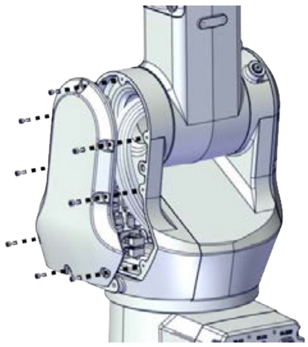
Preparations before removing the lower arm

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

Continues on next page

	Action	Note
2	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: 110° (CRB 1100-4/0.475) /95° (CRB 1100-4/0.58) • Axis 3: -20° (CRB 1100-4/0.475)/ -6° (CRB 1100-4/0.58) • Axis 4: 0° • Axis 5: 0° • Axis 6: No significance.	 xx1800003289
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Remove the swing support cover.	 xx1800002488

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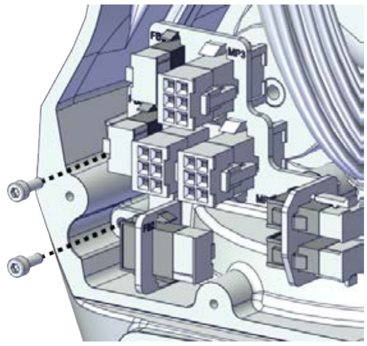
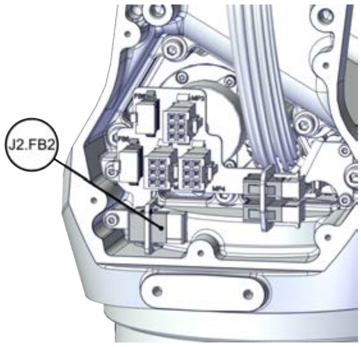
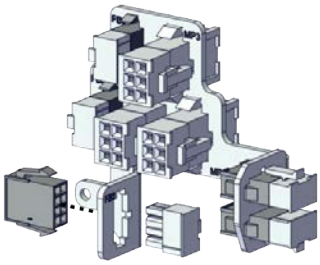
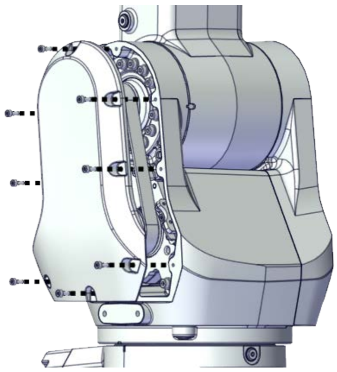
	Action	Note
4	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate.	 xx1800002489
5	Disconnect the connector. • J2.FB2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002490
6	Snap loose and remove the female head of the connector from the connector plate.	 xx1800002491
7	Remove the swing cover.	 xx1800002492

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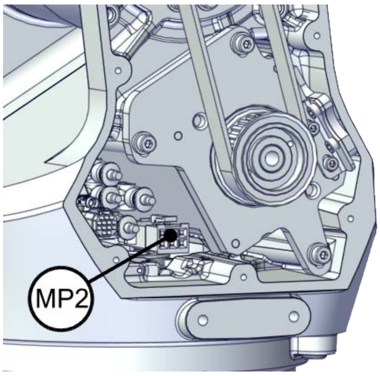
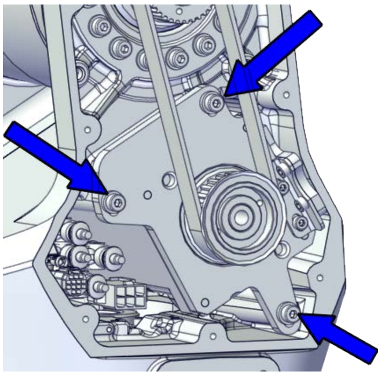
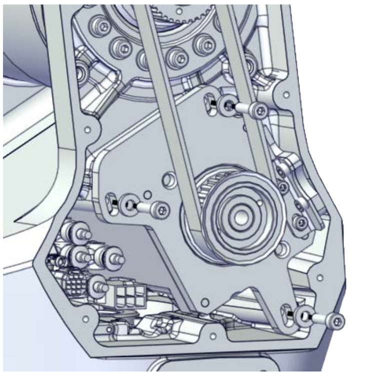
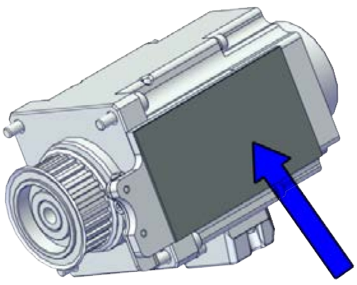
	Action	Note
8	Disconnect the connector. • MP2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002495
9	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002493
10	Remove the screws and washers.	 xx1800002494
11	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad. **CAUTION** Be aware of the motor cabling. The motor cannot be removed completely until the connector is disconnected, as shown in following step.	Cooling pad location  xx1800003603

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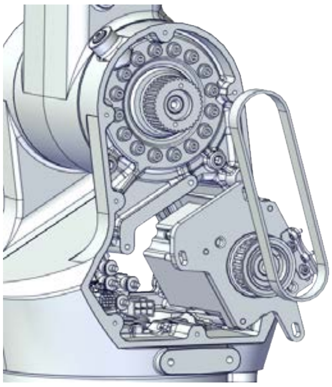
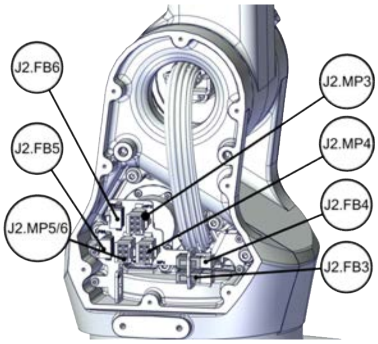
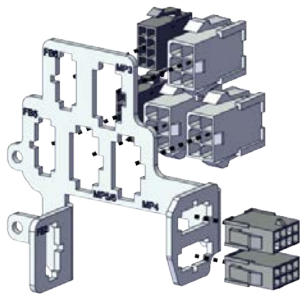
	Action	Note
12	Remove the timing belt from its groove on the motor.	 xx1800002496

Disconnecting the connectors at the division point

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • J2.FB3,4,5,6 • J2.MP3,4,5/6 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002497
3	Snap loose and remove the female head of the connectors from the connector plate.	 xx1800002498

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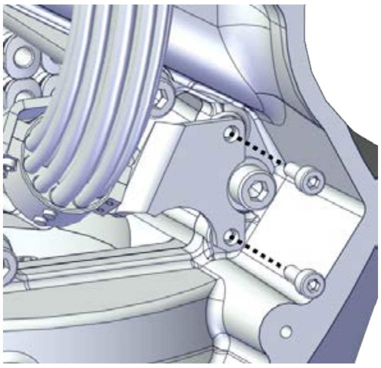
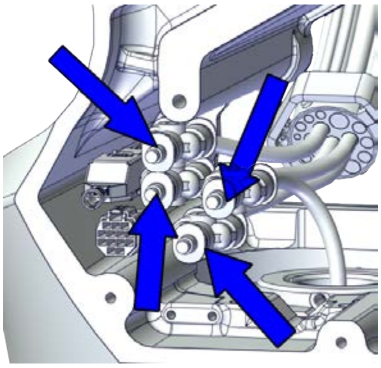
Separating the cable package from the swing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable bracket.	 xx1800002499

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

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the air hoses from the Y-shaped connectors.	 xx1800002500

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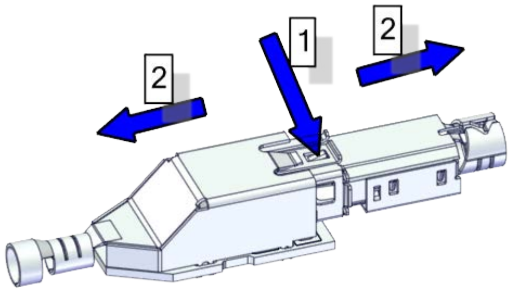
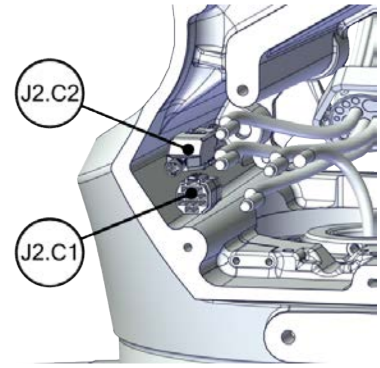
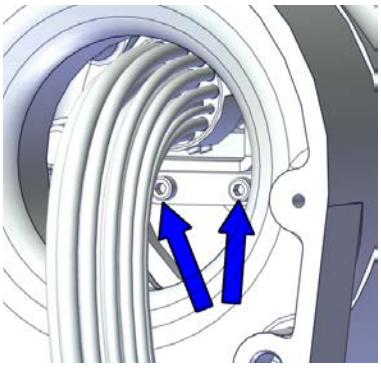
	Action	Note
3	Disconnect the connectors. • J2.C1 • J2.C2  **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.  **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the J2.C2 (for Ethernet cabling).  xx1800002943	 xx1800002501

Separating the upper cable harness from the axis-2 gearbox

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable bracket.	 xx1800003002

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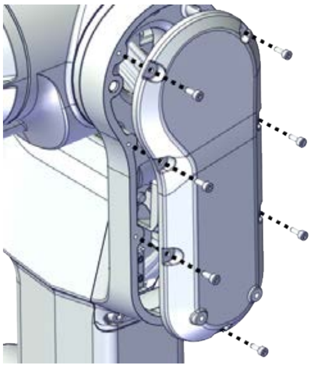
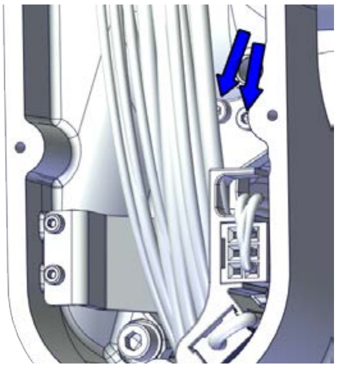
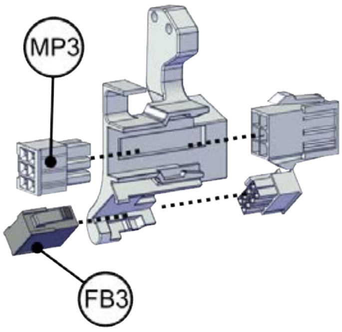
Disconnecting the axis-3 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the lower arm support cover.	 xx1800003003
3	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate, as shown in following step.	 xx1800003004
4	Slide the connectors out of the connector plate and disconnect the connectors. • FB3 • MP3 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003005

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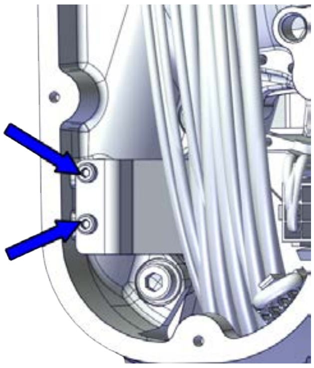
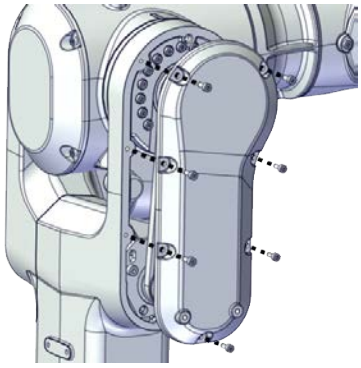
	Action	Note
5	Remove the cable bracket.	 xx1800003006

Removing the axis-3 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Remove the lower arm cover.	 xx1800003007

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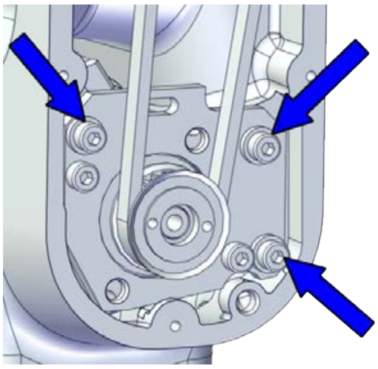
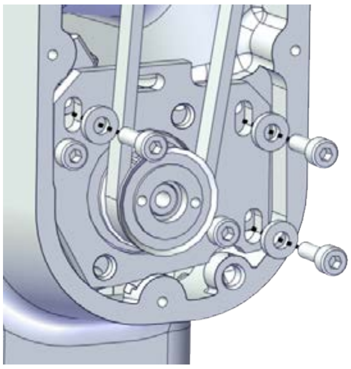
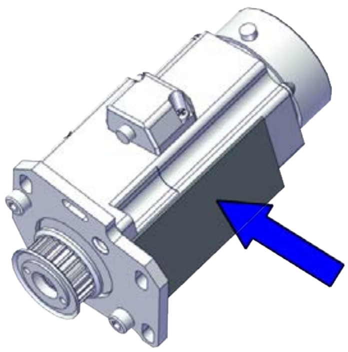
	Action	Note
4	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003008
5	Remove the screws and washers.	 xx1800003009
6	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad.	Cooling pad location  xx1800003604

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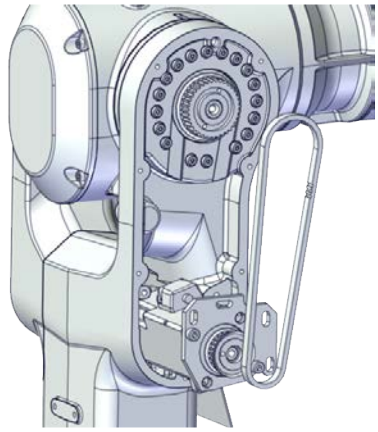
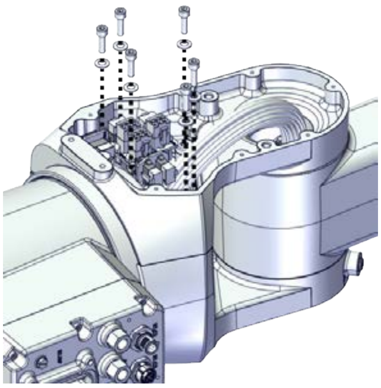
	Action	Note
7	Remove the timing belt from its groove on the motor.	 xx1800003010

Removing the swing support

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the swing support. **Tip** If the swing support is hard to loosen from the lower arm, use a plastic hammer to knock on the swing support lightly.	 xx1800003079
3	Route the upper cable package out of the swing support.	

Separating the swing from the lower arm

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

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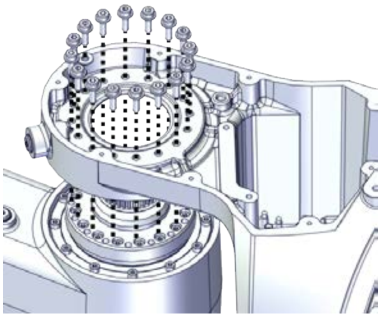
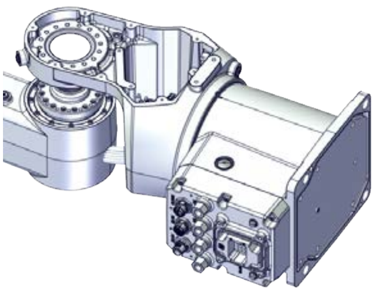
	Action	Note
2	Remove the screws. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	 xx1900002203
3	Separate the swing from the lower arm. **Tip** If the swing is hard to loosen from the housing, use a plastic hammer to knock on the swing lightly.	 xx1800003081

Removing the axis-2 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing gearboxes will release axes. This means the axes can fall down. Make sure axes are well supported before removing gearboxes.	

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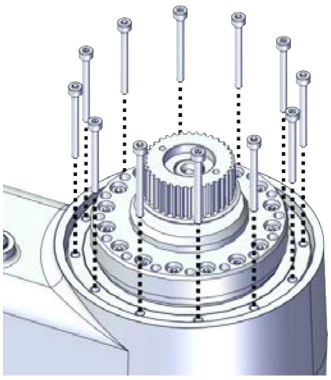
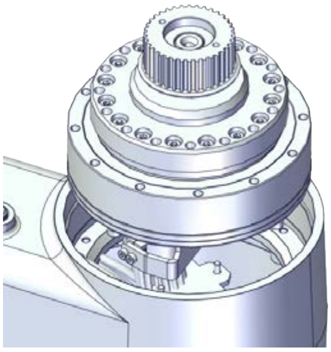
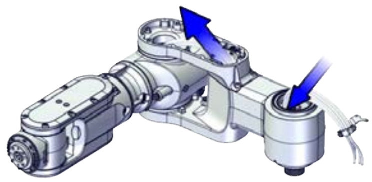
	Action	Note
3	Remove the screws.	 xx1800003082
4	Pull out the gearbox.	 xx1800003083

Pulling out the upper cable package

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Pull out the upper cable harness upwards from the lower arm support.	 xx1800003086

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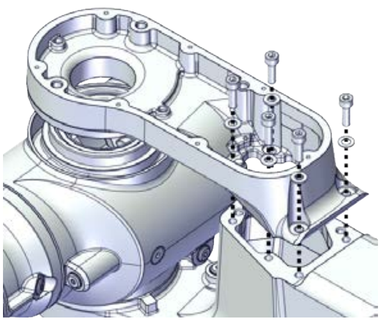
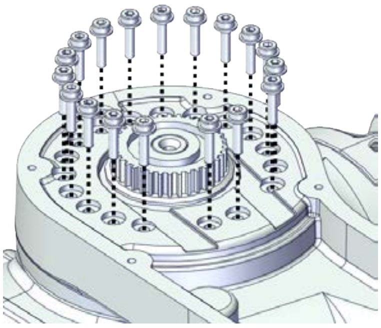
Removing the lower arm support

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the lower arm support. **Tip** If the lower arm support is hard to loosen from the housing, use a plastic hammer to knock on the lower arm support lightly.	 xx1800003088

Separating the lower arm from the housing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	 xx1900002190

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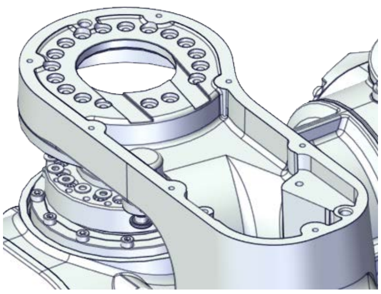
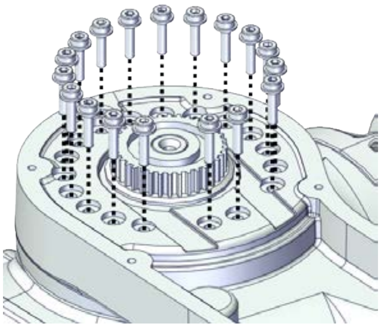
	Action	Note
3	Separate the lower arm from the housing. **Tip** If the lower arm is hard to loosen from the housing, use a plastic hammer to knock on the lower arm lightly.	 xx1800003090

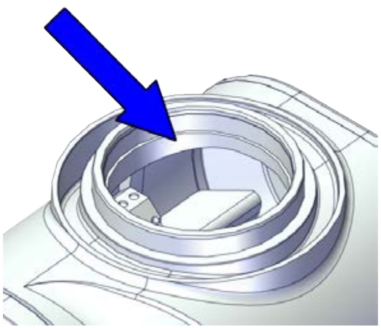
Refitting the lower arm

Use these procedures to refit the lower arm.

Refitting the lower arm to the housing

	Action	Note
1	Refit the lower arm to the housing. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	Flange screws (16 pcs) Tightening torque: 1.9 Nm  xx1900002190

Securing the lower arm support

	Action	Note
1	Apply grease Castrol Molub-Alloy 777-1 NG to the inner surface of the housing, where contacts the bearing on the lower arm support.	 xx2000000059

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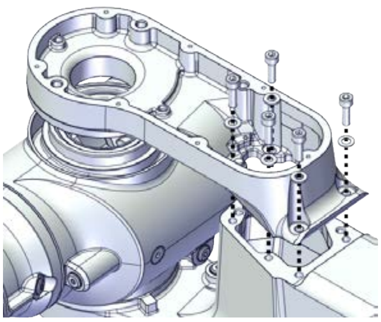
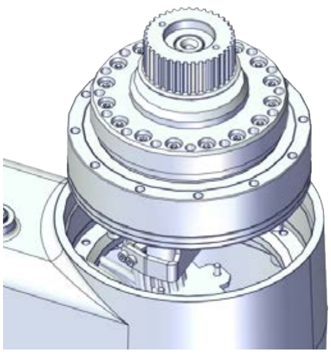
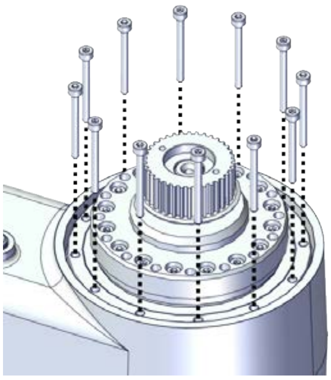
	Action	Note
2	Refit the lower arm support.	Screw: M5x16 12.9 Lafre 2C2B/FC6.9 (5 pcs) Tightening torque: 8 Nm  xx1800003088
3	Route the cable package through the lower arm support.	

Refitting the axis-2 gearbox

	Action	Note
1	Refit the axis-2 gearbox.	 xx1800003083
2	Secure with screws.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (12 pcs) Tightening torque: 1.9 Nm  xx1800003082

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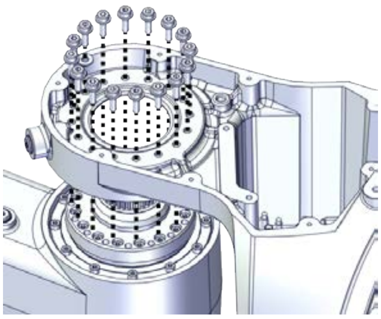
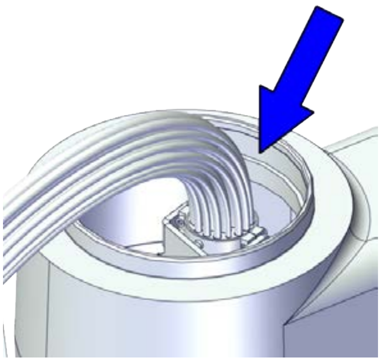
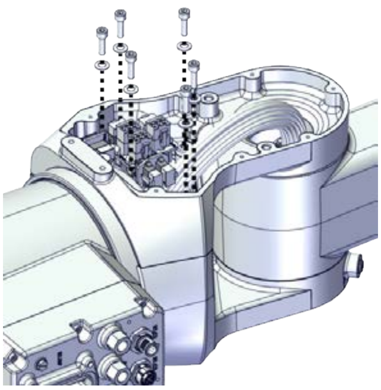
Refitting the swing to the lower arm

	Action	Note
1	Refit the swing to the lower arm. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	Flange screws (16 pcs) Tightening torque: 4.2 Nm  xx1900002203

Securing the swing support

	Action	Note
1	Apply grease Castrol Molub-Alloy 777-1 NG to the inner surface of the lower arm, where contacts the bearing on the swing support.	 xx2000000058
2	Refit the swing support. **Tip** If the swing support is hard to closely fit to the lower arm, use a plastic hammer to knock on the swing support lightly.	Screw: M5x16 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 6 Nm  xx1800003079

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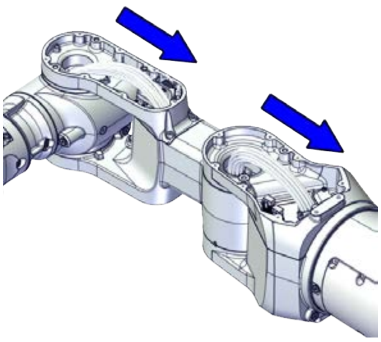
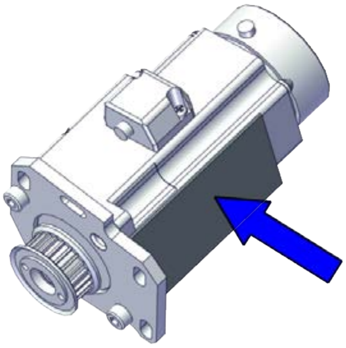
Guiding the upper cable package down to the swing

	Action	Note
1	Guide the upper cable package to go through the lower arm and down to the swing. When inserting the cable package, leave the axis-3 motor connectors in the lower arm. **Tip** Wrap the connectors with the masking tape.	 xx1800003091

Refitting the axis-3 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged.	Cooling pad for axis-3 and -4 motors: 3HAC071021-001  xx1800003604

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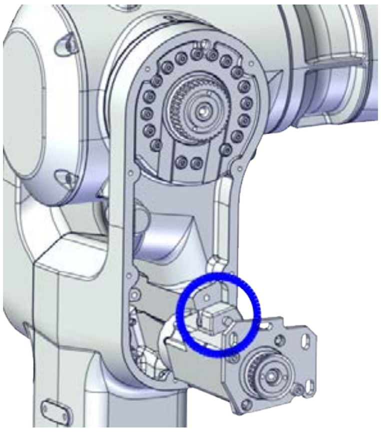
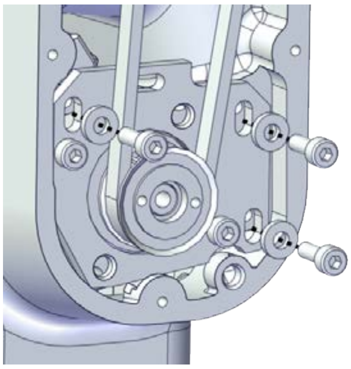
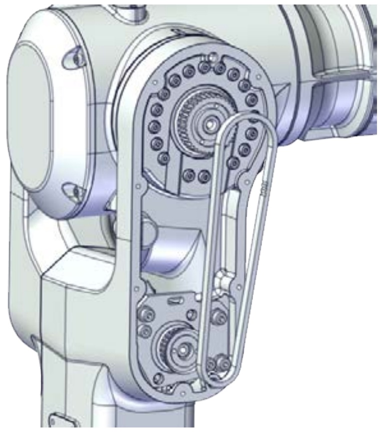
	Action	Note
3	Orient the motor correctly and fit it into the lower arm.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003021
4	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800003009
5	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003022

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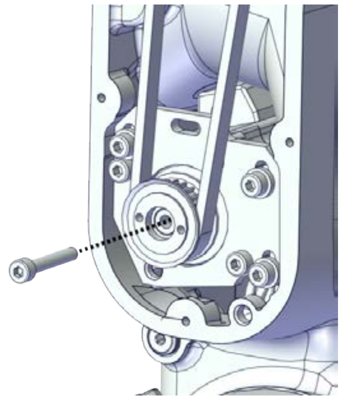
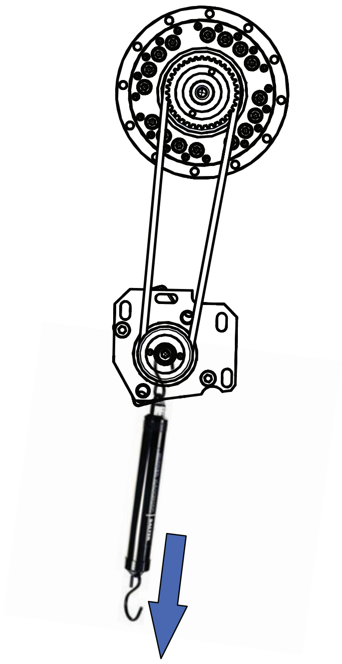
	Action	Note
6	Install an M4x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000009
7	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 21.7-23.94 N (for reference only) Initial referenced force for new belt: 31-34.2 N  xx1900000028

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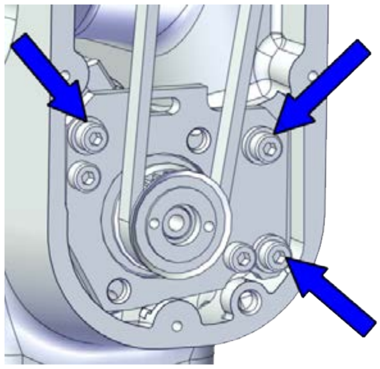
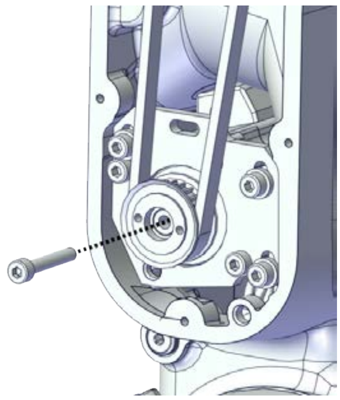
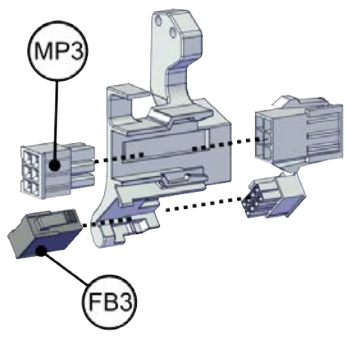
	Action	Note
8	Secure the motor with the screws.	Tightening torque: 3 Nm  xx1800003008
9	Use a sonic tension meter to measure the timing belt tension.	Used belt: 102-109 Hz New belt:113-143 Hz (for reference only)
10	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	
11	Remove the adjustment screw from the motor.	 xx1900000009

Reconnecting the axis-3 motor connectors

	Action	Note
1	Slide the connectors into the connector plate and reconnect the connectors. • FB3 • MP3 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003005

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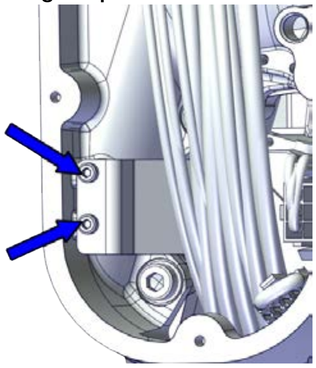
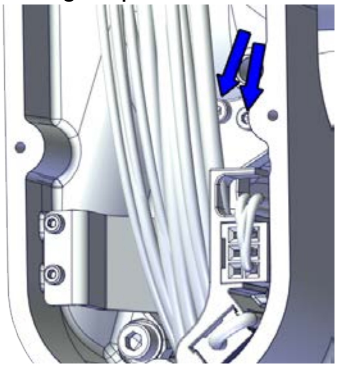
	Action	Note
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003006
4	Refit the connector plate.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.4 Nm  xx1800003004

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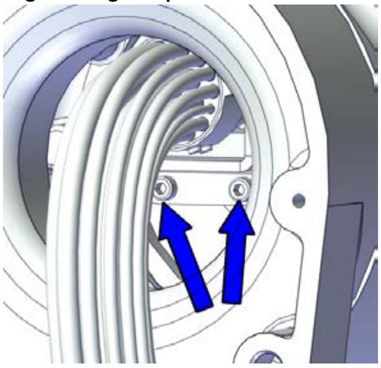
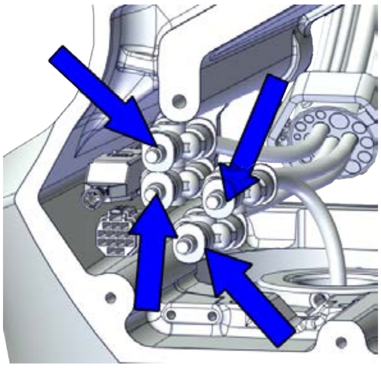
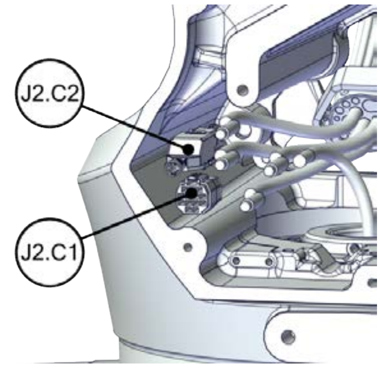
Securing the upper cable package to the axis-2 gearbox

	Action	Note
1	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003002

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

	Action	Note
1	Reconnect the air hoses in a cross pattern to the Y-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	 xx1800002500
2	Reconnect the connectors. • J2.C1 • J2.C2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002501

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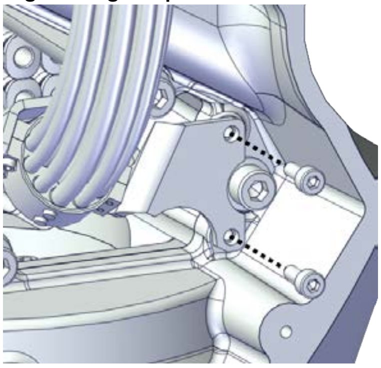
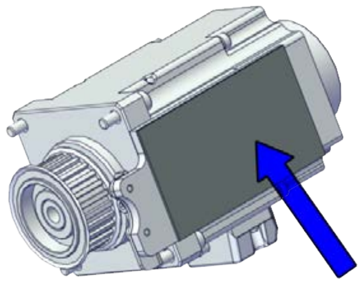
Securing the cable package to the swing

	Action	Note
1	Refit the cable bracket.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002499

Refitting the axis-2 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged, as shown in the following step.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001  xx1800003603

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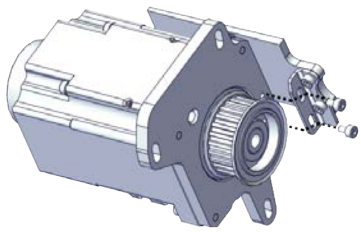
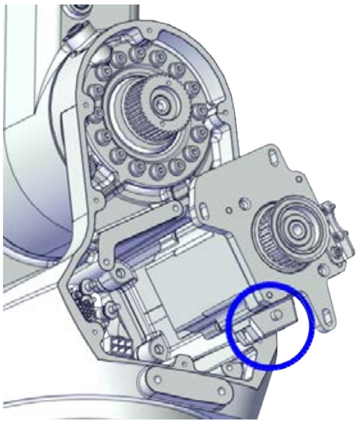
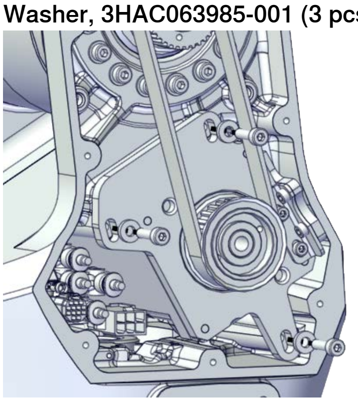
	Action	Note
3	Remove the screws. Replace with a new cooling pad and then refit the screws.	Screw: M3x5 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 1.2 Nm  xx1800003026
4	Orient the motor correctly and fit it into the swing. **Tip** Bend the motor signal cable back towards the swing support.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003027
5	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800002494

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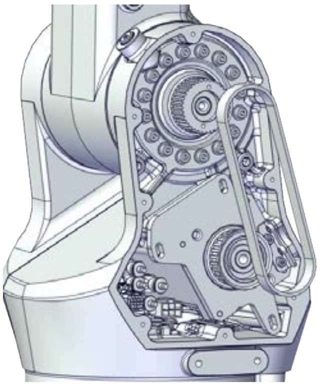
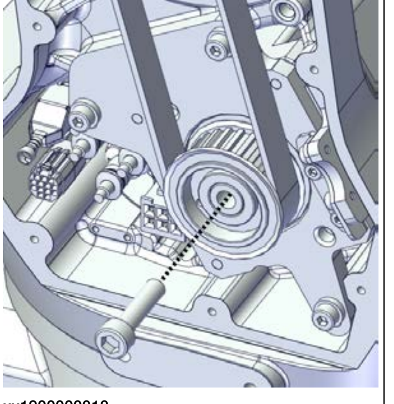
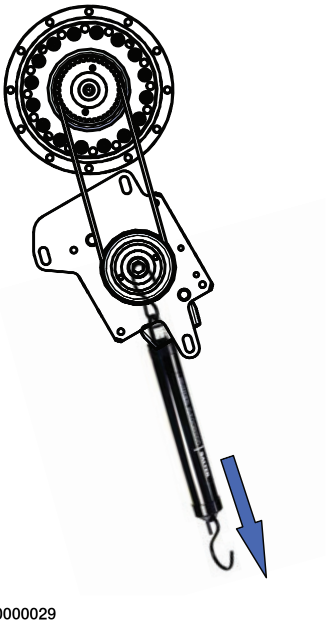
	Action	Note
6	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003028
7	Install an M6x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000010
8	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 68.18-75.04 N (for reference only) Initial referenced force for new belt: 97.4-107.2 N  xx1900000029

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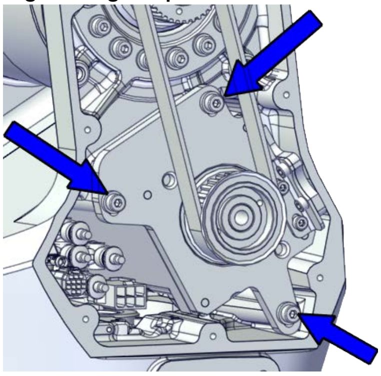
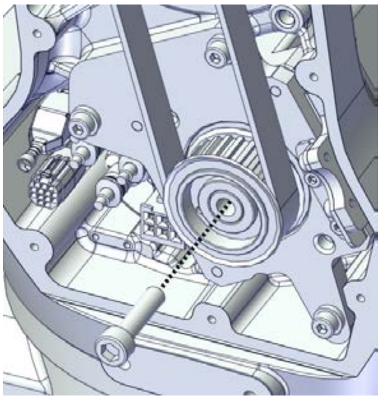
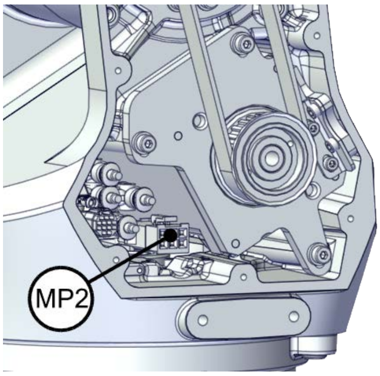
	Action	Note
9	Secure the motor with the screws.	Tightening torque: 3.5 Nm  xx1800002493
10	Use a sonic tension meter to measure the timing belt tension.	Used belt: 163-174 Hz New belt:180-229 Hz (for reference only)
11	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	
12	Remove the adjustment screw from the motor.	 xx1900000010
13	Reconnect the connector. • MP2  **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002495

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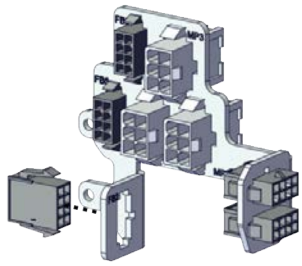
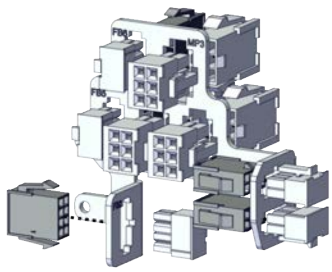
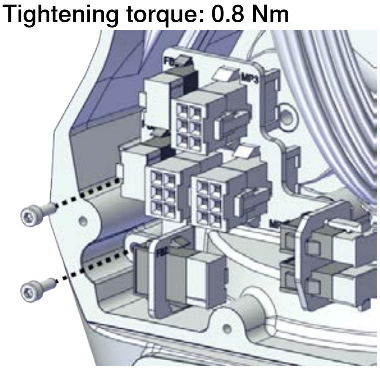
Reconnecting the connectors at the division point

	Action	Note
1	Insert the female header of the connectors to the connector plate.	 xx1800003029
2	Reconnect the connectors. • J2.FB2,3,4,5,6 • J2.MP3,4,5/6 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003030
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002489

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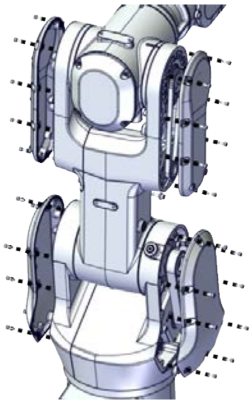
Refitting the covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	
3	Refit the covers. • Lower arm cover • Lower arm support cover • Swing cover • Swing support cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003610

Concluding procedure

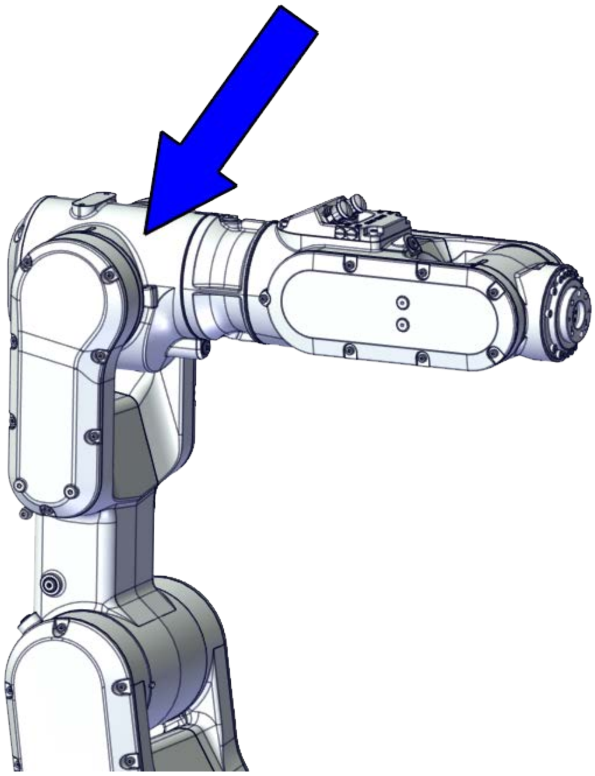
	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 163*.	

5.6 Housing, extender unit and wrist

5.6.1 Replacing the housing

Location of the housing

The housing is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 1100 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Process hub with lamp unit (CP/CS and air hose, with Ethernet)	3HAC077335-001	
Housing	3HAC069053-001	
Gear unit with pulley, axis 3	3HAC073518-001	
Labyrinth sealing ring	3HAC073218-001	
Timing belt, axis 3	3HAC061936-001	
Motor with flange, axis 4	3HAC083586-001	

Continues on next page

Spare part	Article number	Note
Timing belt, axis 4	3HAC061937-001	
Motor with flange, axis 6	3HAC083584-001	
Timing belt, axis 6	3HAC061939-001	
Housing cover	3HAC069054-001	
Wrist cover	3HAC069061-001	
Cooling pad for axis-3 and -4 motors	3HAC071021-001	Cooling pads are wear parts. One cooling pad sheet includes 10 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel
Washer	3HAC064765-001	7x3.2x1.5, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.
M3x25 eye bolt	-	Included in the special toolkit 3HAC071022-001.
axis-4 motor fitting tool	-	Included in the special toolkit 3HAC071022-001. Used to refit the axis-4 motor.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222
Grease	-	Castrol Molub. Alloy 777-1 NG
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)

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Deciding calibration routine

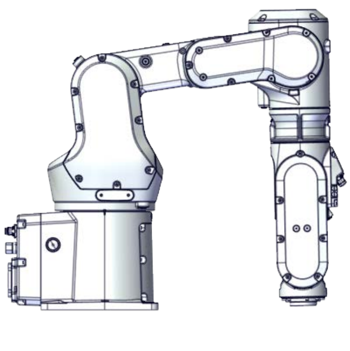
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the housing

Use these procedures to remove the housing.

Preparations before removing the housing

	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: 0° • Axis 2: 110° (CRB 1100-4/0.475) /95° (CRB 1100-4/0.58) • Axis 3: -20° (CRB 1100-4/0.475)/ -6° (CRB 1100-4/0.58) • Axis 4: 0° • Axis 5: 0° • Axis 6: No significance.	 xx1800003289

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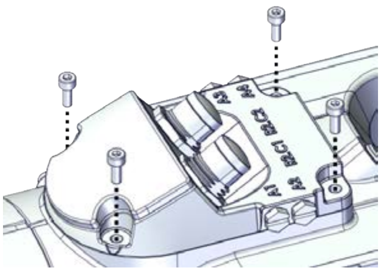
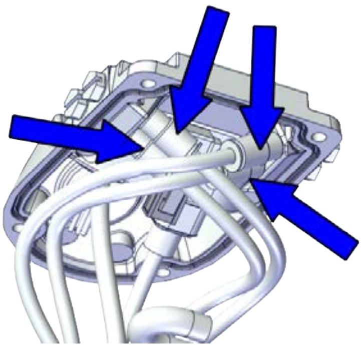
	Action	Note
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the process hub

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and carefully open the cover. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	 xx2000002219
3	Disconnect the air hoses.	 xx1800002945

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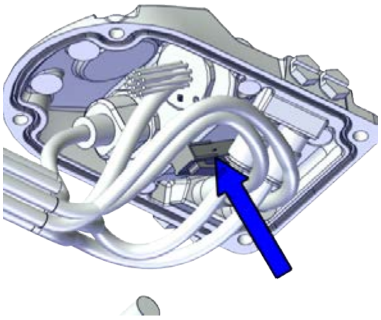
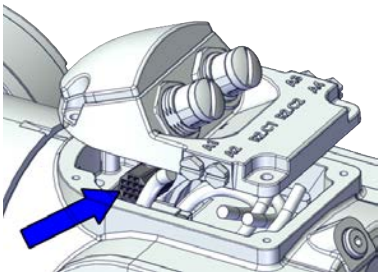
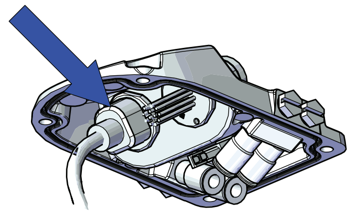
	Action	Note
4	Carefully pull out lamp unit connector behind the air hose connectors and disconnect the connector J5.UL.	 xx1800002946
5	**For robots with CP/CS cabling** Disconnect the connector. • J5.C1	 xx2100000293
6	**For robots with Ethernet cabling** Disconnect the connector J5.C2 using the tool.	J5.C2 connector assembly tool: -  xx1800002948

Removing the wrist covers

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

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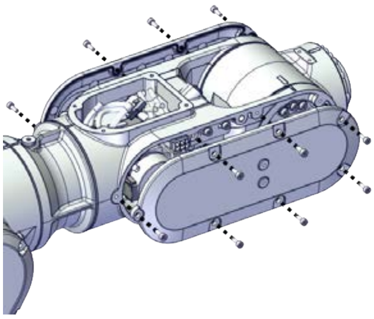
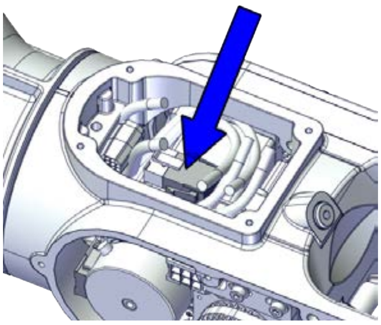
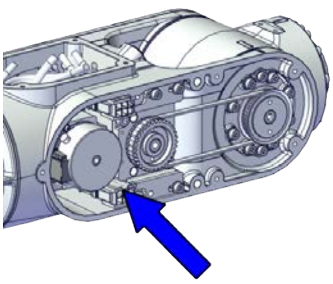
	Action	Note
2	Remove the wrist covers from both sides.	 xx1800002949

Disconnecting the axis-5 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Access the connector FB5 from the process hub and disconnect the connector.	 xx1800002950
3	Disconnect the connector. • MP5	 xx1800002993

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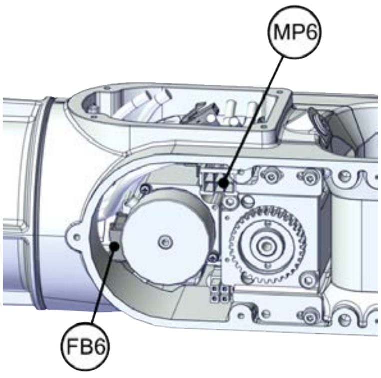
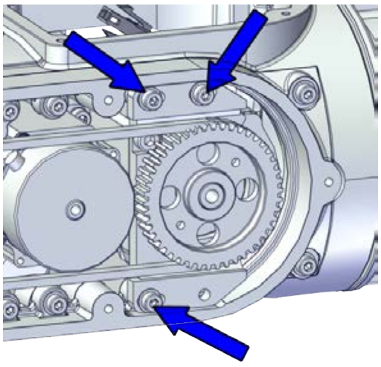
Disconnecting the axis-6 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • MP6 • FB6	 xx1800002994

Removing the axis-6 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002995

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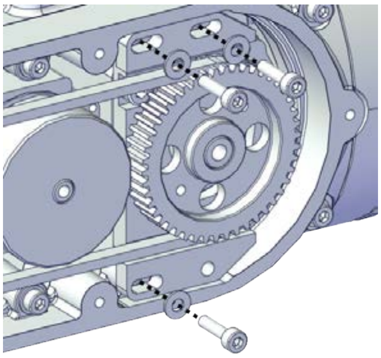
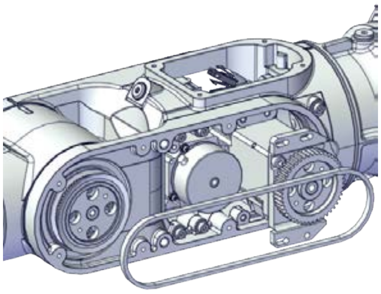
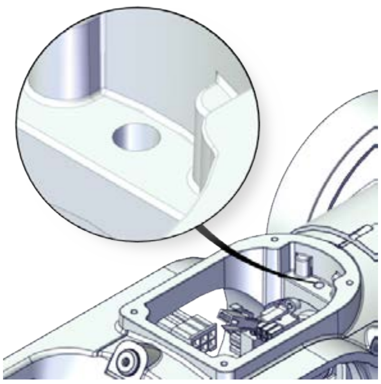
	Action	Note
4	Remove the screws and washers.	 xx1800002996
5	Carefully lift out the motor.	
6	Remove the timing belt from its groove on the motor.	 xx1800002997

Loosening the cable package from axis-4 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**Valid for CRB 1100-4/0.475** Access the cable package locking screw on the axis-4 gearbox from the wrist and then loosen the locking screw.	 xx1800003031

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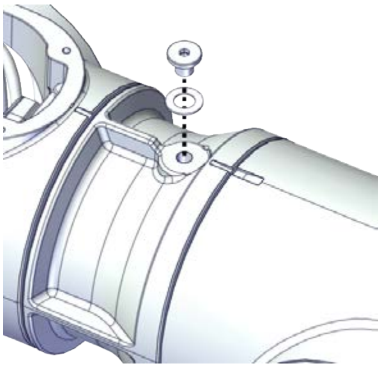
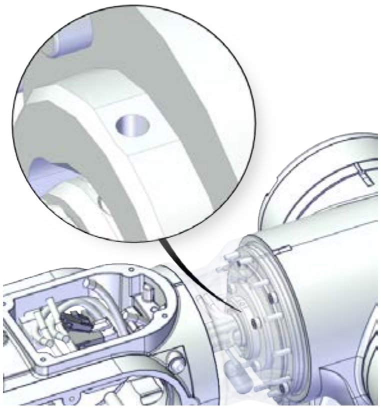
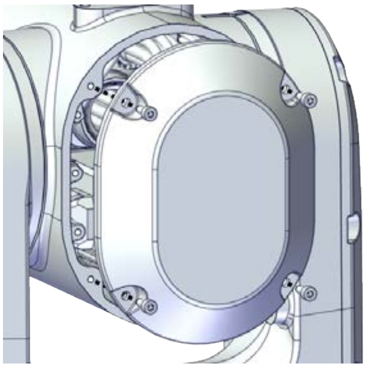
	Action	Note
3	Remove the plug screw and washer on the extender unit to access the cable package locking screw on the axis-4 gearbox and then loosen the locking screw.	 xx1800003000  xx1800003001

Disconnecting the axis-4 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the housing cover.	 xx1800003011

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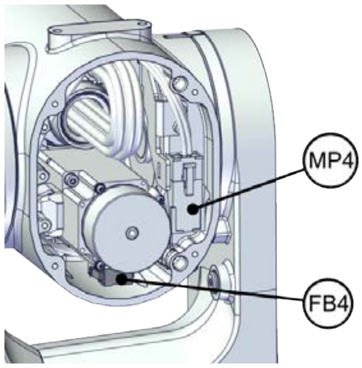
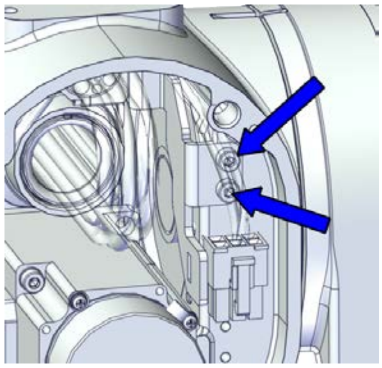
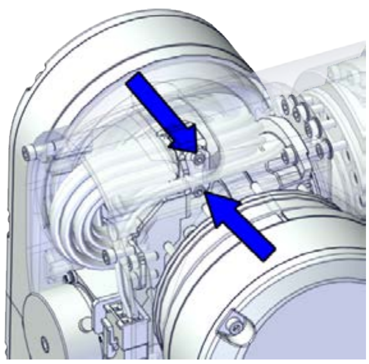
	Action	Note
3	Disconnect the motor connectors. • FB4 • MP4	 xx1800003012

Separating the upper cable package from the housing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable bracket.	 xx1800003013  xx1800003014

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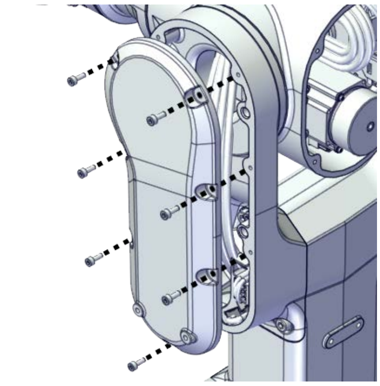
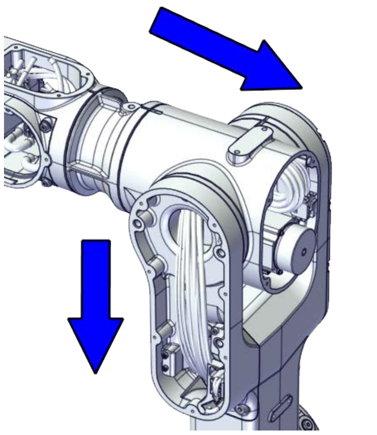
Pulling out the upper cable harness

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the lower arm support cover.	 xx1800003092
3	Pull out the upper cable harness from the housing, out from the lower arm support.	 xx1800003093

Removing the axis-4 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	

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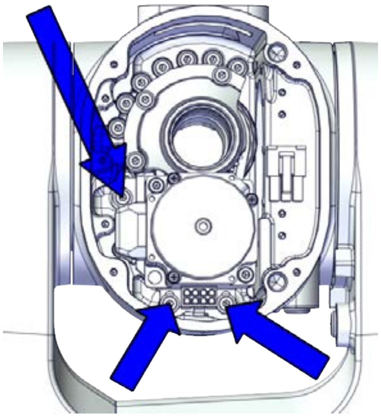
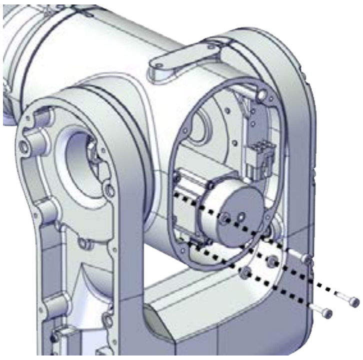
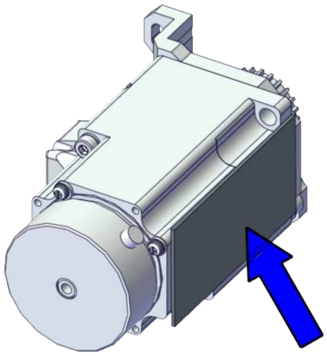
	Action	Note
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003094
4	Remove the screws and washers.	 xx1800003095
5	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad.	Cooling pad location  xx1800003605

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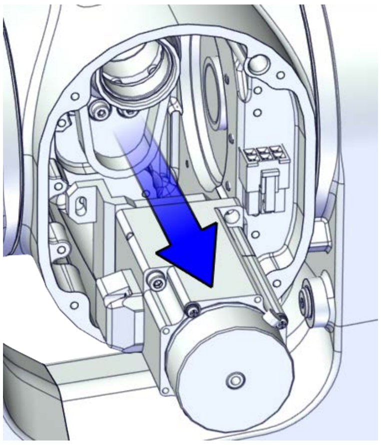
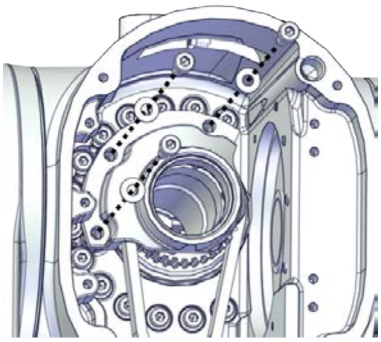
	Action	Note
6	Remove the timing belt from its groove on the motor.	 xx1800003096

Removing the pulley cover and axis-4 timing belt

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	 **CAUTION** Loosening timing belts will release axes. This means the axes can fall down. Make sure axes are well supported before loosening timing belts.	
3	Remove the pulley cover.	 xx1800003097

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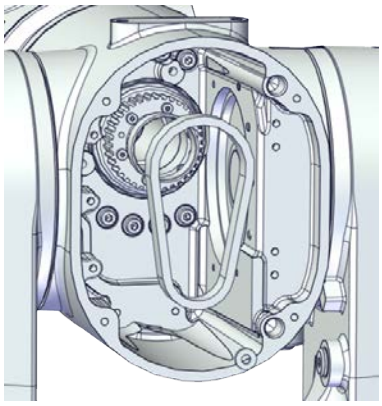
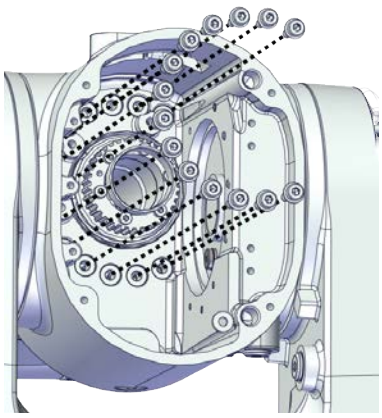
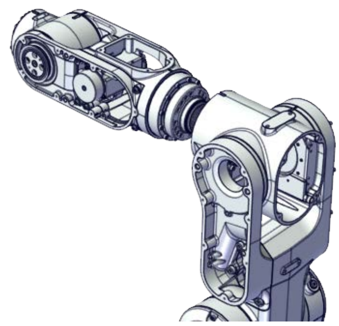
	Action	Note
4	Remove the timing belt from its groove on the gearbox.	 xx1800003098

Separating the housing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	 xx1900002191
3	**Valid for CRB 1100-4/0.475** Separate the wrist from the housing.	 xx1800003075

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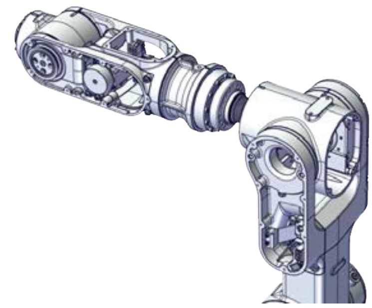
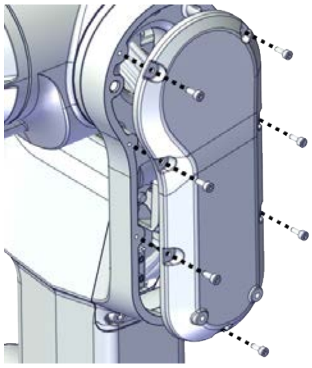
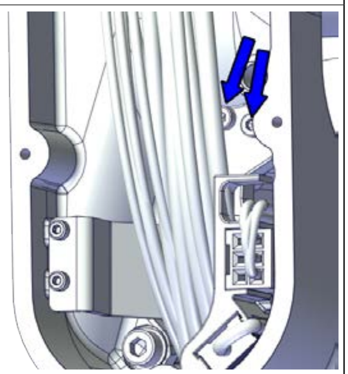
	Action	Note
4	Separate the extender unit and wrist from the housing.	 xx1800003100

Disconnecting the axis-3 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the lower arm support cover.	 xx1800003003
3	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate, as shown in following step.	 xx1800003004

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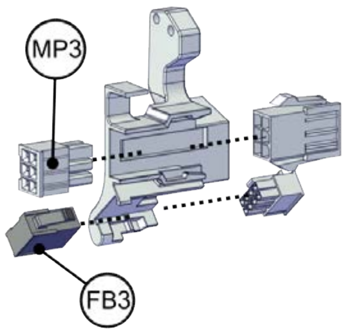
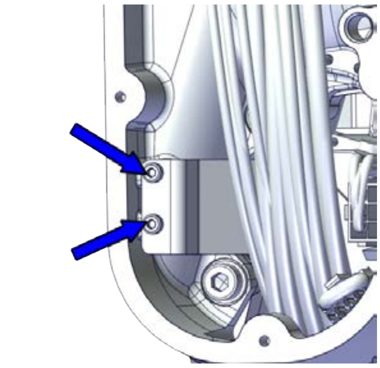
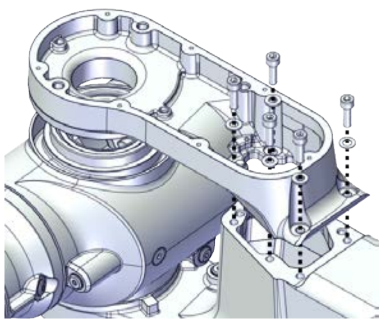
	Action	Note
4	Slide the connectors out of the connector plate and disconnect the connectors. • FB3 • MP3 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003005
5	Remove the cable bracket.	 xx1800003006

Removing the lower arm support

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the lower arm support. **Tip** If the lower arm support is hard to loosen from the housing, use a plastic hammer to knock on the lower arm support lightly.	 xx1800003088

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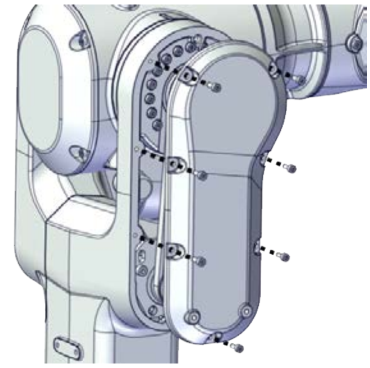
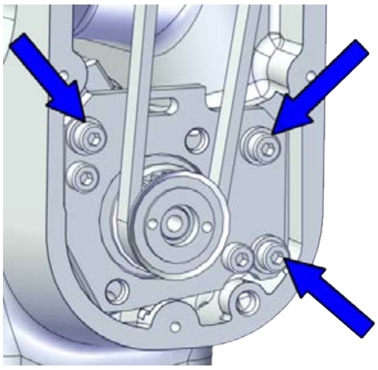
Loosening the axis-3 motor

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	 **CAUTION** Loosening timing belts will release axes. This means the axes can fall down. Make sure axes are well supported before loosening timing belts.	
3	Remove the lower arm cover.	 xx1800003007
4	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003008

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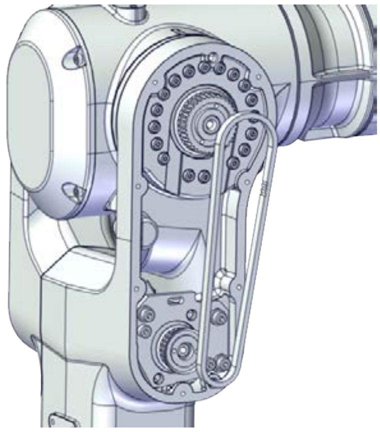
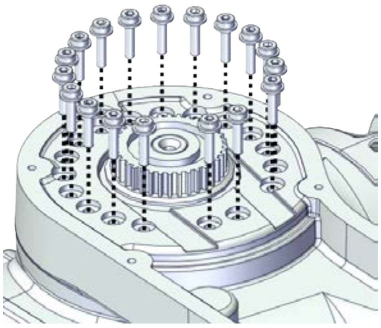
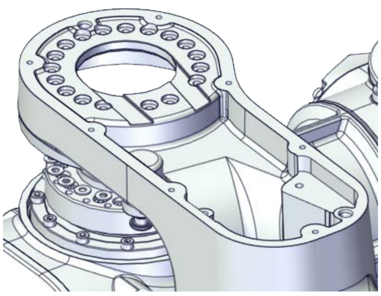
	Action	Note
5	Remove the timing belt from its grooves on the motor and gearbox.	 xx1800003022

Separating the lower arm from the housing

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws.  **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	 xx1900002190
3	Separate the lower arm from the housing.  **Tip** If the lower arm is hard to loosen from the housing, use a plastic hammer to knock on the lower arm lightly.	 xx1800003090

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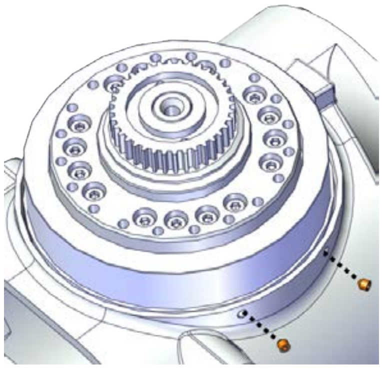
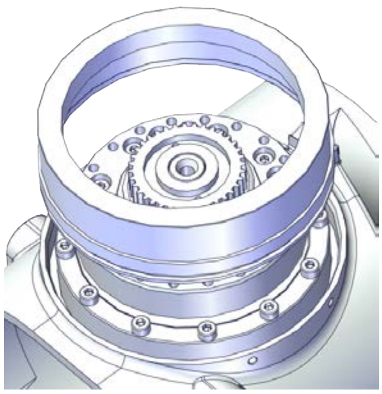
Removing the axis-3 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing gearboxes will release axes. This means the axes can fall down. Make sure axes are well supported before removing gearboxes.	
3	Remove the screws on the labyrinth sealing ring.	 xx1900001425
4	Remove the labyrinth sealing ring lightly and evenly.	 xx1900001417

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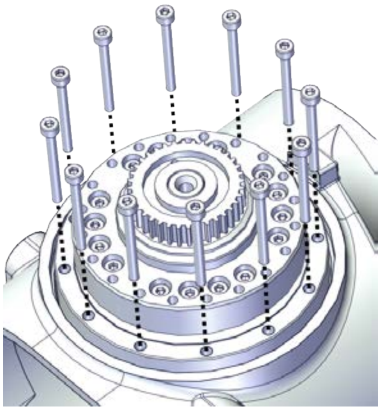
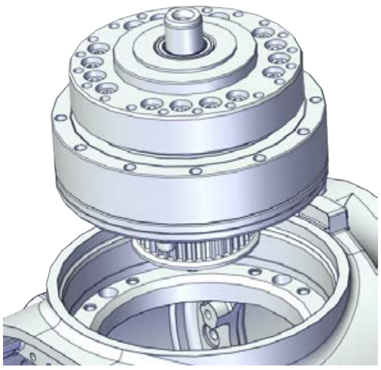
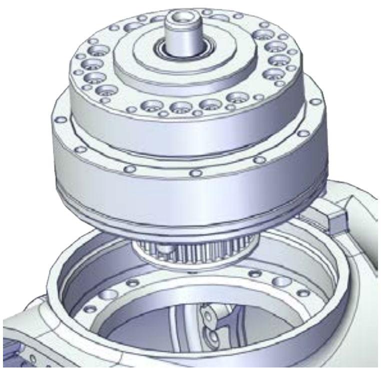
	Action	Note
5	Remove the screws.	 xx1800003284
6	Pull out the gearbox.	 xx1800003285

Refitting the housing

Use these procedures to refit the housing.

Refitting the axis-3 gearbox

	Action	Note
1	Refit the axis-3 gearbox.	 xx1800003285

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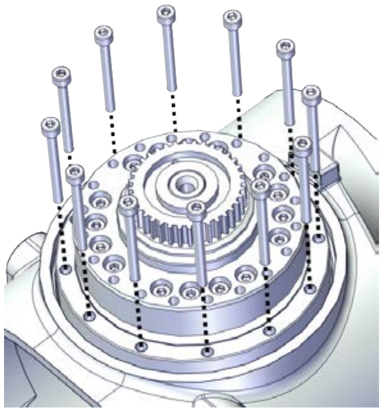
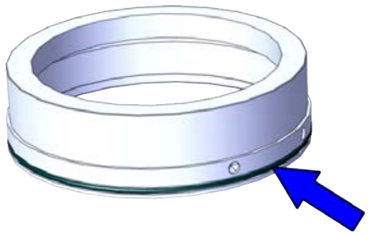
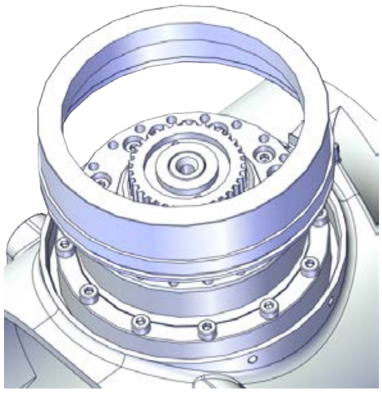
	Action	Note
2	Secure with screws.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (12 pcs) Tightening torque: 1.8 Nm  xx1800003284
3	Check the O-ring. Replace if damaged.	 xx1900001424
4	Refit the labyrinth sealing ring lightly and evenly. **Note** Make sure the labyrinth sealing ring is well fitted to the axis-3 gearbox without any deflection.	 xx1900001417

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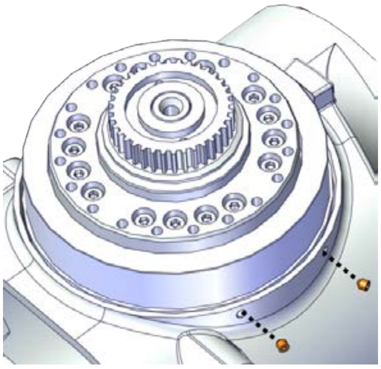
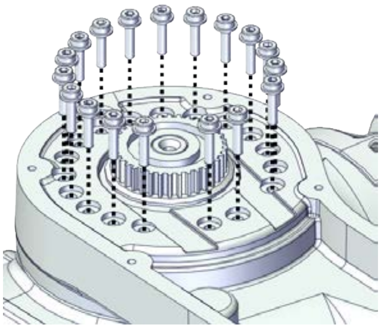
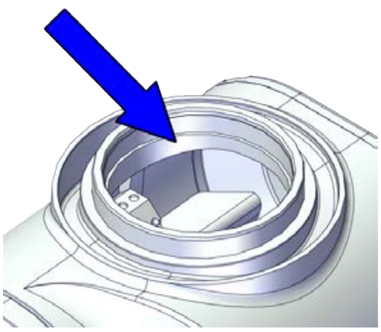
	Action	Note
5	Apply a little Loctite 243 to the screws and secure the labyrinth sealing ring with the screws.	Screw: M3x4 (2 pcs) Tightening torque: 0.8 Nm  xx1900001425

Refitting the lower arm to the housing

	Action	Note
1	Refit the lower arm to the housing. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	Flange screws (16 pcs) Tightening torque: 1.9 Nm  xx1900002190

Securing the lower arm support

	Action	Note
1	Apply grease Castrol Molub-Alloy 777-1 NG to the inner surface of the housing, where contacts the bearing on the lower arm support.	 xx2000000059

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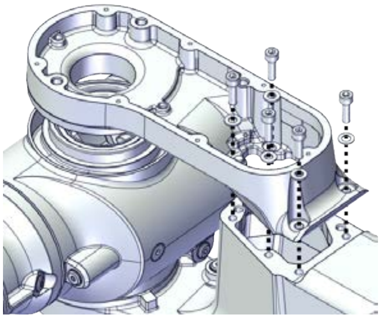
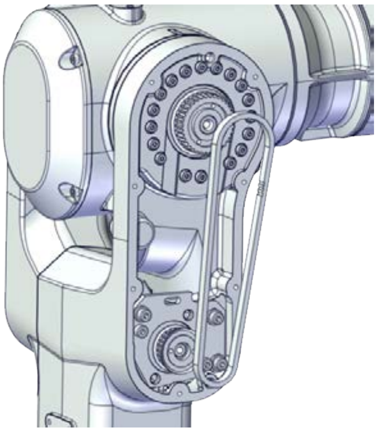
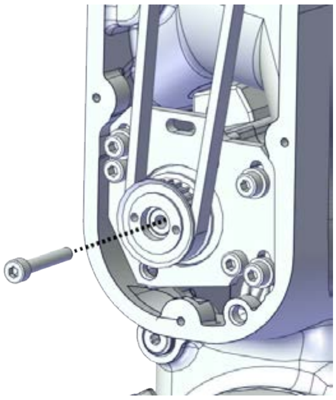
	Action	Note
2	Refit the lower arm support.	Screw: M5x16 12.9 Lafre 2C2B/FC6.9 (5 pcs) Tightening torque: 8 Nm  xx1800003088
3	Route the cable package through the lower arm support.	

Securing the axis-3 motor

	Action	Note
1	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003022
2	Install an M4x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000009

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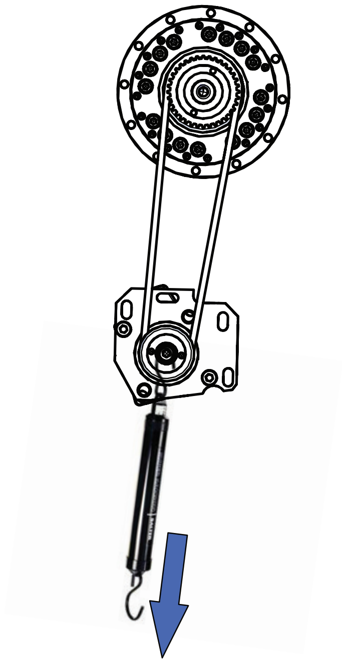
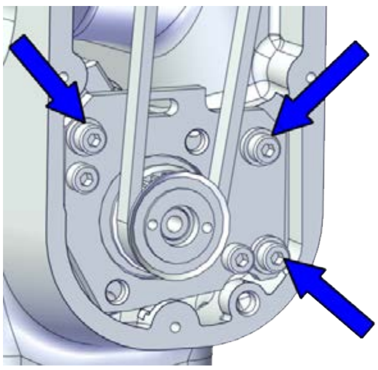
	Action	Note
3	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 21.7-23.94 N (for reference only) Initial referenced force for new belt: 31-34.2 N  xx1900000028
4	Secure the motor with the screws.	Screw: M4x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs) Tightening torque: 3 Nm  xx1800003008
5	Use a sonic tension meter to measure the timing belt tension.	Used belt: 102-109 Hz New belt: 113-143 Hz (for reference only)
6	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	

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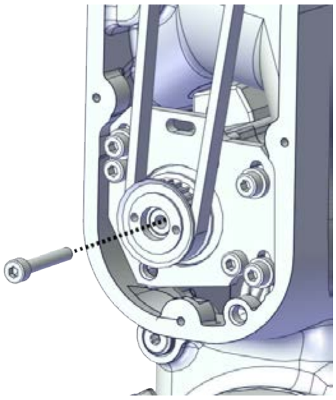
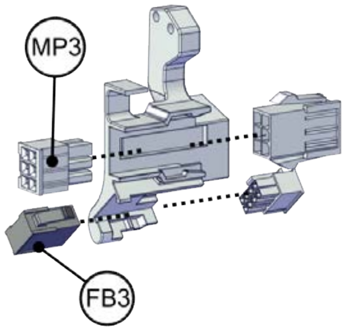
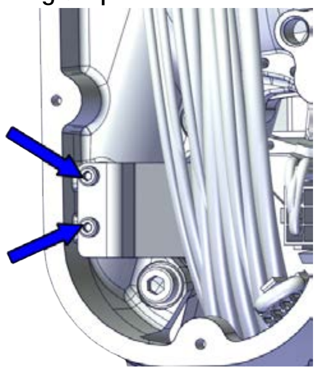
	Action	Note
7	Remove the adjustment screw from the motor.	 xx1900000009

Reconnecting the axis-3 motor connectors

	Action	Note
1	Slide the connectors into the connector plate and reconnect the connectors. • FB3 • MP3 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003005
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003006

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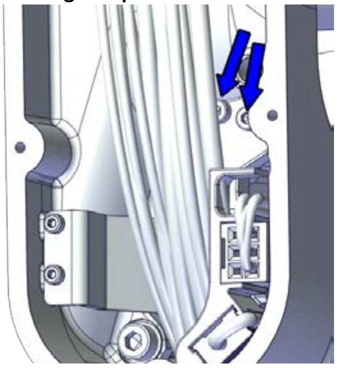
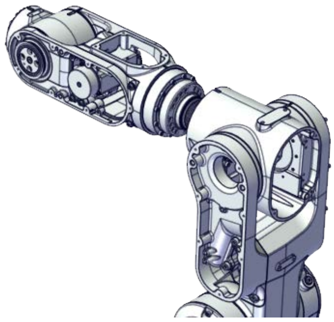
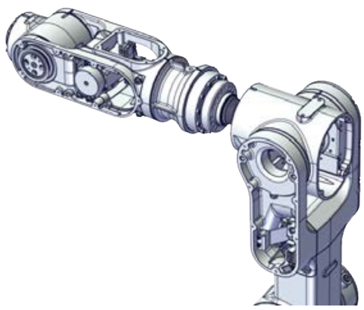
	Action	Note
4	Refit the connector plate.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.4 Nm  xx1800003004

Refitting the housing

	Action	Note
1	**Valid for CRB 1100-4/0.475** Refit the the wrist to the housing.	 xx1800003075
2	Refit the extender unit and wrist to the housing.	 xx1800003100

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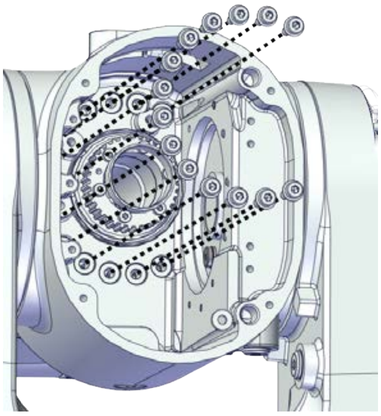
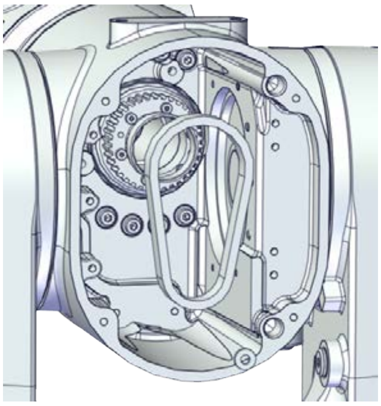
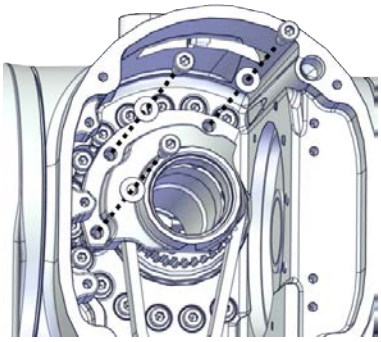
	Action	Note
3	Refit the screws and washers. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	Flange screws (14 pcs) Tightening torque: 1.9 Nm  xx1900002191

Refitting the axis-4 timing belt and pulley cover

	Action	Note
1	Install the timing belt to the gearbox pulley and verify that the belt runs correctly in the groove of the pulley.	 xx1800003098
2	Refit the pulley cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.2 Nm  xx1800003097

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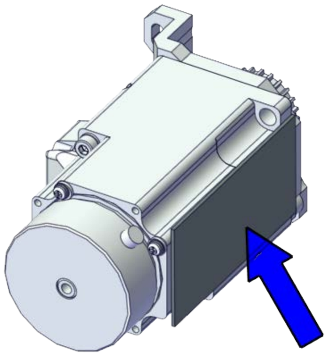
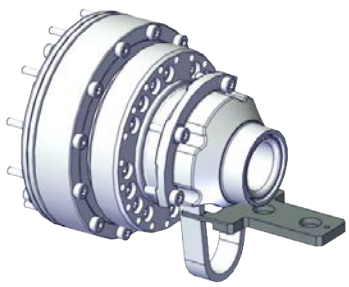
Refitting the axis-4 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged.	Cooling pad for axis-3 and -4 motors: 3HAC071021-001  xx1800003605
3	Use the motor fitting tool to fix the timing belt.	axis-4 motor fitting tool, included in the special toolkit 3HAC071022-001.  xx1900000044

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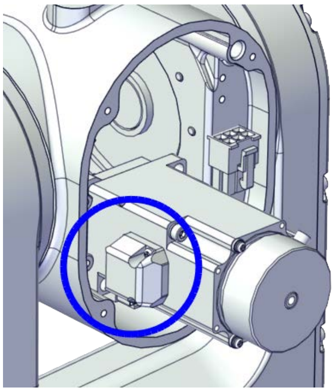
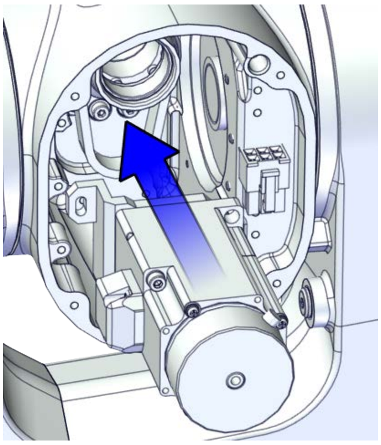
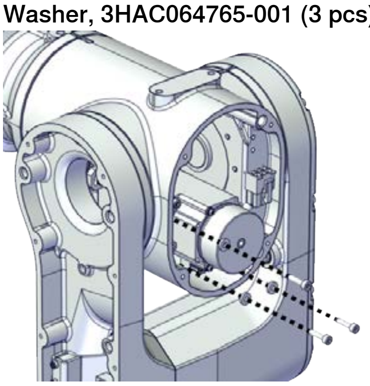
	Action	Note
4	Orient the motor correctly and fit it into the housing. **Note** Make sure the motor flange does not press on the timing belt.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003287
5	Install the timing belt to the motor pulley.	 xx1800003617
6	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC064765-001 (3 pcs)  xx1800003095
7	Remove the motor fitting tool.	

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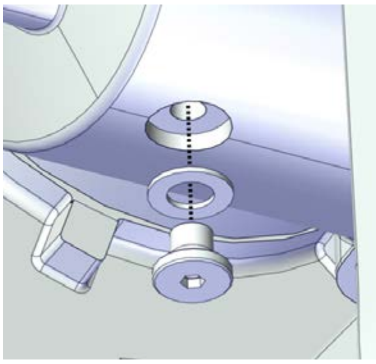
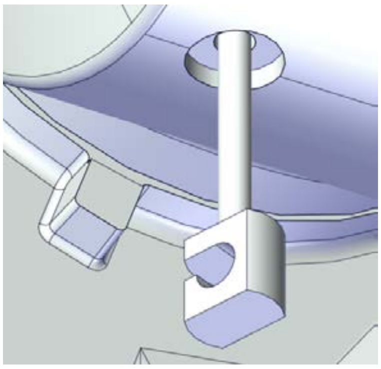
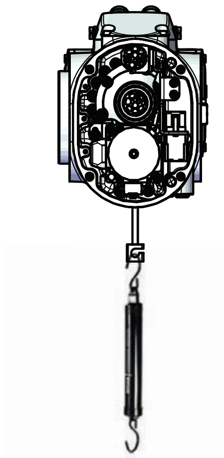
Adjusting the axis-4 timing belt tension

	Action	Note
1	Remove the screw and washer below the housing.	 xx1900000036
2	Fit an M3x25 eye bolt o the screw hole.	 xx1900000037
3	Use a handheld dynamometer hooking to the eye bolt.	 xx1900000038

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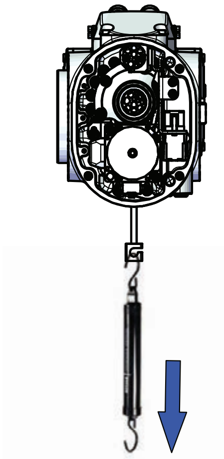
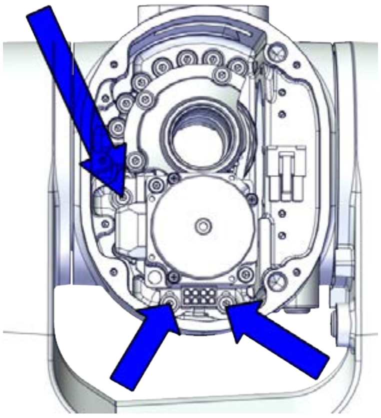
	Action	Note
4	Pull the dynamometer to make the tension falling in the allowed force range. **Note** Pay attention to the force application direction.	Used belt: 20.09-22.05 N New belt:28.7-31.5 N  xx1900000039
5	Secure the motor with the screws.	Tightening torque: 1.4 Nm  xx1800003094
6	Remove eye bolt and refit the screw and washer below the housing.	Plug screw: 3HAC064146-001 Tightening torque: 2 Nm

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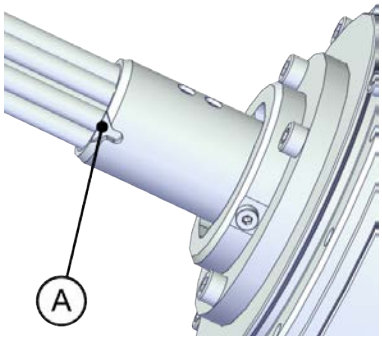
Refitting the upper cable harness through the axis-4 gearbox

	Action	Note
1	Insert the cable package from the lower arm support, into the housing and through the axis-4 gearbox. **Tip** Wrap the connectors with the masking tape. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	Cable protection tube orientation: use the notch (A) on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole on the gearbox.  xx1800003017

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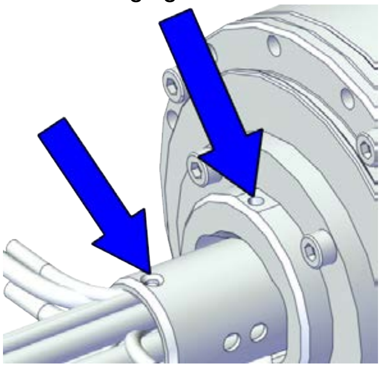
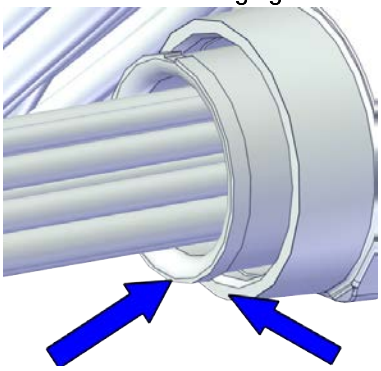
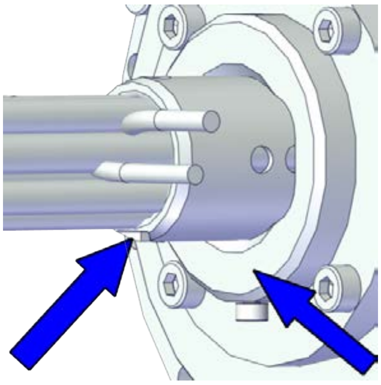
Securing the upper cable package to the axis-4 gearbox

	Action	Note
1	Make sure that: • The hole on the cable protection tube is aligned with the locking screw hole on the gearbox. • The cable protection tube surface is completely parallel with the pulley cover at one side and with the flange at the other side.	Holes to be aligned are shown in the following figure.  xx1800003018 Surfaces to be paralleled are shown in the following figures.  xx1800003019  xx1800003020

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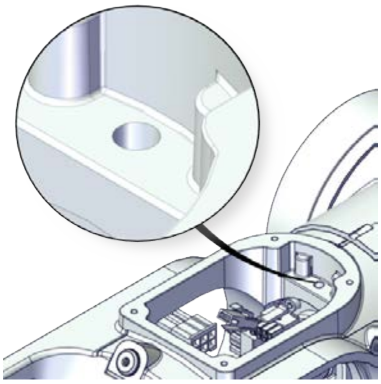
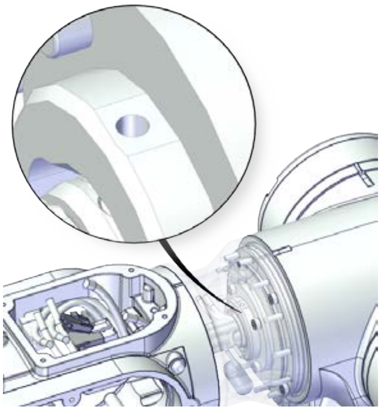
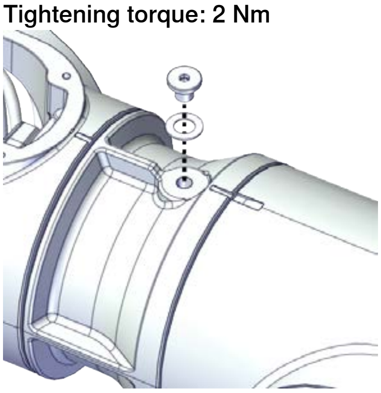
	Action	Note
2	Apply a little Loctite 243 to the locking screw and refit the locking screw. **Note** Make sure the locking screw header is parallel with flange surface. **Note** If there is locking liquid residues on the screw or screw hole, please clean it before refitting. Remove residual locking liquid after refitting.	Screw: M3x8 (1 pcs) Tightening torque: 0.4 Nm **Valid for CRB 1100-4/0.475**  xx1800003031  xx1800003001
3	Refit the plug screw and washer on the extender unit.	Plug screw: 3HAC064146-001 Tightening torque: 2 Nm  xx1800003000

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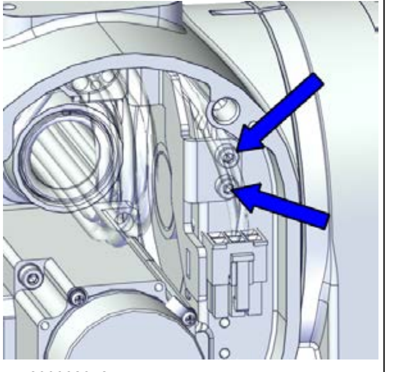
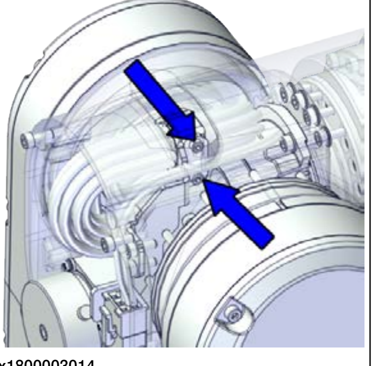
Securing the upper cable package to the housing

	Action	Note
1	Refit the cable bracket.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800003013 Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003014
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

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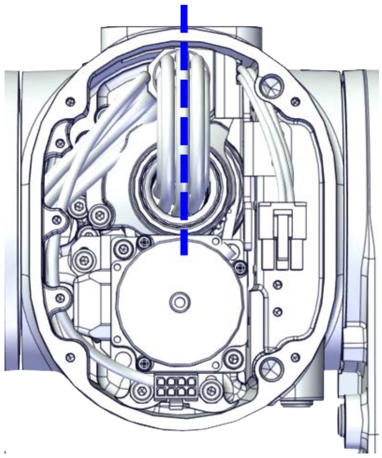
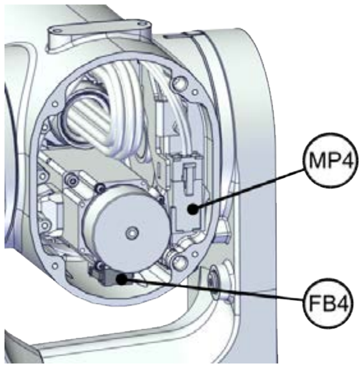
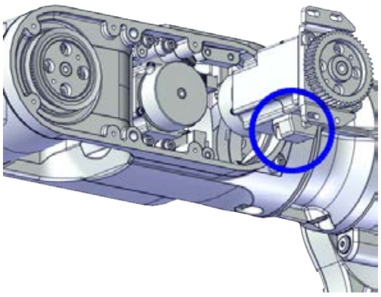
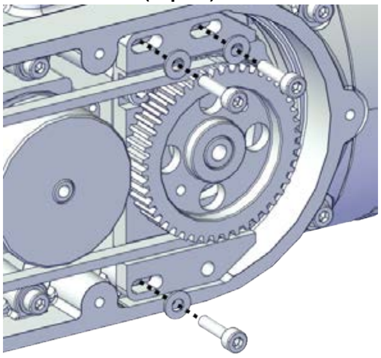
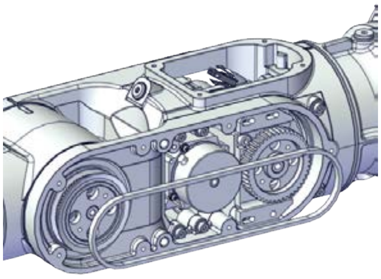
Reconnecting the axis-4 motor connectors

	Action	Note
1	Check the cabling status. Make sure the cabling is in vertical state and is not twisted.	 xx1800003618
2	Reconnect the connectors. • FB4 • MP4 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003012

Refitting the axis-6 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	

Continues on next page

	Action	Note
2	Orient the motor correctly and fit it into the lower arm. **Tip** Leave the connectors FB5 and FB6 accessible from the process hub and the connectors MP5 and MP6 accessible from wrist side.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003023
3	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs)  xx1800002996
4	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003024

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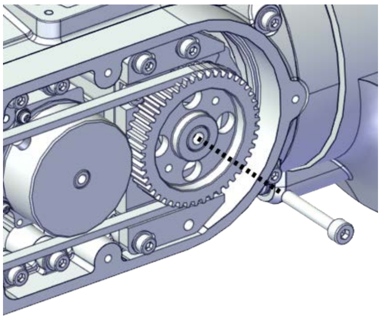
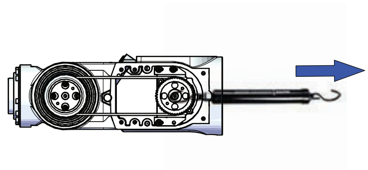
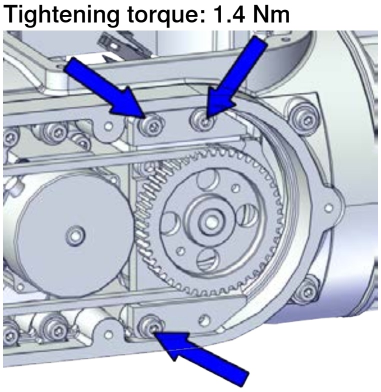
	Action	Note
5	Install an M4x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000007
6	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 8.96-9.8 N (for reference only) Initial referenced force for new belt: 12.8-14  xx1900000026
7	Secure the motor with the screws.	Tightening torque: 1.4 Nm  xx1800002995
8	Use a sonic tension meter to measure the timing belt tension.	Used belt: 81.3-86.9 Hz New belt:90-114 Hz (for reference only)
9	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	

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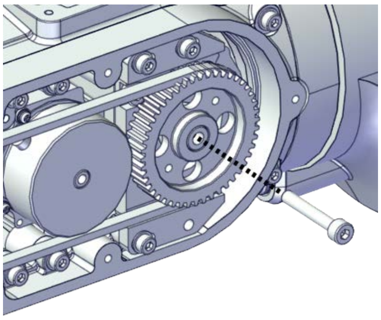
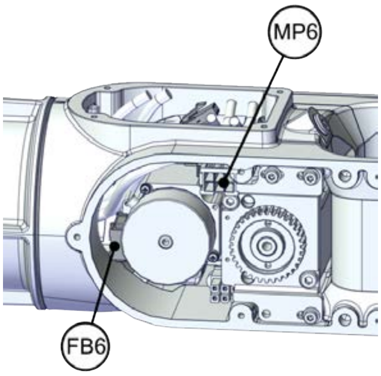
	Action	Note
10	Remove the adjustment screw from the motor.	 xx1900000007

Reconnecting the axis-6 motor connectors

	Action	Note
1	Reconnect the connectors. • FB6 • MP6 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002994
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Insert the cabling and connectors into the wrist.	

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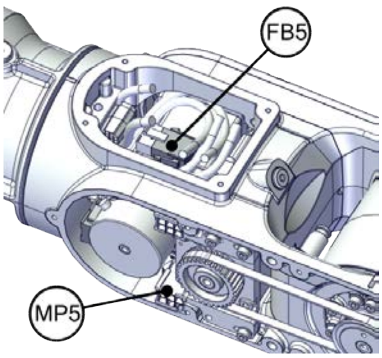
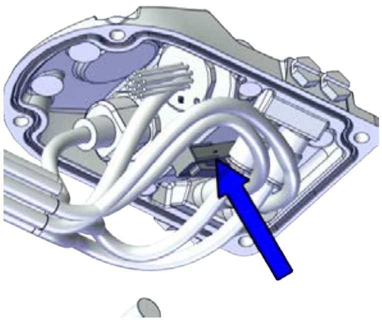
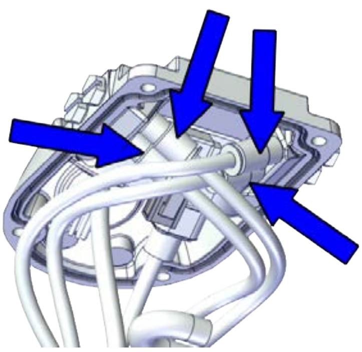
Reconnecting the axis-5 motor connectors

	Action	Note
1	Reconnect the connectors. • FB5 • MP5 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003025
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Insert the cabling and connectors into the wrist.	

Refitting the process hub

	Action	Note
1	Reconnect the lamp unit connector J5.UL and place the connector behind the air hose connectors.	 xx1800002946
2	Reconnect the air hoses in a cross pattern. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	 xx1800002945

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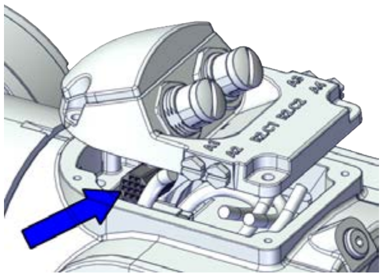
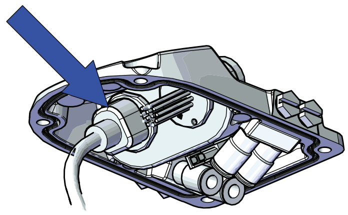
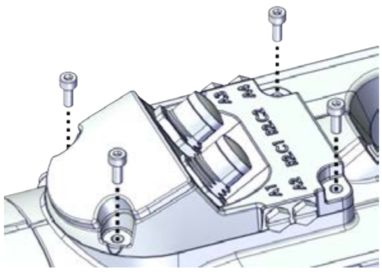
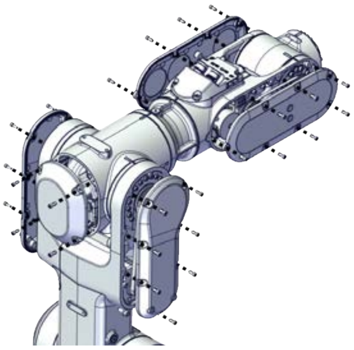
	Action	Note
3	**For robots with CP/CS cabling** Reconnect the connector. • J5.C1	 xx2100000293
4	**For robots with Ethernet cabling** Reconnect the connector J5.C2 using the tool.	J5.C2 connector assembly tool, included in the special toolkit 3HAC071022-001  xx1800002948
5	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
6	Refit the cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.2 Nm  xx2000002219

Refitting the covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	

Continues on next page

	Action	Note
3	Refit the covers. • Wrist covers • Lower arm cover • Lower arm support cover • Housing cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003611

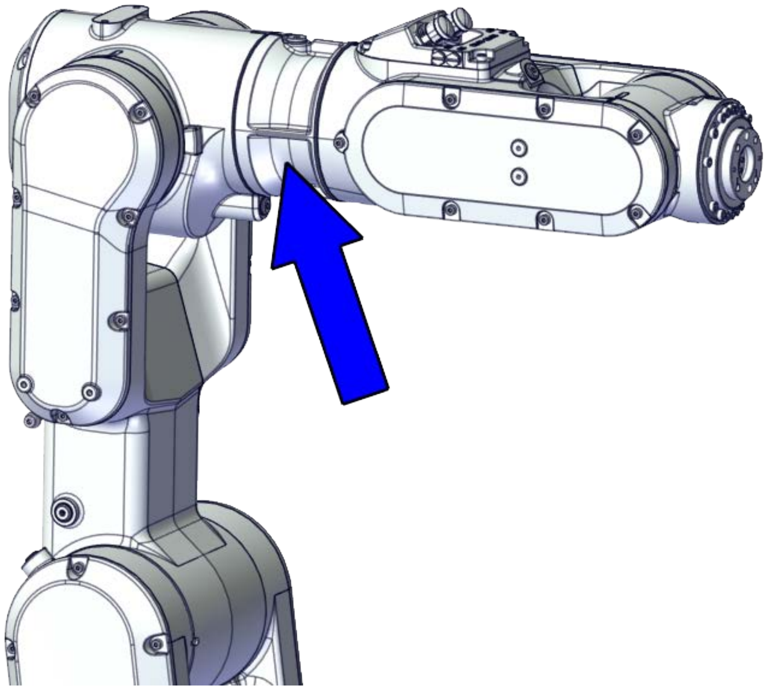
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

5.6.2 Replacing the extender unit and wrist

Location of the extender unit and wrist

The CRB 1100-4/0.58 has an extender unit connecting the housing and wrist, which is located as shown in the figure.



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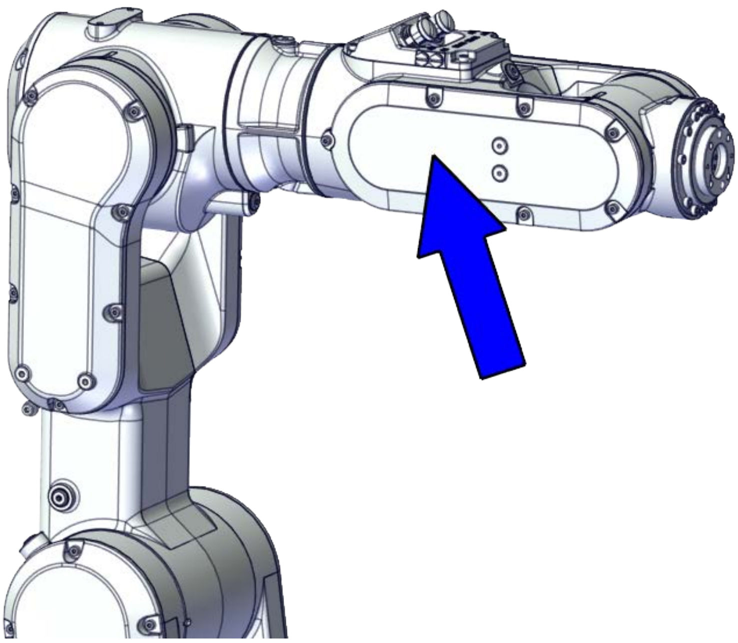
The wrist is located as shown in the figure.



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Required spare parts

Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the CRB 1100 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Process hub with lamp unit (CP/CS and air hose, with Ethernet)	3HAC077335-001	
Extender unit	3HAC069037-001	Used for CRB 1100-4/0.58.
Wrist	3HAC075794-001	
Gear unit with pulley, axis 4	3HAC073519-001	
Motor with flange, axis 4	3HAC083586-001	
Timing belt, axis 4	3HAC061937-001	
Motor with flange, axis 5	3HAC083585-001	
Timing belt, axis 5	3HAC061938-001	
Motor with flange, axis 6	3HAC083584-001	
Timing belt, axis 6	3HAC061939-001	
Housing cover	3HAC069054-001	

Continues on next page

Spare part	Article number	Note
Wrist cover	3HAC069061-001	
Lower arm cover	3HAC069057-001	
Lower arm support cover	3HAC069059-001	
Cooling pad for axis-3 and -4 motors	3HAC071021-001	Cooling pads are wear parts. One cooling pad sheet includes 10 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel
Washer	3HAC064765-001	7x3.2x1.5, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.
axis-4 motor fitting tool	-	Included in the special toolkit 3HAC071022-001. Used to refit the axis-4 motor.
M3x25 eye bolt	-	Included in the special toolkit 3HAC071022-001.
J5.C2 connector assembly tool	-	Included in the special toolkit 3HAC071022-001. Used to remove and refit the J5.C2 connector, if the Ethernet cabling is equipped.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)

Continues on next page

Deciding calibration routine

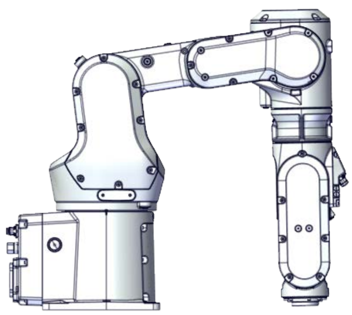
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the extender unit and wrist

Use these procedures to remove the extender unit and wrist.

Preparations before removing the extender unit and wrist

	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: 0° • Axis 2: 110° (CRB 1100-4/0.475) /95° (CRB 1100-4/0.58) • Axis 3: -20° (CRB 1100-4/0.475)/ -6° (CRB 1100-4/0.58) • Axis 4: 0° • Axis 5: 0° • Axis 6: No significance.	 xx1800003289

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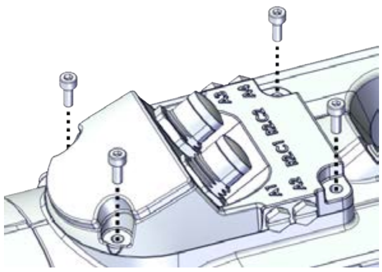
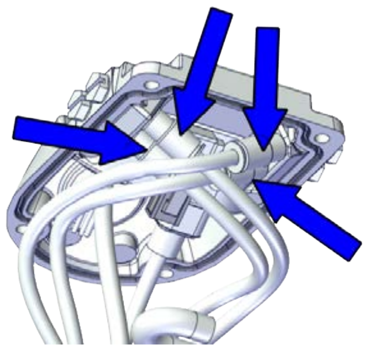
	Action	Note
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the process hub

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and carefully open the cover. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	 xx2000002219
3	Disconnect the air hoses.	 xx1800002945

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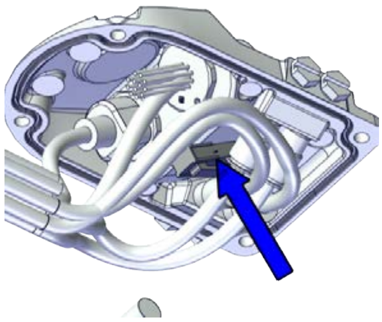
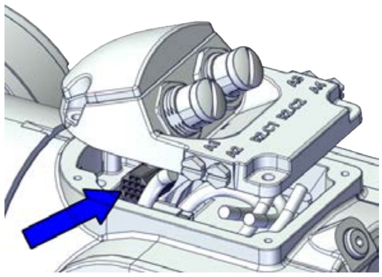
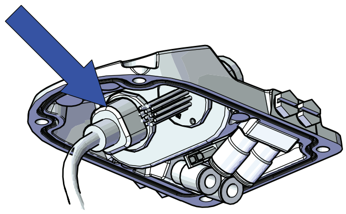
	Action	Note
4	Carefully pull out lamp unit connector behind the air hose connectors and disconnect the connector J5.UL.	 xx1800002946
5	**For robots with CP/CS cabling** Disconnect the connector. • J5.C1	 xx2100000293
6	**For robots with Ethernet cabling** Disconnect the connector J5.C2 using the tool.	J5.C2 connector assembly tool: -  xx1800002948

Removing the wrist covers

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

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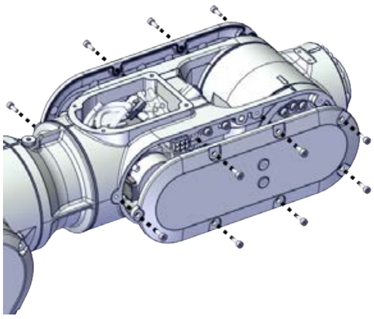
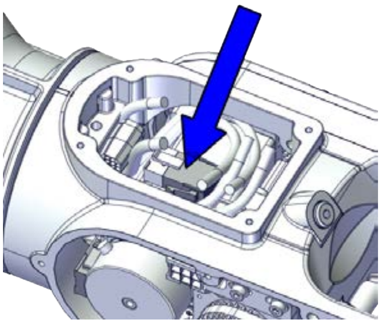
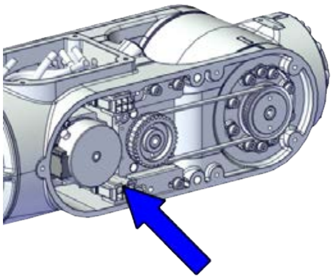
	Action	Note
2	Remove the wrist covers from both sides.	 xx1800002949

Disconnecting the axis-5 motor connectors

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Access the connector FB5 from the process hub and disconnect the connector.	 xx1800002950
3	Disconnect the connector. • MP5	 xx1800002993

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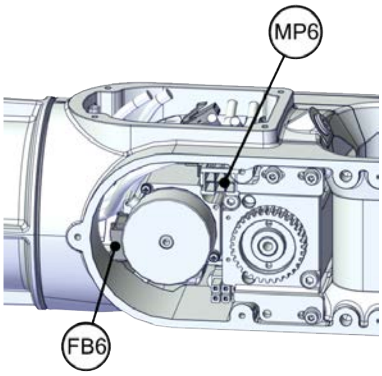
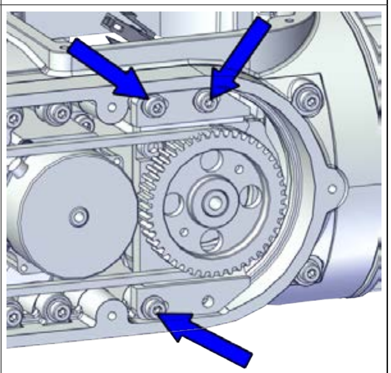
Disconnecting the axis-6 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • MP6 • FB6	 xx1800002994

Removing the axis-6 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002995

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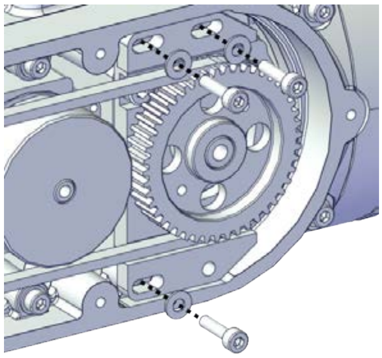
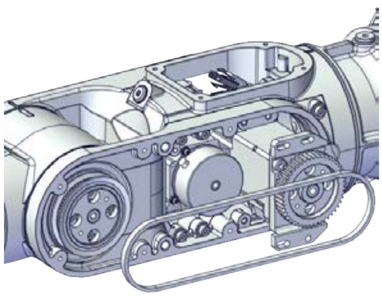
	Action	Note
4	Remove the screws and washers.	 xx1800002996
5	Carefully lift out the motor.	
6	Remove the timing belt from its groove on the motor.	 xx1800002997

Removing the axis-5 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	

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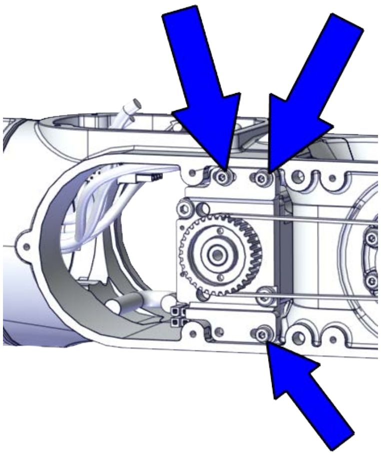
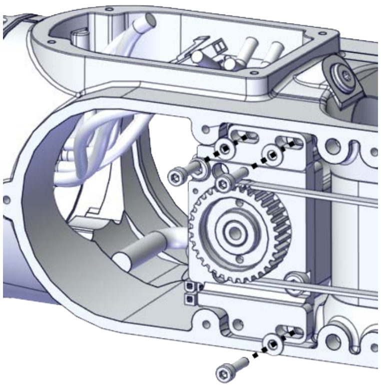
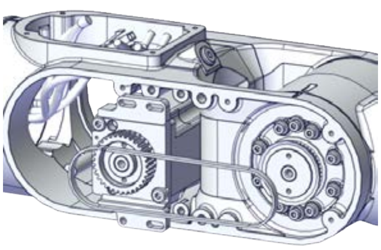
	Action	Note
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003293
4	Remove the screws and washers.	 xx1800003294
5	Carefully lift out the motor.	
6	Remove the timing belt from its groove on the motor.	 xx1800003295

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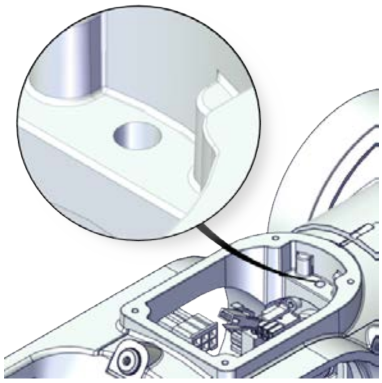
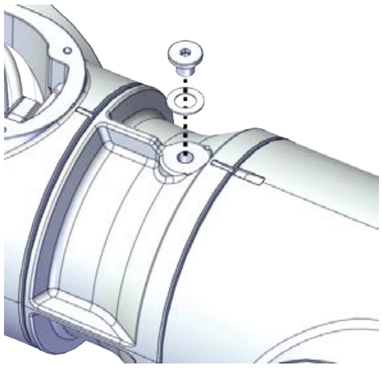
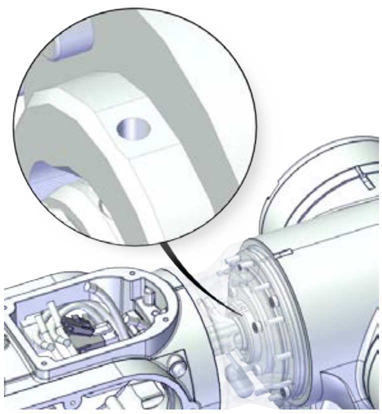
Loosening the cable package from axis-4 gearbox

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**Valid for CRB 1100-4/0.475** Access the cable package locking screw on the axis-4 gearbox from the wrist and then loosen the locking screw.	 xx1800003031
3	Remove the plug screw and washer on the extender unit to access the cable package locking screw on the axis-4 gearbox and then loosen the locking screw.	 xx1800003000  xx1800003001

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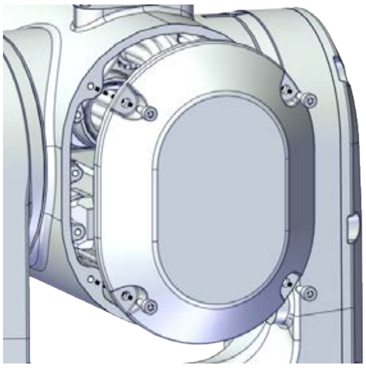
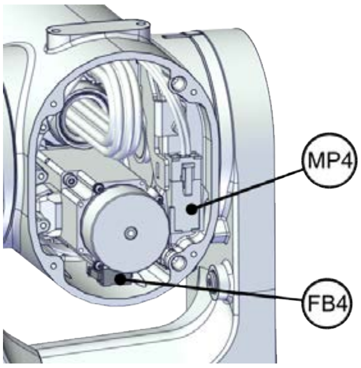
Disconnecting the axis-4 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the housing cover.	 xx1800003011
3	Disconnect the motor connectors. • FB4 • MP4	 xx1800003012

Separating the upper cable package from the housing

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

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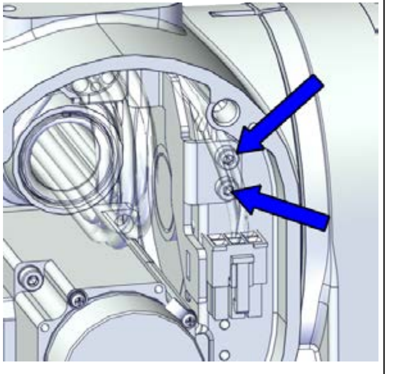
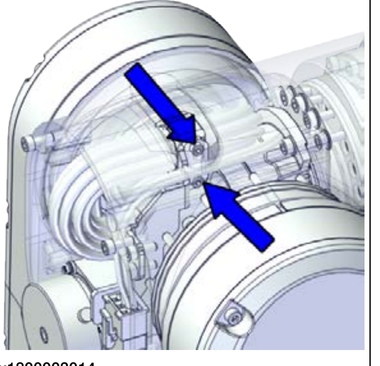
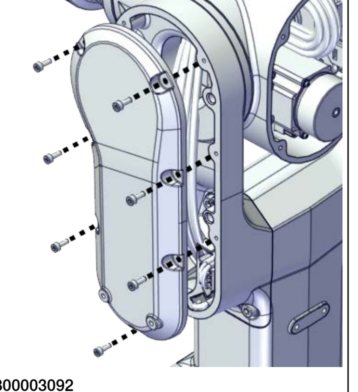
	Action	Note
2	Remove the cable bracket.	 xx1800003013  xx1800003014

Pulling out the upper cable harness

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the lower arm support cover.	 xx1800003092

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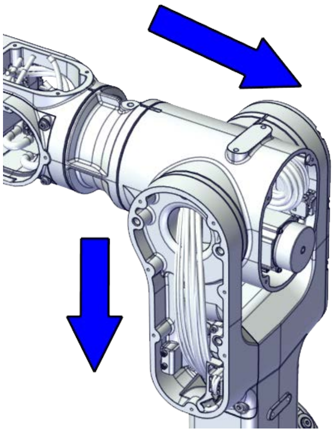
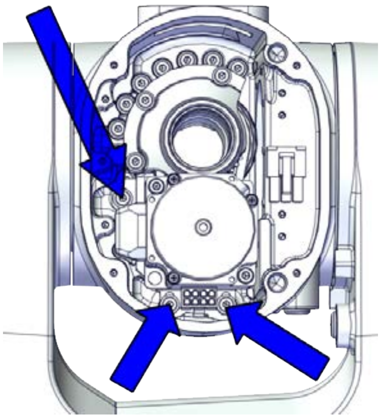
	Action	Note
3	Pull out the upper cable harness from the housing, out from the lower arm support.	 xx1800003093

Removing the axis-4 motor

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	 **CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003094

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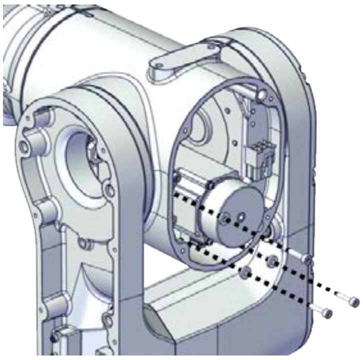
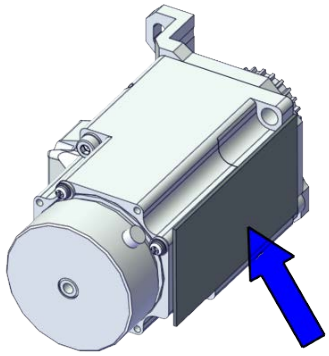
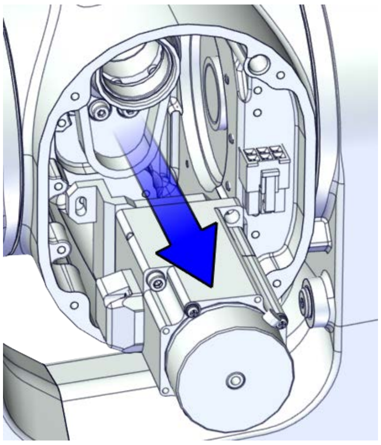
	Action	Note
4	Remove the screws and washers.	 xx1800003095
5	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad.	Cooling pad location  xx1800003605
6	Remove the timing belt from its groove on the motor.	 xx1800003096

Removing the pulley cover and axis-4 timing belt

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

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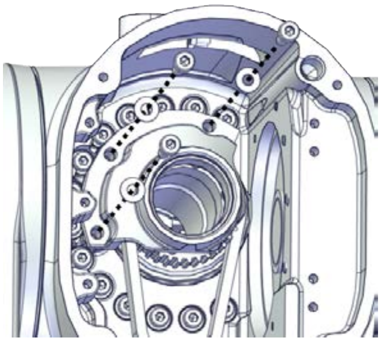
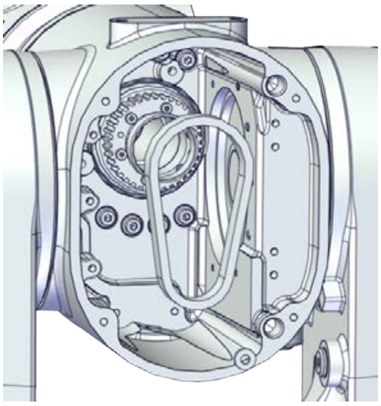
	Action	Note
2	**CAUTION** Loosening timing belts will release axes. This means the axes can fall down. Make sure axes are well supported before loosening timing belts.	
3	Remove the pulley cover.	 xx1800003097
4	Remove the timing belt from its groove on the gearbox.	 xx1800003098

Separating the housing

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

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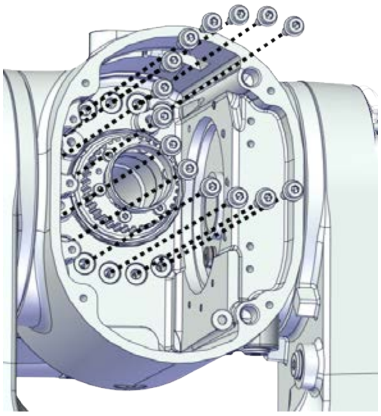
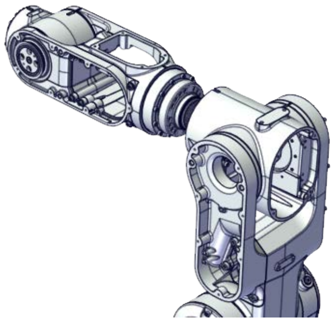
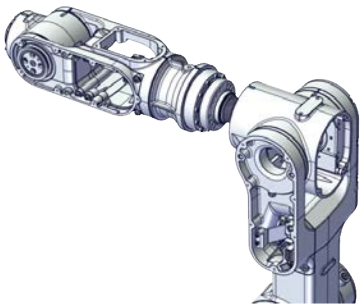
	Action	Note
2	Remove the screws. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	 xx1900002191
3	**Valid for CRB 1100-4/0.475** Separate the wrist from the housing.	 xx1800003299
4	Separate the extender unit and wrist from the housing.	 xx1800003298

Removing the axis-4 gearbox

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

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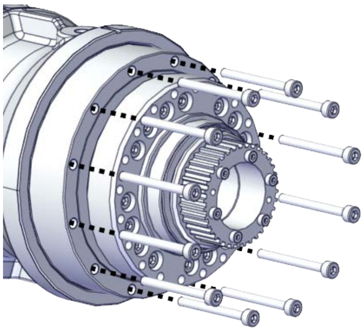
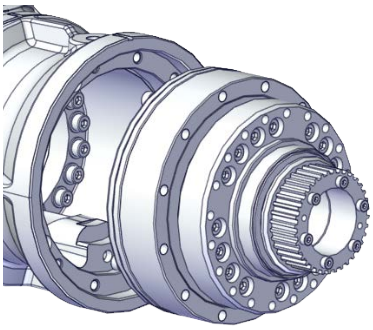
	Action	Note
2	**CAUTION** Removing gearboxes will release axes. This means the axes can fall down. Make sure axes are well supported before removing gearboxes.	
3	Remove the screws.	 xx1800003300
4	Pull out the gearbox.	 xx1800003310

Separating the extender unit and wrist

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

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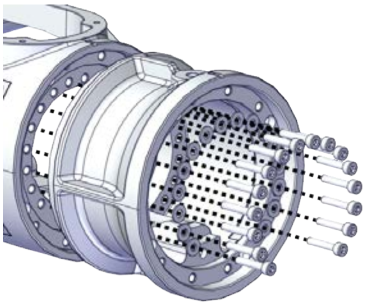
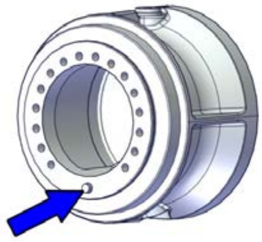
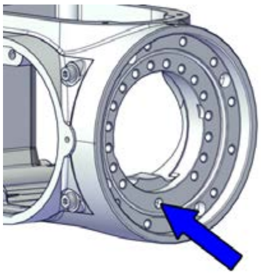
	Action	Note
2	Separate the extender unit from the wrist.	 xx1800003311

Refitting the extender unit and wrist

Use these procedures to refit the extender unit and wrist.

Refitting the extender unit to the wrist

	Action	Note
1	Align the parallel pin on the extender unit with the pin hole on the wrist. **Note** Some robots may not have the parallel pin. In those cases, order one and press fit it to the extender unit.	Parallel pin: 3HAC050369-032  xx2100001504  xx2100001505

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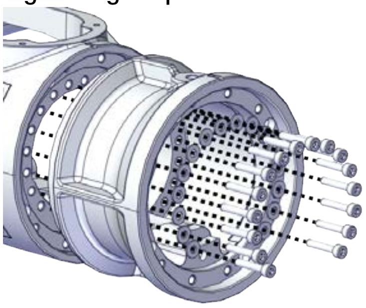
	Action	Note
2	Refit the extender unit to the wrist.	Screw: M3x16 12.9 Lafre 2C2B/FC6.9 (16 pcs) Tightening torque: 2 Nm  xx1800003311

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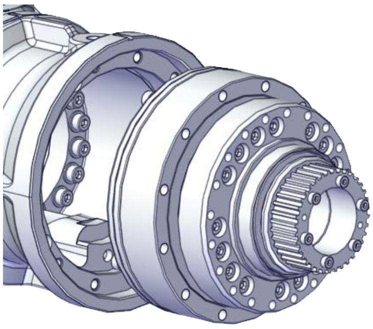
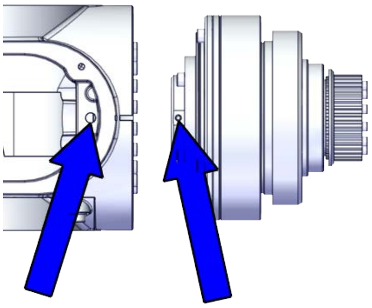
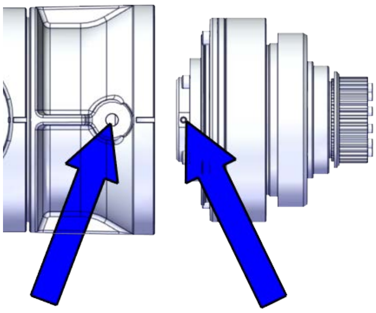
Refitting the axis-4 gearbox

	Action	Note
1	Refit the axis-4 gearbox. Make sure the locking screw holes on the gearbox and extender unit or wrist are aligned with each other.	 xx1800003310 **Valid for CRB 1100-4/0.475**  xx1800003313  xx1800003312

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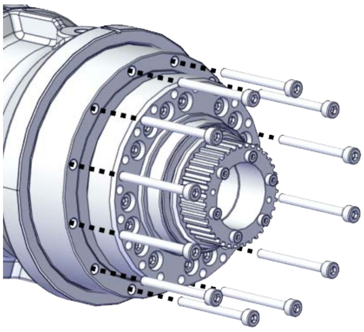
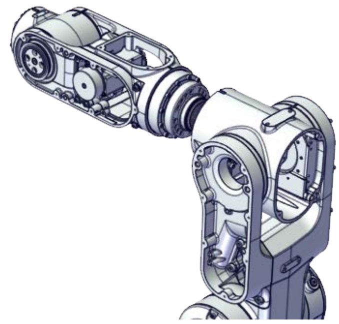
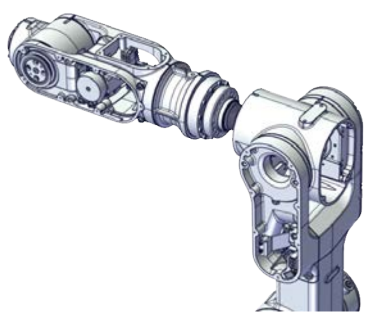
	Action	Note
2	Secure with screws.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (12 pcs) Tightening torque: 1.8 Nm  xx1800003300

Refitting the housing

	Action	Note
1	**Valid for CRB 1100-4/0.475** Refit the the wrist to the housing.	 xx1800003075
2	Refit the extender unit and wrist to the housing.	 xx1800003100

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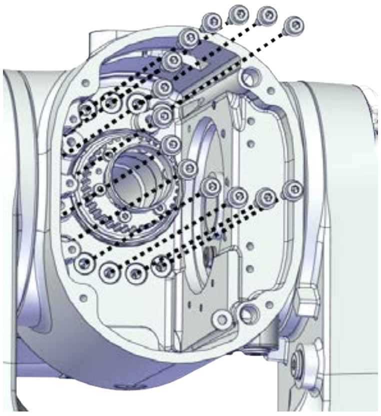
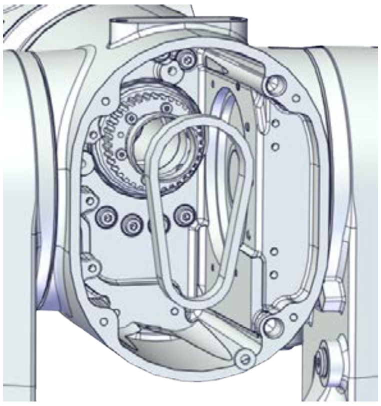
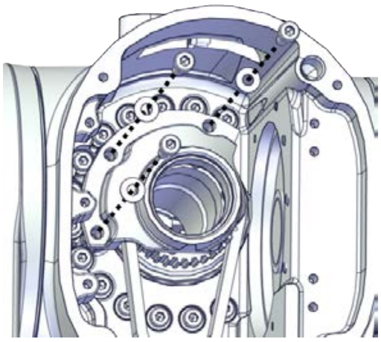
5.6.2 Replacing the extender unit and wrist

Continued

	Action	Note
3	Refit the screws and washers. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	Flange screws (14 pcs) Tightening torque: 1.9 Nm  xx1900002191

Refitting the axis-4 timing belt and pulley cover

	Action	Note
1	Install the timing belt to the gearbox pulley and verify that the belt runs correctly in the groove of the pulley.	 xx1800003098
2	Refit the pulley cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.2 Nm  xx1800003097

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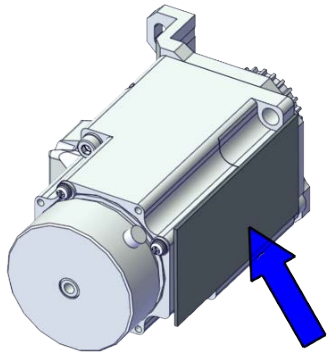
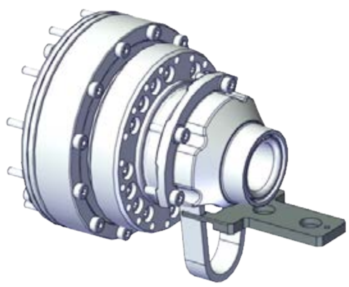
Refitting the axis-4 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged.	Cooling pad for axis-3 and -4 motors: 3HAC071021-001  xx1800003605
3	Use the motor fitting tool to fix the timing belt.	axis-4 motor fitting tool, included in the special toolkit 3HAC071022-001.  xx1900000044

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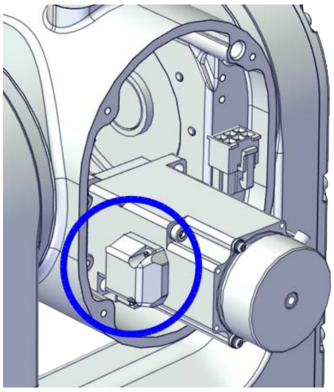
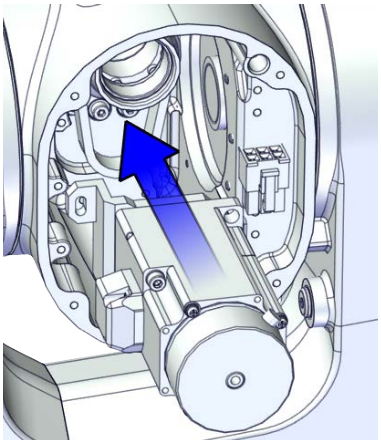
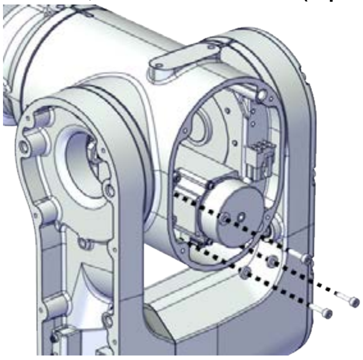
	Action	Note
4	Orient the motor correctly and fit it into the housing. **Note** Make sure the motor flange does not press on the timing belt.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003287
5	Install the timing belt to the motor pulley.	 xx1800003617
6	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC064765-001 (3 pcs)  xx1800003095
7	Remove the motor fitting tool.	

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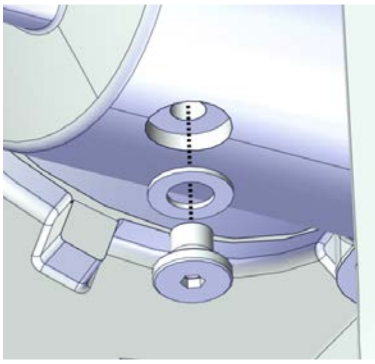
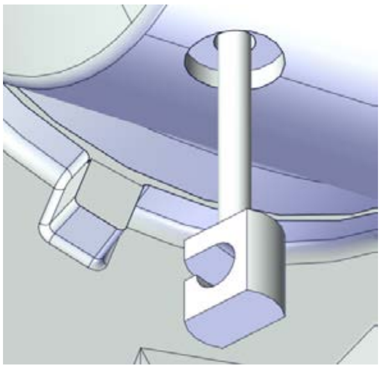
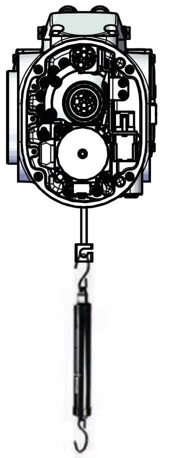
Adjusting the axis-4 timing belt tension

	Action	Note
1	Remove the screw and washer below the housing.	 xx1900000036
2	Fit an M3x25 eye bolt o the screw hole.	 xx1900000037
3	Use a handheld dynamometer hooking to the eye bolt.	 xx1900000038

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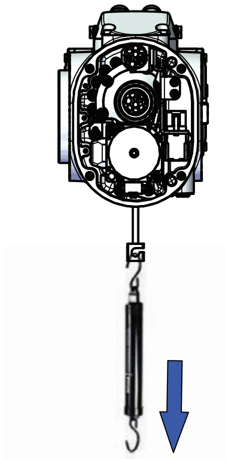
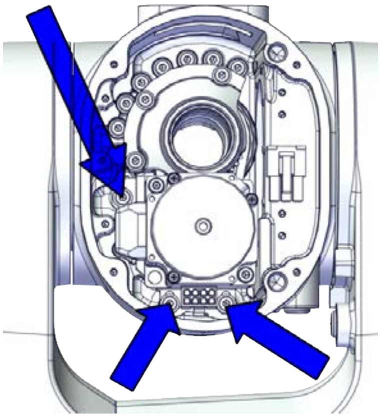
	Action	Note
4	Pull the dynamometer to make the tension falling in the allowed force range. **Note** Pay attention to the force application direction.	Used belt: 20.09-22.05 N New belt:28.7-31.5 N  xx1900000039
5	Secure the motor with the screws.	Tightening torque: 1.4 Nm  xx1800003094
6	Remove eye bolt and refit the screw and washer below the housing.	Plug screw: 3HAC064146-001 Tightening torque: 2 Nm

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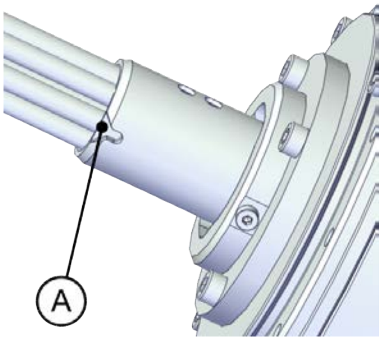
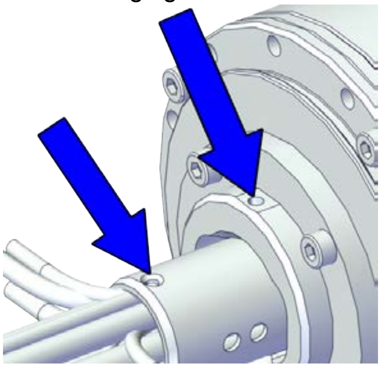
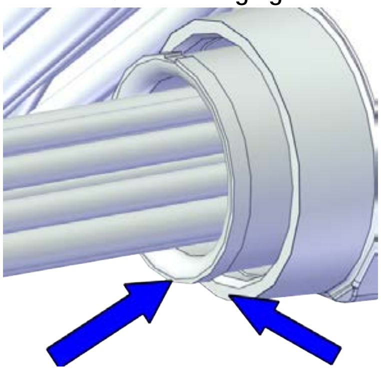
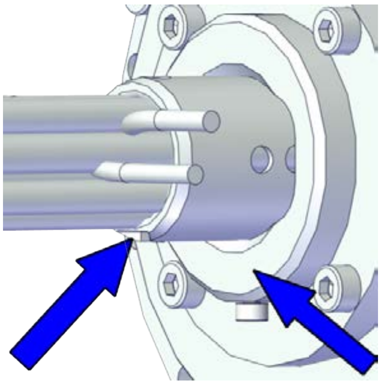
Refitting the upper cable harness through the axis-4 gearbox

	Action	Note
1	Insert the cable package from the lower arm support, into the housing and through the axis-4 gearbox. **Tip** Wrap the connectors with the masking tape. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	Cable protection tube orientation: use the notch (A) on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole on the gearbox.  xx1800003017

Continues on next page

Securing the upper cable package to the axis-4 gearbox

	Action	Note
1	Make sure that: • The hole on the cable protection tube is aligned with the locking screw hole on the gearbox. • The cable protection tube surface is completely parallel with the pulley cover at one side and with the flange at the other side.	Holes to be aligned are shown in the following figure.  xx1800003018 Surfaces to be paralleled are shown in the following figures.  xx1800003019  xx1800003020

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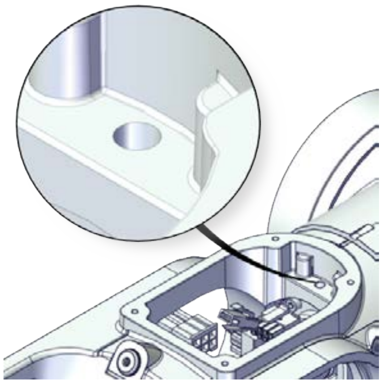
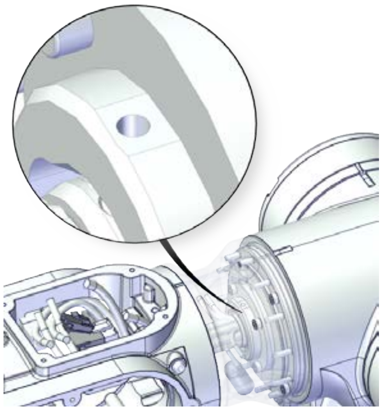
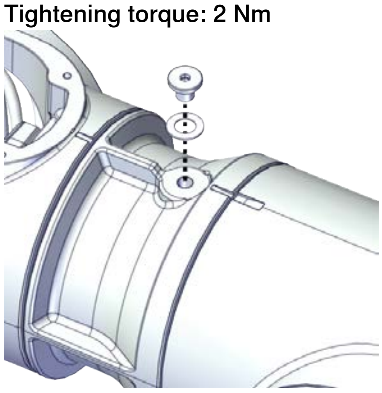
	Action	Note
2	Apply a little Loctite 243 to the locking screw and refit the locking screw. **Note** Make sure the locking screw header is parallel with flange surface. **Note** If there is locking liquid residues on the screw or screw hole, please clean it before refitting. Remove residual locking liquid after refitting.	Screw: M3x8 (1 pcs) Tightening torque: 0.4 Nm **Valid for CRB 1100-4/0.475**  xx1800003031  xx1800003001
3	Refit the plug screw and washer on the extender unit.	Plug screw: 3HAC064146-001 Tightening torque: 2 Nm  xx1800003000

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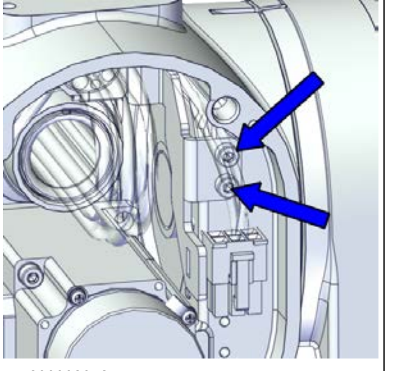
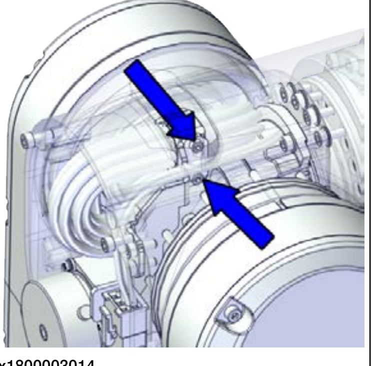
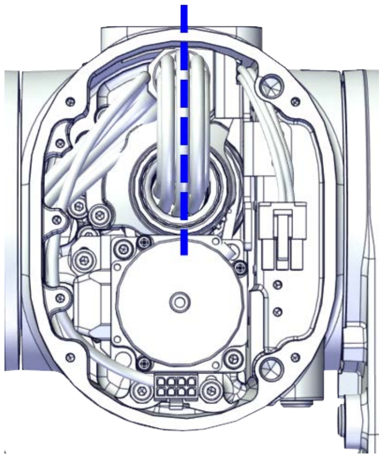
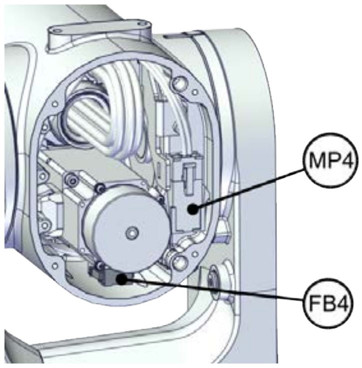
Securing the upper cable package to the housing

	Action	Note
1	Refit the cable bracket.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800003013 Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003014
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

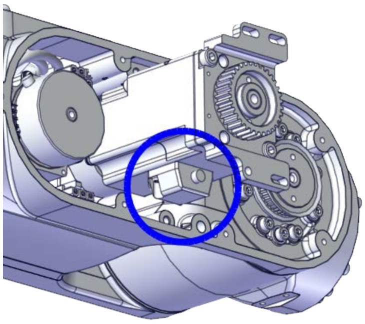
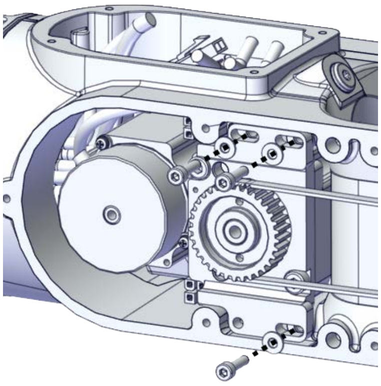
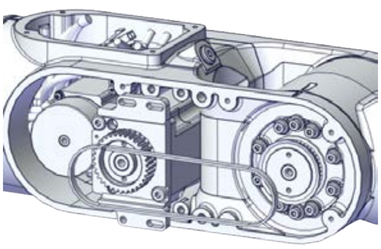
Reconnecting the axis-4 motor connectors

	Action	Note
1	Check the cabling status. Make sure the cabling is in vertical state and is not twisted.	 xx1800003618
2	Reconnect the connectors. • FB4 • MP4 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003012

Refitting the axis-5 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	

Continues on next page

	Action	Note
2	Orient the motor correctly and fit it into the wrist. **Tip** Leave the connectors FB5 and FB6 accessible from the process hub and the connectors MP5 and MP6 accessible from wrist side.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003296
3	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs)  xx1800003291
4	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003292

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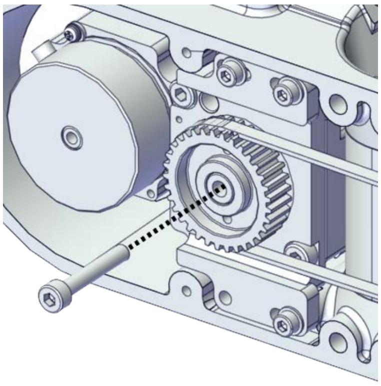
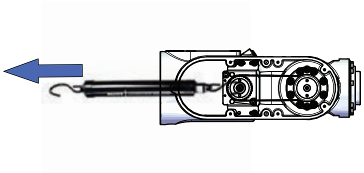
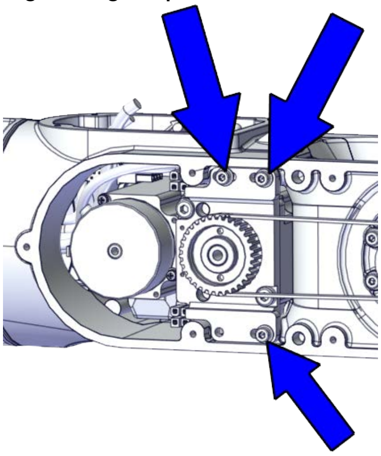
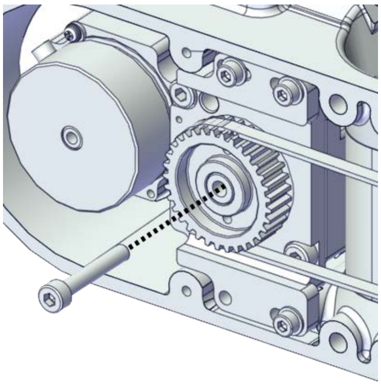
<table>
<tr><th></th><th>Action</th><th>Note</th></tr>
<tr><td>5</td><td>Install an M4x25 or longer adjustment screw to the motor.

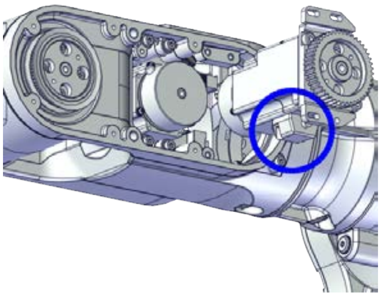
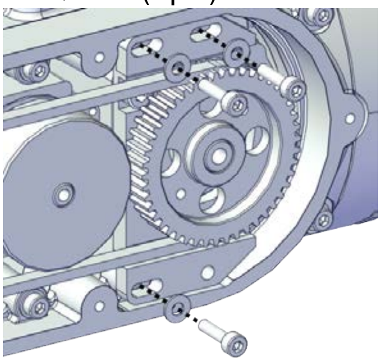
Note

Do not insert the entire screw to the hole.</td><td>
xx1900000008</td></tr>
<tr><td>6</td><td>Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.</td><td>Initial referenced force for used belt: 13.58-14.84 N (for reference only)
Initial referenced force for new belt: 19.4-21.2 N

xx1900000027</td></tr>
<tr><td>7</td><td>Secure the motor with the screws.</td><td>Tightening torque: 1.4 Nm

xx1800003290</td></tr>
<tr><td>8</td><td>Use a sonic tension meter to measure the timing belt tension.</td><td>Used belt: 151-162 Hz
New belt: 167-213 Hz (for reference only)</td></tr>
<tr><td>9</td><td>If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.</td><td></td></tr>
</table>

Continues on next page

	Action	Note
10	Remove the adjustment screw from the motor.	 xx1900000008

Refitting the axis-6 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Orient the motor correctly and fit it into the lower arm. **Tip** Leave the connectors FB5 and FB6 accessible from the process hub and the connectors MP5 and MP6 accessible from wrist side.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003023
3	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs)  xx1800002996

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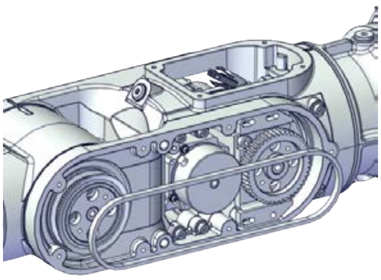
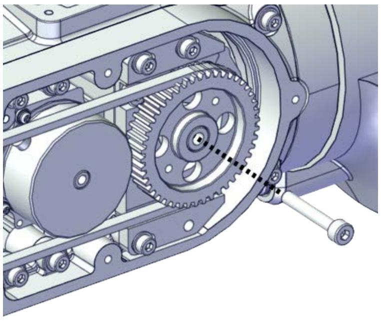
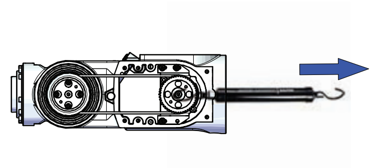
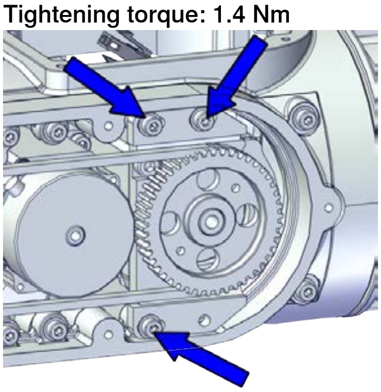
	Action	Note
4	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003024
5	Install an M4x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000007
6	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 8.96-9.8 N (for reference only) Initial referenced force for new belt: 12.8-14  xx1900000026
7	Secure the motor with the screws.	Tightening torque: 1.4 Nm  xx1800002995

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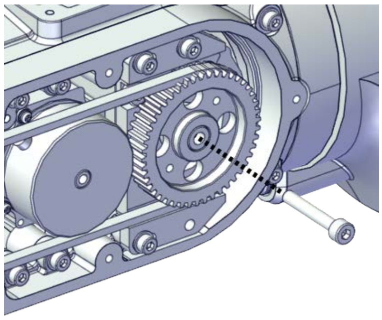
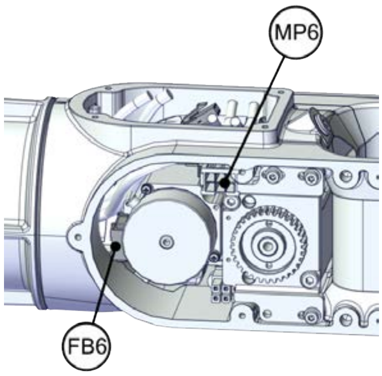
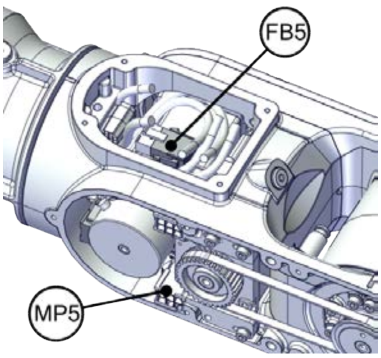
	Action	Note
8	Use a sonic tension meter to measure the timing belt tension.	Used belt: 81.3-86.9 Hz New belt:90-114 Hz (for reference only)
9	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	
10	Remove the adjustment screw from the motor.	 xx1900000007

Reconnecting the axis-6 motor connectors

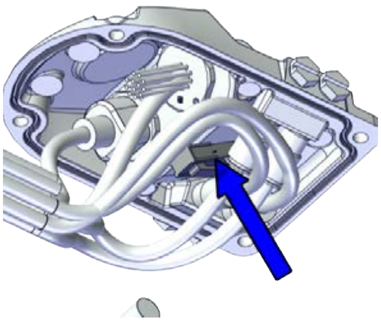
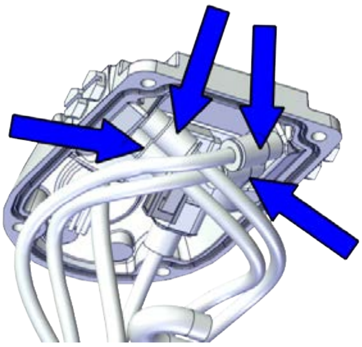
	Action	Note
1	Reconnect the connectors. • FB6 • MP6 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002994
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Insert the cabling and connectors into the wrist.	

Continues on next page

Reconnecting the axis-5 motor connectors

	Action	Note
1	Reconnect the connectors. • FB5 • MP5 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003025
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Insert the cabling and connectors into the wrist.	

Refitting the process hub

	Action	Note
1	Reconnect the lamp unit connector J5.UL and place the connector behind the air hose connectors.	 xx1800002946
2	Reconnect the air hoses in a cross pattern. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	 xx1800002945

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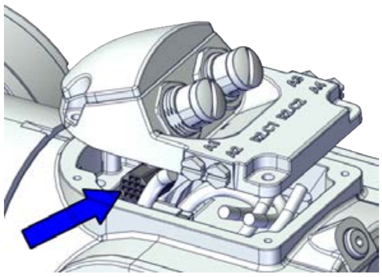
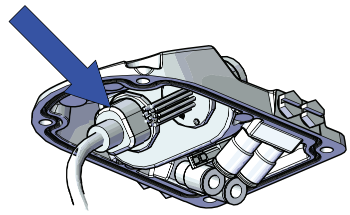
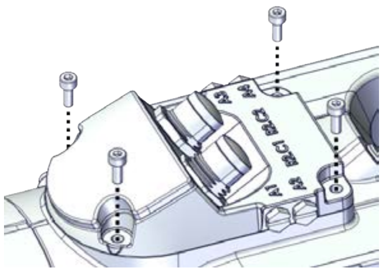
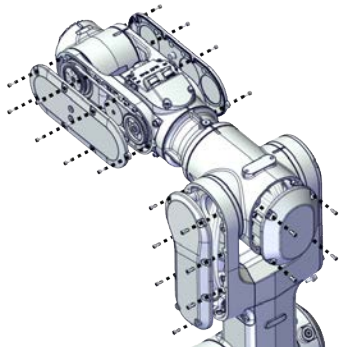
	Action	Note
3	**For robots with CP/CS cabling** Reconnect the connector. • J5.C1	 xx2100000293
4	**For robots with Ethernet cabling** Reconnect the connector J5.C2 using the tool.	J5.C2 connector assembly tool, included in the special toolkit 3HAC071022-001  xx1800002948
5	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
6	Refit the cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.2 Nm  xx2000002219

Refitting the covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	

Continues on next page

	Action	Note
3	Refit the covers. • Wrist covers • Lower arm support cover • Housing cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003612

Concluding procedure

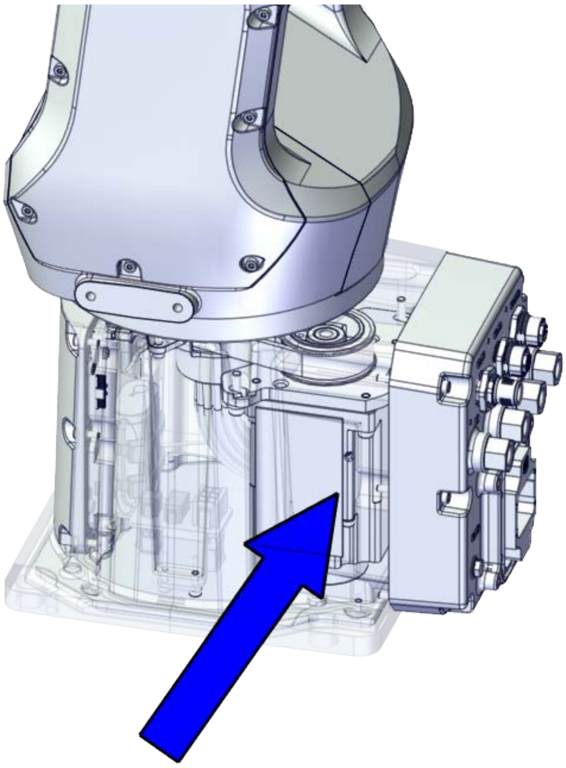
	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 163*.	

5.7 Motors

5.7.1 Replacing the axis-1 motor

Location of the axis-1 motor

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



xx1800002482

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 1100 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Motor with flange, axis 1	3HAC083589-001	
Timing belt, axis 2	3HAC061935-001	
Base bottom cover	3HAC060463-001	Standard configuration, used for robots with rear connector interface.
Base rear cover	3HAC070312-001	Used for robots with bottom connector interface.

Continues on next page

Spare part	Article number	Note
Base adapter	3HAC070313-001	Used for robots with bottom connector interface.
Cooling pad for axis-1 and -2 motors	3HAC071020-001	Cooling pads are wear parts. One cooling pad sheet contains 6 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Dynamometer	-	Used for measuring the timing belt tension.

Required consumables

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

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.

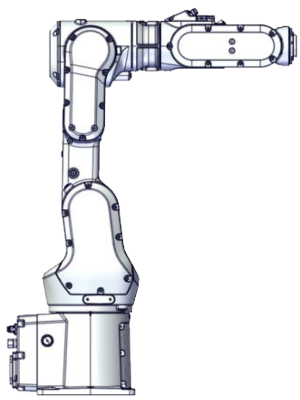
Continues on next page

	Action	Note
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the motor

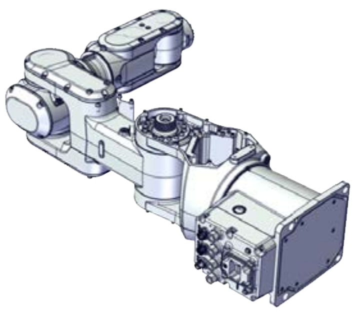
Use these procedures to remove the axis-1 motor.

Preparations before removing the axis-1 motor

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx1800003288
3	 **DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Continues on next page

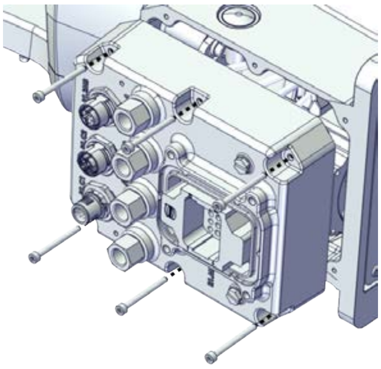
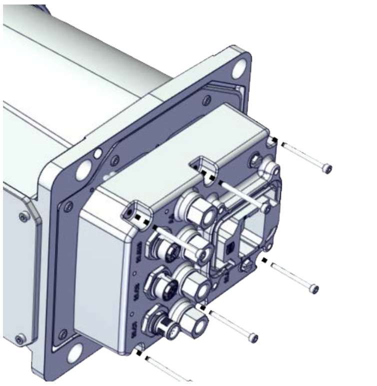
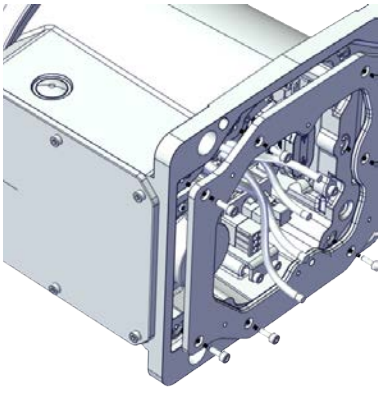
Putting the robot on its side

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** The CRB 1100 robot weighs 21.1 kg and can be lifted by one person.	
3	**WARNING** The robot is likely to be mechanically unstable if not secured to the foundation.	
4	Loosen the robot from the foundation by removing the foundation attachment screws and put the robot on its side.	 xx1800003033

Opening the connector interface plate

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

Continues on next page

	Action	Note
2	Remove the connector interface plate attachment screws and carefully open the plate. **CAUTION** There are cabling attached to the cover. The cover cannot be removed completely until the connectors are removed.	**Valid for cabling with rear interface**  xx1800003034 **Valid for cabling with bottom interface (option 3309-1)**  xx1800003055
3	**Valid for cabling with bottom interface (option 3309-1)** Remove the base adapter.	 xx1800003056

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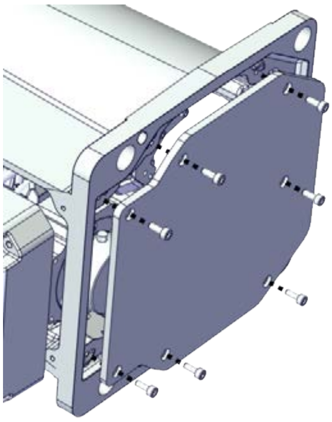
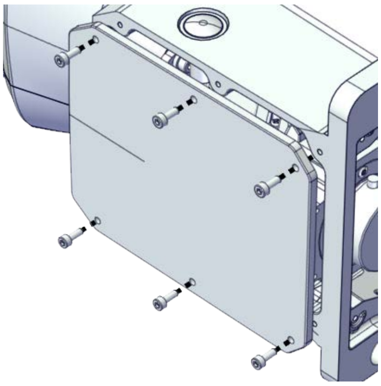
Removing base covers

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**Valid for cabling with rear interface** Remove the base bottom cover.	 xx1800003035
3	**Valid for cabling with bottom interface (option 3309-1)** Remove the base rear cover.	 xx1800003057

Disconnecting axis-1 motor connectors

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

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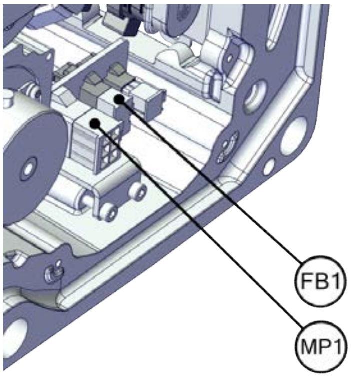
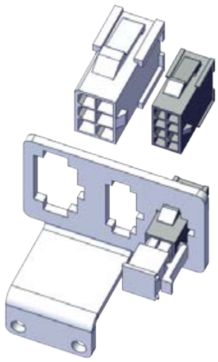
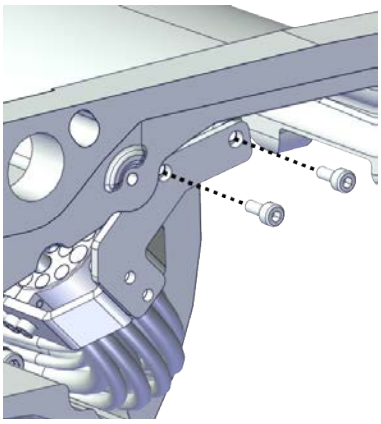
	Action	Note
2	Disconnect the connectors. • FB1 • MP1 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003613
3	Snap loose and remove the female head of the connectors from the connector plate.	 xx1800003314

Separating the cable package from the base

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable bracket.	 xx1800003042

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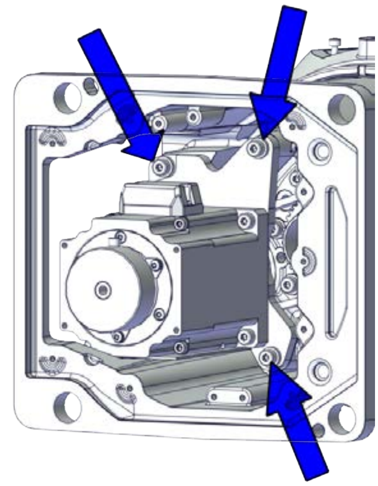
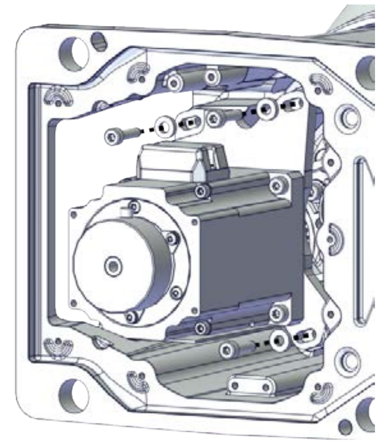
Removing the axis-1 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003064
4	Remove the screws and washers.	 xx1800003065

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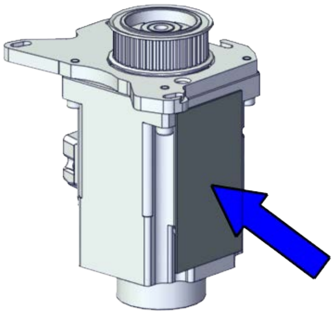
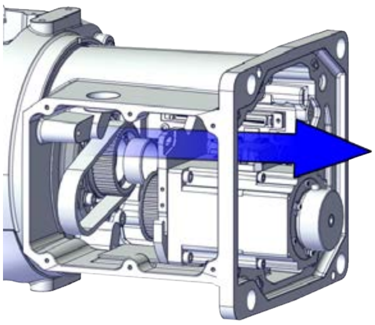
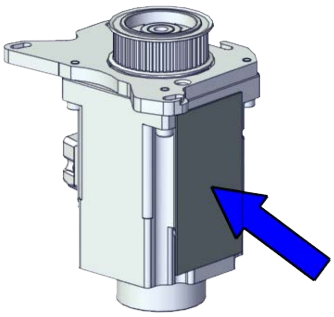
	Action	Note
5	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad.	Cooling pad location  xx1800003602
6	Remove the timing belt from its groove on the motor.	 xx1800003614

Refitting the motor

Use these procedures to refit the axis-1 motor.

Refitting the axis-1 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001  xx1800003602

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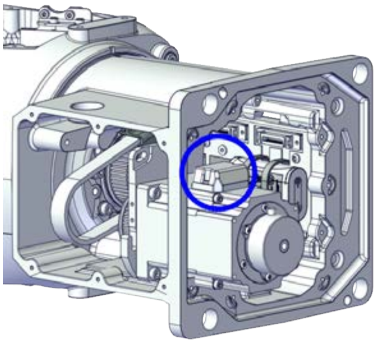
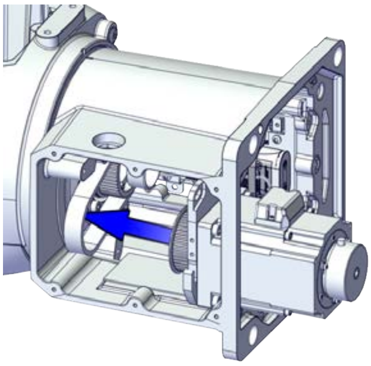
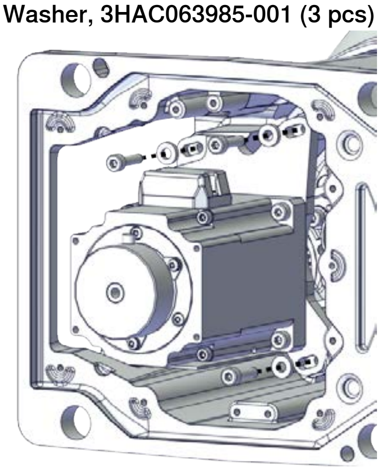
	Action	Note
3	Orient the motor correctly and fit it into the base.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003616
4	Install the timing belt to the motor pulley.	 xx1800003615
5	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800003065

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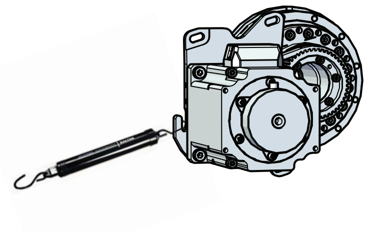
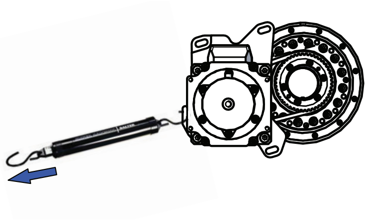
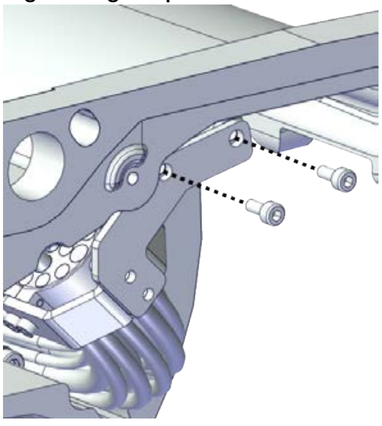
Adjusting the axis-1 timing belt tension

	Action	Note
1	Use a handheld dynamometer hooking to the motor.	 xx1900000040
2	Pull the dynamometer to make the tension falling in the allowed force range. **Note** During the measurement, make sure that all interferences that may affect the force are removed. Pay attention to the force application direction.	Used belt: 58.24-63.56 N New belt:83.2-90.8 N (for reference only)  xx1900000041
3	Secure the motor with the screws.	Tightening torque: 3 Nm

Securing the lower cable package to the base

	Action	Note
1	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003042

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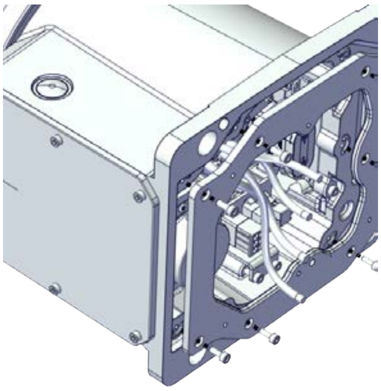
Refitting the connector interface plate

	Action	Note
1	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
2	**Valid for cabling with bottom interface (option 3309-1)** Refit the base adapter.	Screw: M3x8 Steel 8.8-A2F (7 pcs) Tightening torque: 1.2 Nm  xx1800003056

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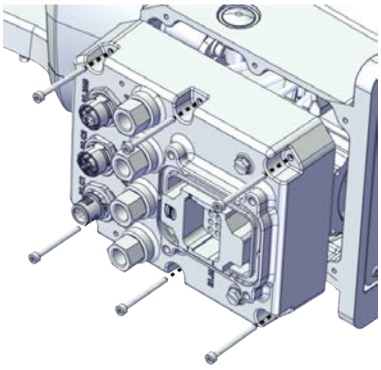
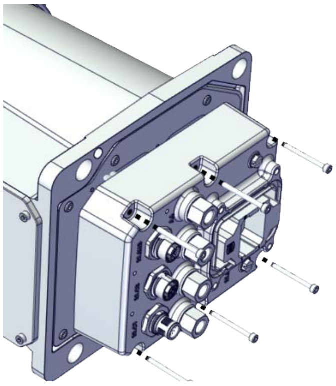
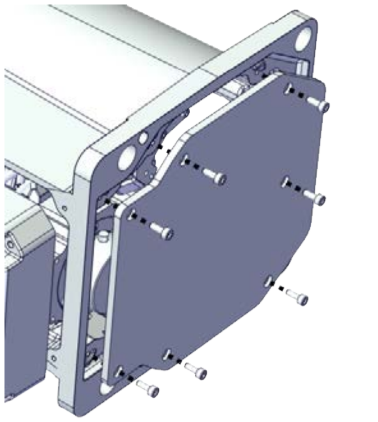
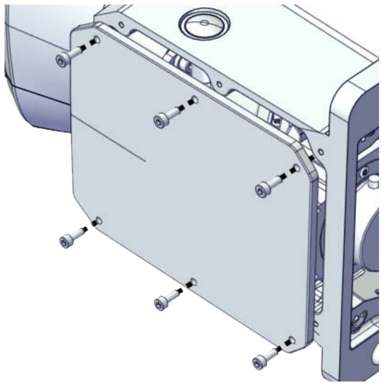
	Action	Note
3	Refit the connector interface plate to the base.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm **Valid for cabling with rear interface**  xx1800003034 **Valid for cabling with bottom interface (option 3309-1)**  xx1800003055

Refitting the base cover

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

	Action	Note
4	**Valid for cabling with rear interface** Refit the bottom cover.	Screw: M3x8 Steel 8.8-A2F (7 pcs) Tightening torque: 1.2 Nm  xx1800003035
5	Refit the rear cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm  xx1800003057

Securing the robot to the foundation

	Action	Note
1	**CAUTION** The CRB 1100 robot weighs 21.1 kg and can be lifted by one person.	
2	Raise the robot to standing and secure to the foundation with the attachment screws and washers.	Attachment screws: M12x25 (robot installation directly on foundation), quality: 8.8. Washers: 4 pcs, 24 x 13 x 2.5. Tightening Torque: 50 Nm±5 Nm.

Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.

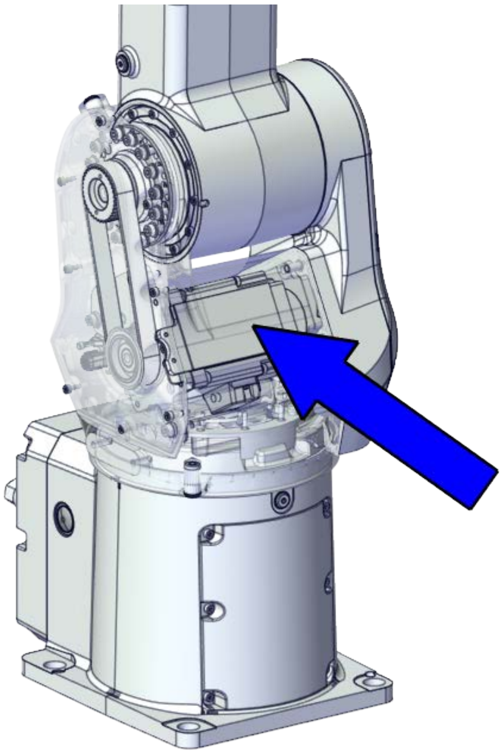
Continues on next page

	Action	Note
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 163*.	

5.7.2 Replacing the axis-2 motor

Location of the axis-2 motor

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



xx1800002483

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 1100 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Motor with flange, axis 2	3HAC083588-001	.
Timing belt, axis 2	3HAC061935-001	
Swing cover	3HAC069051-001	
Swing support cover	3HAC069052-001	
Cooling pad for axis-1 and -2 motors	3HAC071020-001	Cooling pads are wear parts. One cooling pad sheet contains 6 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel

Continues on next page

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222
Sealing compound	3HAC026759-002	Sikaflex 521 FC

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.

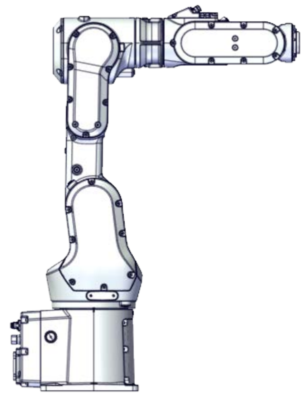
Continues on next page

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

Removing the motor

Use these procedures to remove the axis-2 motor.

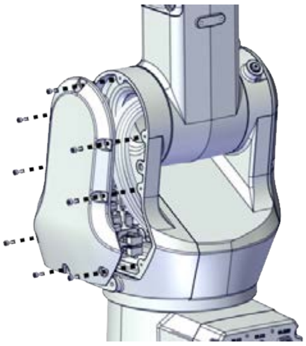
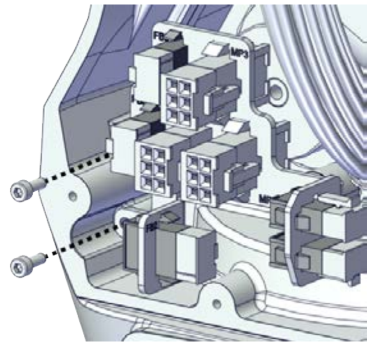
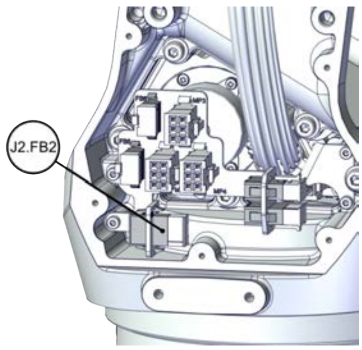
Preparations before removing the axis-2 motor

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx1800003288
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the axis-2 motor

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

Continues on next page

	Action	Note
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Remove the swing support cover.	 xx1800002488
4	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate.	 xx1800002489
5	Disconnect the connector. • J2.FB2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002490

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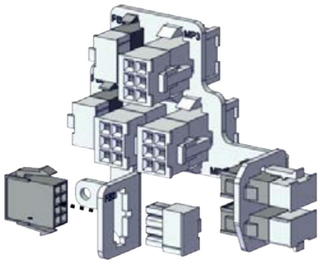
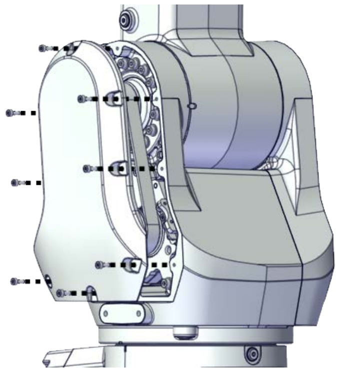
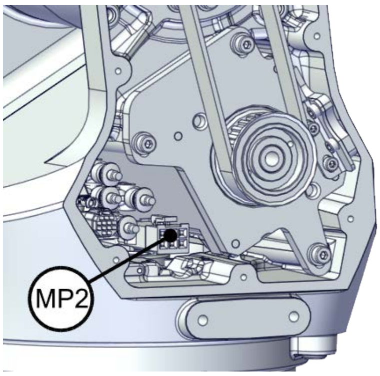
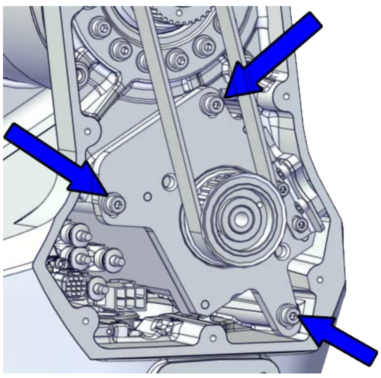
	Action	Note
6	Snap loose and remove the female head of the connector from the connector plate.	 xx1800002491
7	Remove the swing cover.	 xx1800002492
8	Disconnect the connector. • MP2  **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002495
9	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002493

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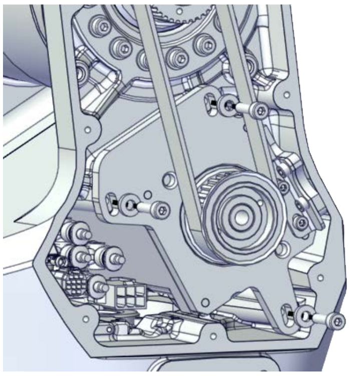
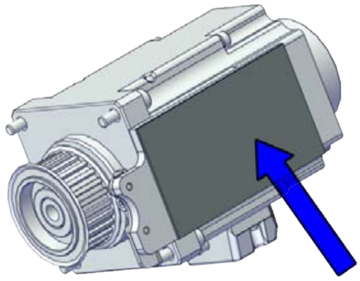
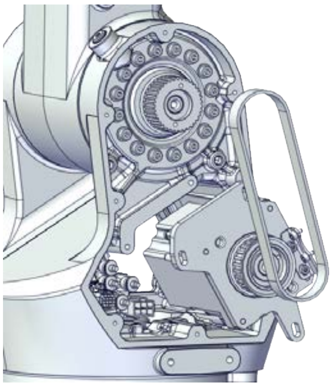
	Action	Note
10	Remove the screws and washers.	 xx1800002494
11	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad. **CAUTION** Be aware of the motor cabling. The motor cannot be removed completely until the connector is disconnected, as shown in following step.	Cooling pad location  xx1800003603
12	Remove the timing belt from its groove on the motor.	 xx1800002496

Removing the cooling pad

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

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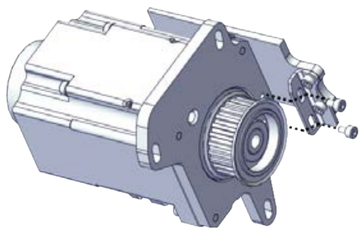
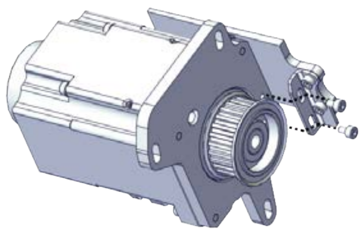
	Action	Note
2	Loosen the cooling pad bracket screws on the motor flange.	 xx1800003026
3	Use a plastic sheet with caution to remove the cooling pad together with the bracket from the motor. Pay attention not to scratch the motor or damage the pad.	

Refitting the motor

Use these procedures to refit the axis-2 motor.

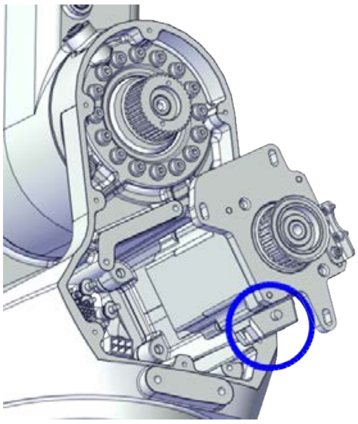
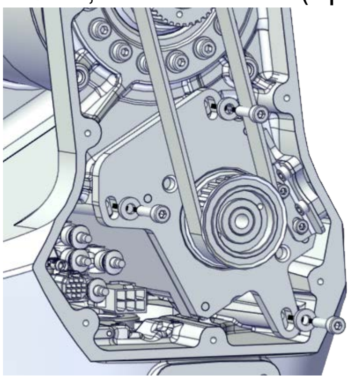
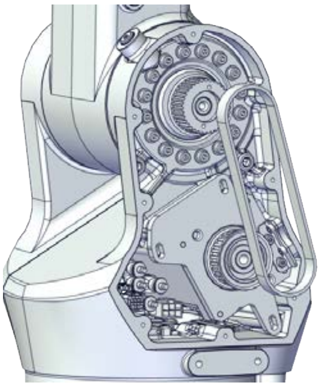
Refitting the cooling pad

	Action	Note
1	Attach the cooling pad together with the bracket to the motor. Make sure the bracket does not exceed the motor flange and the screw holes are aligned.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001
2	Refit the cooling pad bracket.	Screw: M3x5 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 1.2 Nm  xx1800003026

Refitting the axis-2 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	

Continues on next page

	Action	Note
2	Orient the motor correctly and fit it into the swing. **Tip** Bend the motor signal cable back towards the swing support.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003027
3	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800002494
4	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003028

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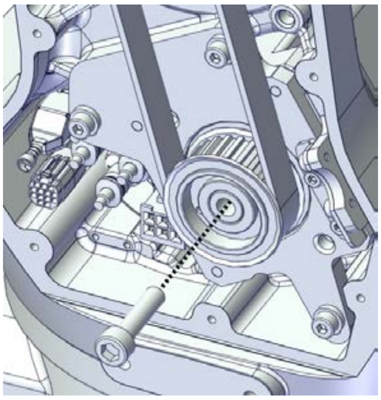
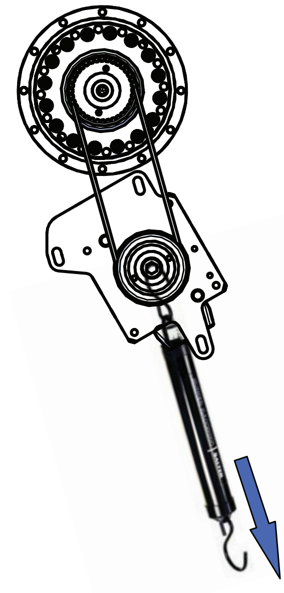
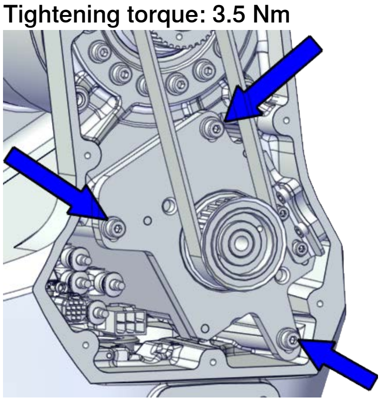
	Action	Note
5	Install an M6x25 or longer adjustment screw to the motor.  **Note** Do not insert the entire screw to the hole.	 xx1900000010
6	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 68.18-75.04 N (for reference only) Initial referenced force for new belt: 97.4-107.2 N  xx1900000029
7	Secure the motor with the screws.	Tightening torque: 3.5 Nm  xx1800002493

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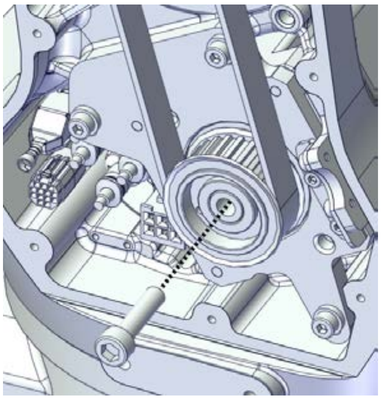
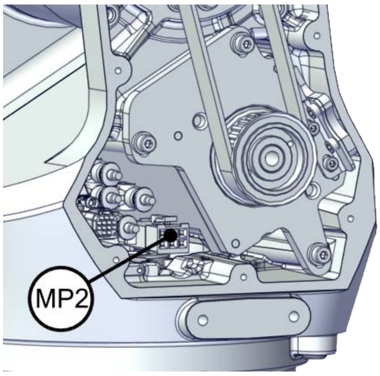
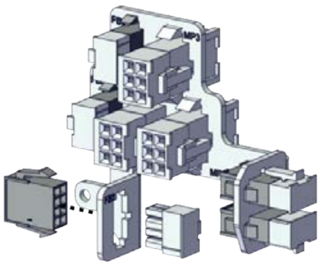
	Action	Note
8	Use a sonic tension meter to measure the timing belt tension.	Used belt: 163-174 Hz New belt: 180-229 Hz (for reference only)
9	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	
10	Remove the adjustment screw from the motor.	 xx1900000010
11	Reconnect the connector. • MP2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002495

Reconnecting the connector J2.FB2

	Action	Note
1	Insert the female header of the J2.FB2 connector to the connector plate.	 xx1800002491

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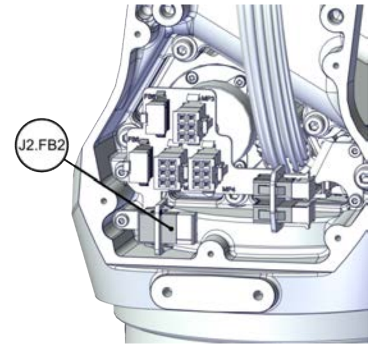
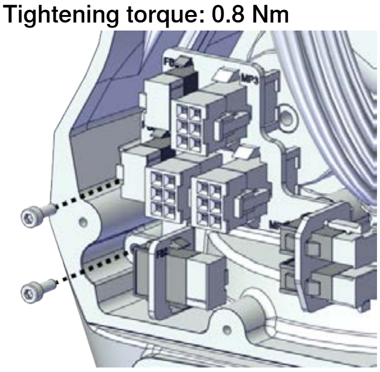
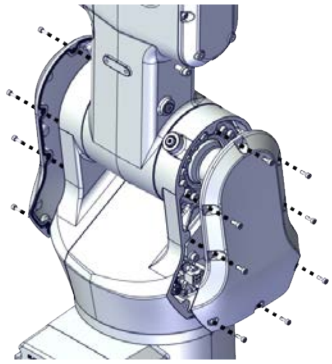
	Action	Note
2	Reconnect the connector. • J2.FB2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002490
3	Apply grease to the cable package, cover all moving area of the package.	
4	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
5	Refit the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002489

Refitting the swing covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	

Continues on next page

	Action	Note
3	Refit the covers. • Swing cover • Swing support cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003607

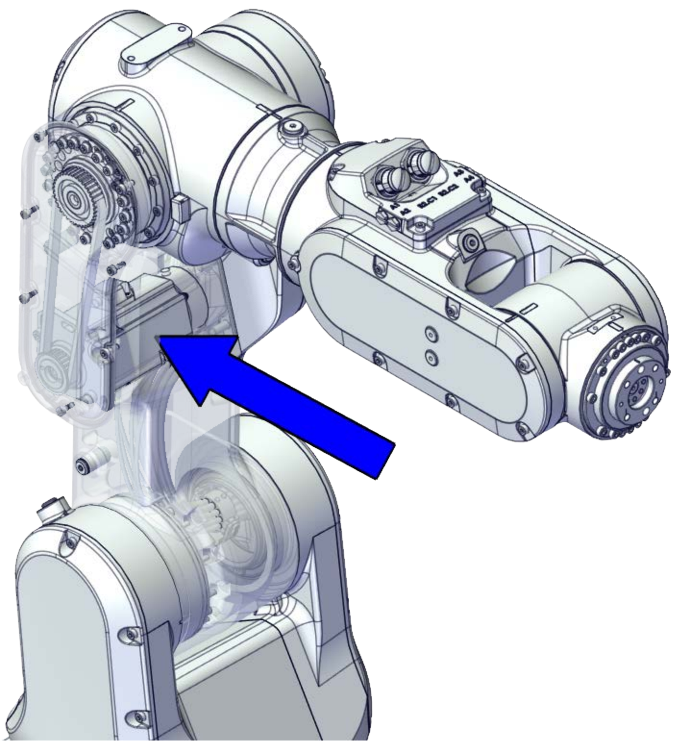
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

5.7.3 Replacing the axis-3 motor

Location of the axis-3 motor

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



xx1800002484

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 1100 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Motor with flange, axis 3	3HAC083587-001	
Timing belt, axis 3	3HAC061936-001	
Lower arm cover	3HAC069057-001	
Lower arm support cover	3HAC069059-001	
Cooling pad for axis-3 and -4 motors	3HAC071021-001	Cooling pads are wear parts. One cooling pad sheet includes 10 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel

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Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.

Required consumables

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

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.

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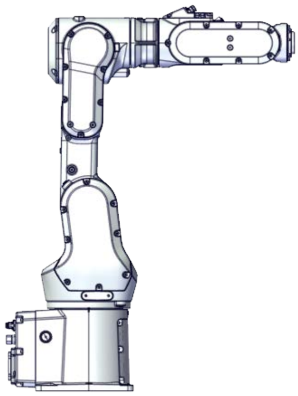
	Action	Note
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the motor

Use these procedures to remove the axis-3 motor.

Preparations before removing the axis-3 motor

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx1800003288
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Disconnecting the axis-3 motor connectors

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

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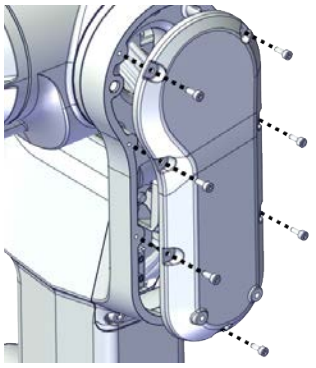
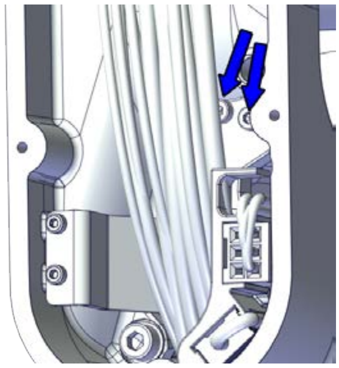
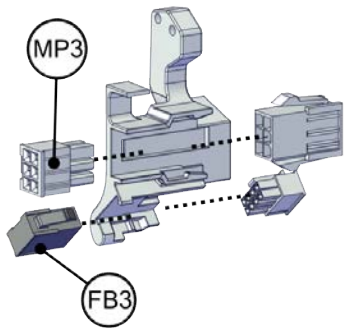
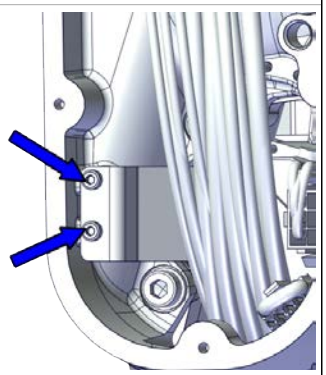
	Action	Note
2	Remove the lower arm support cover.	 xx1800003003
3	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are re-move from the plate, as shown in following step.	 xx1800003004
4	Slide the connectors out of the connector plate and disconnect the connectors. • FB3 • MP3 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003005
5	Remove the cable bracket.	 xx1800003006

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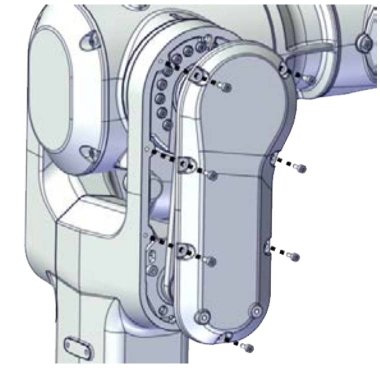
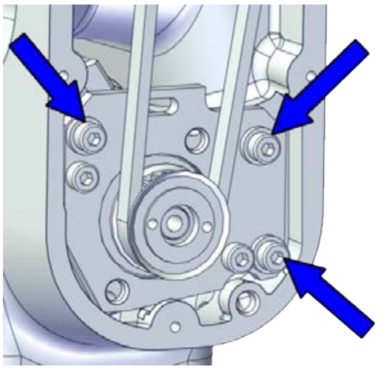
Removing the axis-3 motor

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	 **CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Remove the lower arm cover.	 xx1800003007
4	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003008

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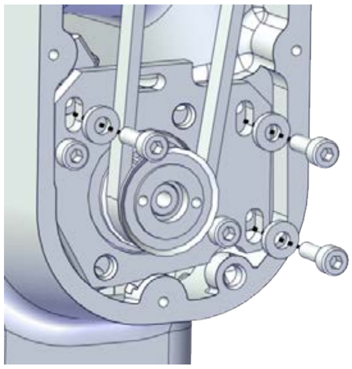
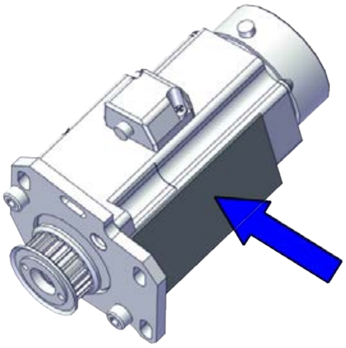
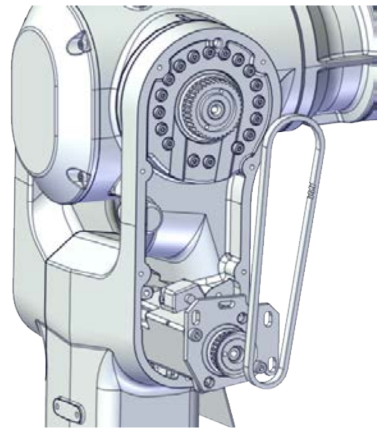
	Action	Note
5	Remove the screws and washers.	 xx1800003009
6	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad.	Cooling pad location  xx1800003604
7	Remove the timing belt from its groove on the motor.	 xx1800003010

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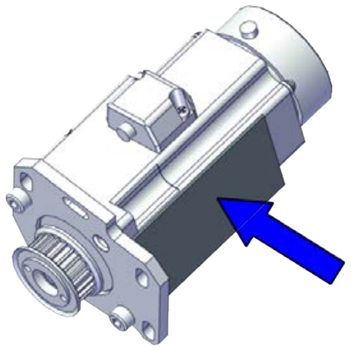
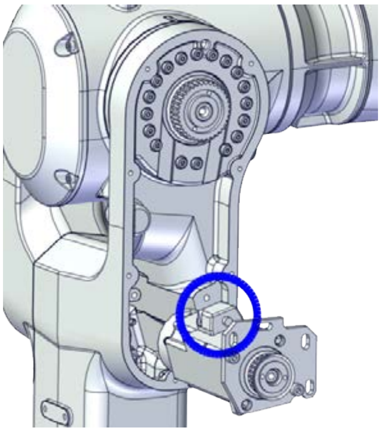
Refitting the motor

Use these procedures to refit the axis-3 motor.

Refitting the axis-3 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged.	Cooling pad for axis-3 and -4 motors: 3HAC071021-001  xx1800003604
3	Orient the motor correctly and fit it into the lower arm.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003021

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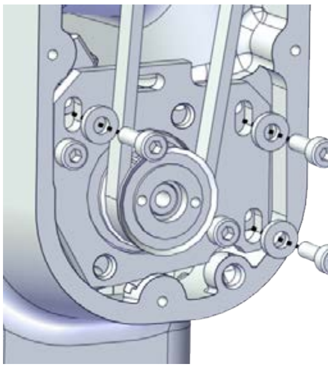
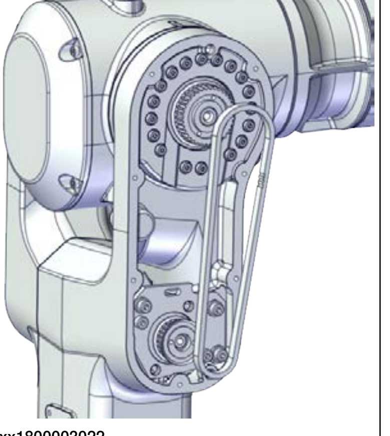
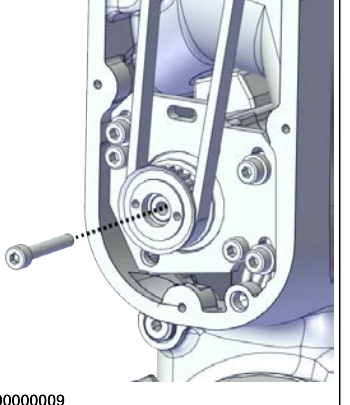
	Action	Note
4	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800003009
5	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pul-leys.	 xx1800003022
6	Install an M4x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000009

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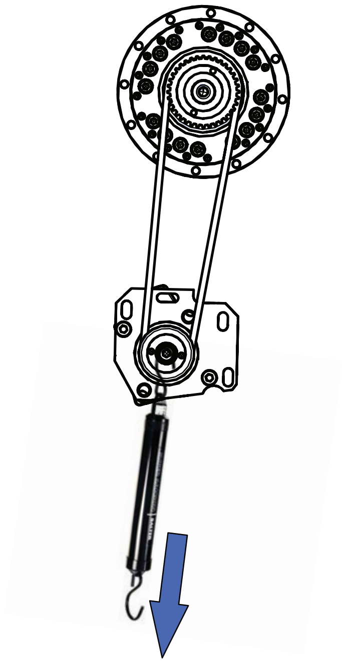
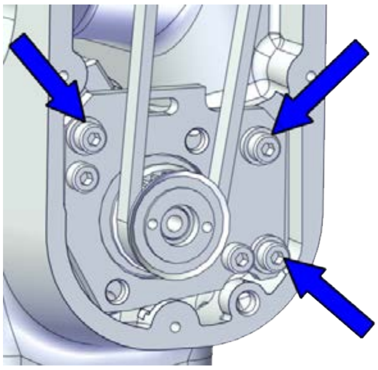
	Action	Note
7	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 21.7-23.94 N (for reference only) Initial referenced force for new belt: 31-34.2 N  xx1900000028
8	Secure the motor with the screws.	Tightening torque: 3 Nm  xx1800003008
9	Use a sonic tension meter to measure the timing belt tension.	Used belt: 102-109 Hz New belt:113-143 Hz (for reference only)
10	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	

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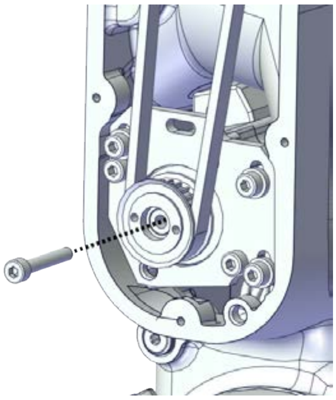
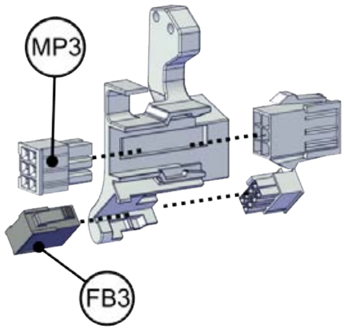
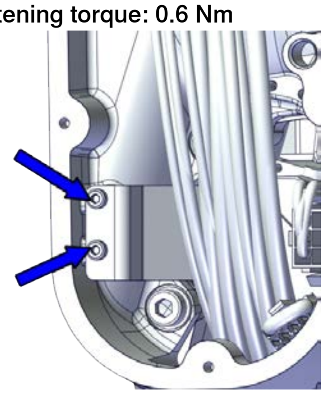
	Action	Note
11	Remove the adjustment screw from the motor.	 xx1900000009

Reconnecting the axis-3 motor connectors

	Action	Note
1	Slide the connectors into the connector plate and reconnect the connectors. • FB3 • MP3 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003005
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003006

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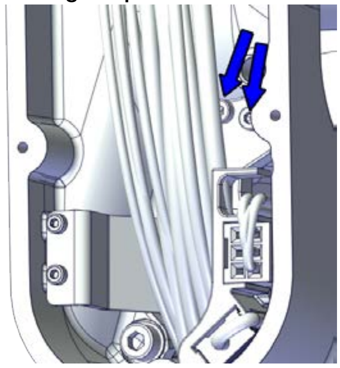
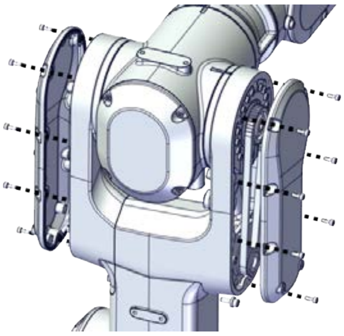
	Action	Note
4	Refit the connector plate.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.4 Nm  xx1800003004

Refitting the lower arm covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	
3	Refit the covers. • Lower arm cover • Lower arm support cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003608

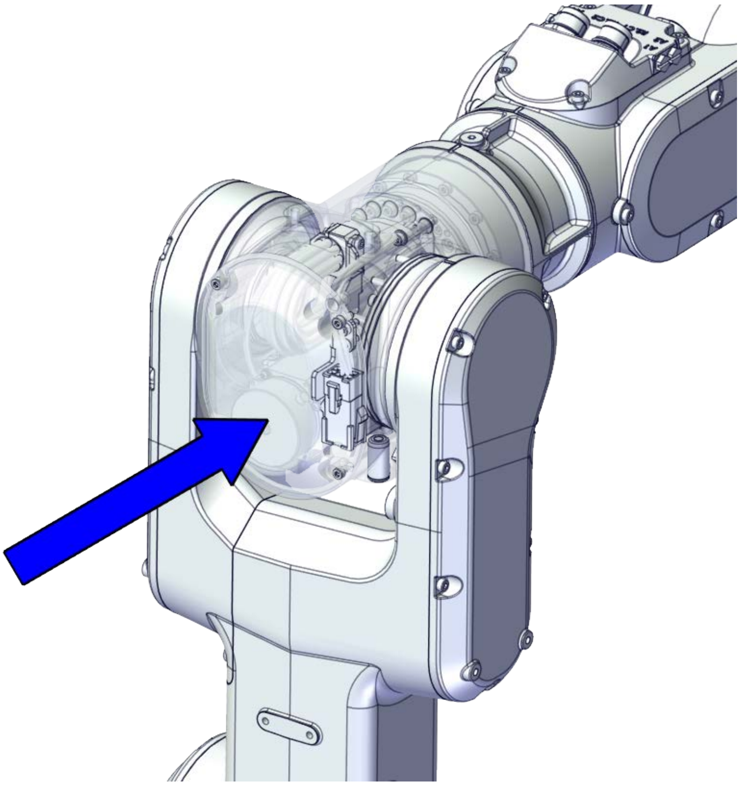
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

5.7.4 Replacing the axis-4 motor

Location of the axis-4 motor

The xx is located as shown in the figure.



xx1800002485

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 1100 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Motor with flange, axis 4	3HAC083586-001	
Timing belt, axis 4	3HAC061937-001	
Housing cover	3HAC069054-001	
Cooling pad for axis-3 and -4 motors	3HAC071021-001	Cooling pads are wear parts. One cooling pad sheet includes 10 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC064765-001	7x3.2x1.5, Steel

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Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
M3x25 eye bolt	-	Included in the special toolkit 3HAC071022-001.
axis-4 motor fitting tool	-	Included in the special toolkit 3HAC071022-001. Used to refit the axis-4 motor.
Dynamometer	-	Used for measuring the timing belt tension.

Required consumables

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

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.

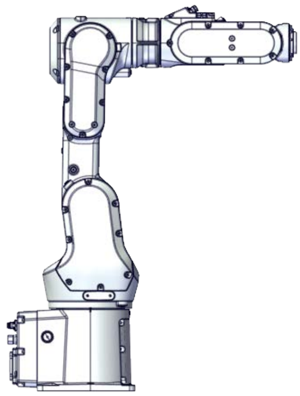
Continues on next page

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

Removing the motor

Use these procedures to remove the axis-4 motor.

Preparations before removing the axis-4 motor

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx1800003288
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Disconnecting the axis-4 motor connectors

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

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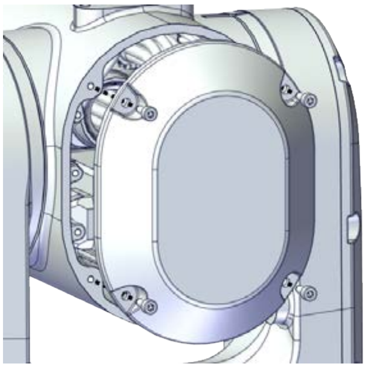
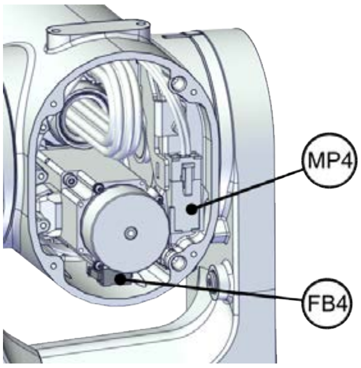
	Action	Note
2	Remove the housing cover.	 xx1800003011
3	Disconnect the motor connectors. • FB4 • MP4	 xx1800003012

Removing the axis-4 motor

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	 **CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	

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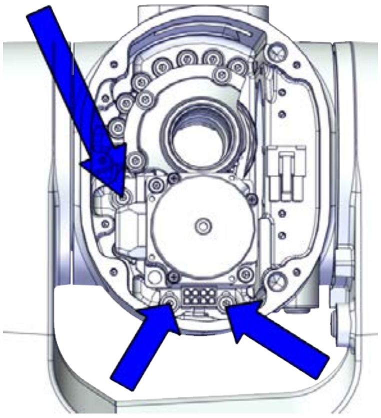
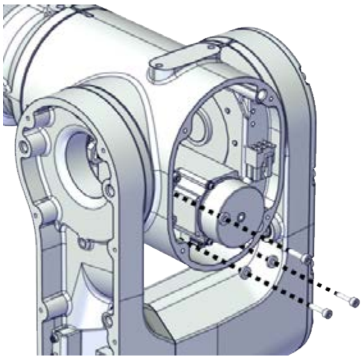
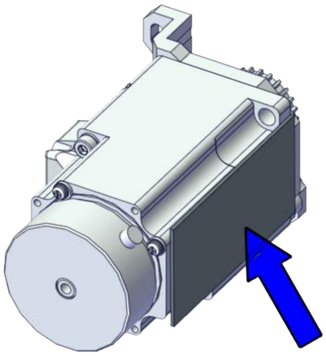
	Action	Note
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003094
4	Remove the screws and washers.	 xx1800003095
5	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad.	Cooling pad location  xx1800003605

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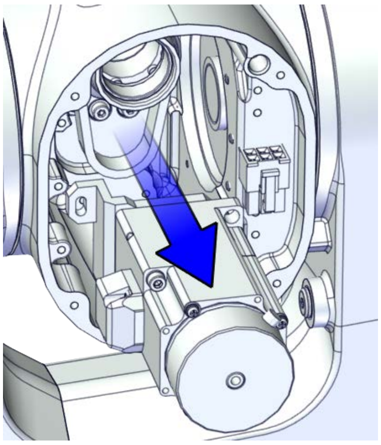
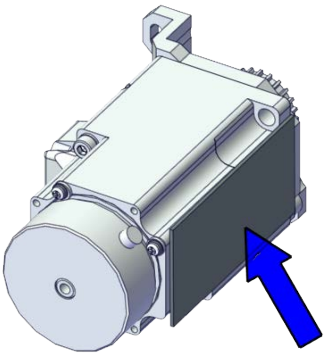
	Action	Note
6	Remove the timing belt from its groove on the motor.	 xx1800003096

Refitting the motor

Use these procedures to refit the axis-4 motor.

Refitting the axis-4 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged.	Cooling pad for axis-3 and -4 motors: 3HAC071021-001  xx1800003605

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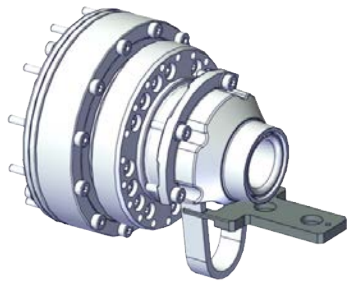
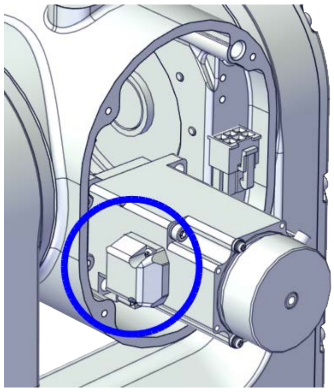
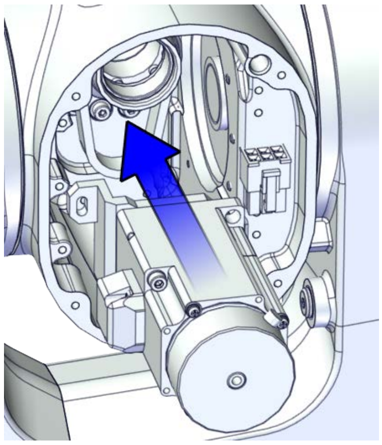
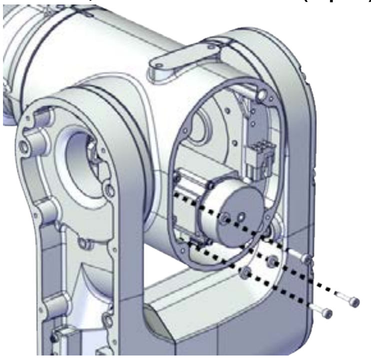
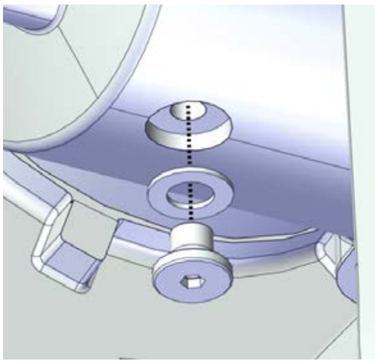
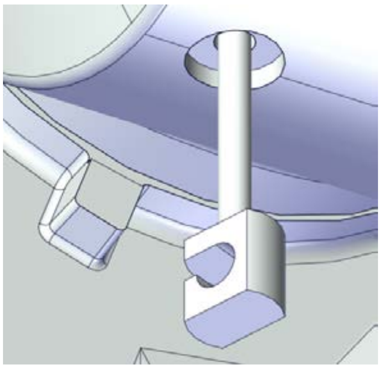
	Action	Note
3	Use the motor fitting tool to fix the timing belt.	axis-4 motor fitting tool, included in the special toolkit 3HAC071022-001.  xx1900000044
4	Orient the motor correctly and fit it into the housing. **Note** Make sure the motor flange does not press on the timing belt.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003287
5	Install the timing belt to the motor pulley.	 xx1800003617

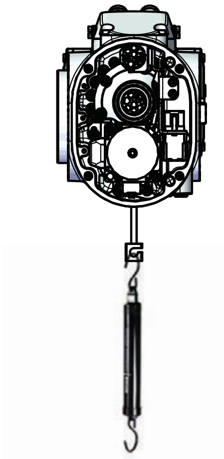
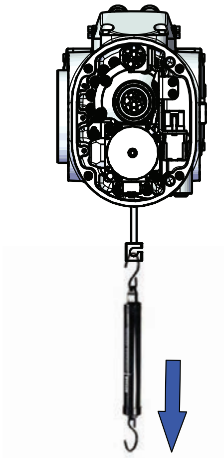
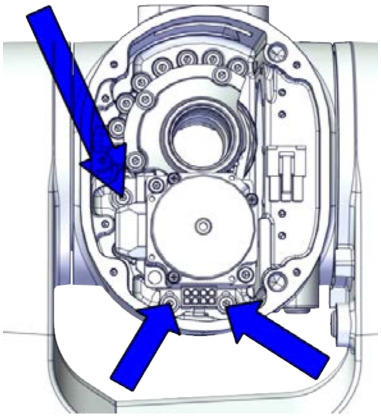
Continues on next page

	Action	Note
6	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC064765-001 (3 pcs)  xx1800003095
7	Remove the motor fitting tool.	

Adjusting the axis-4 timing belt tension

	Action	Note
1	Remove the screw and washer below the housing.	 xx1900000036
2	Fit an M3x25 eye bolt o the screw hole.	 xx1900000037

Continues on next page

	Action	Note
3	Use a handheld dynamometer hooking to the eye bolt.	 xx1900000038
4	Pull the dynamometer to make the tension falling in the allowed force range. **Note** Pay attention to the force application direction.	Used belt: 20.09-22.05 N New belt:28.7-31.5 N  xx1900000039
5	Secure the motor with the screws.	Tightening torque: 1.4 Nm  xx1800003094
6	Remove eye bolt and refit the screw and washer below the housing.	Plug screw: 3HAC064146-001 Tightening torque: 2 Nm

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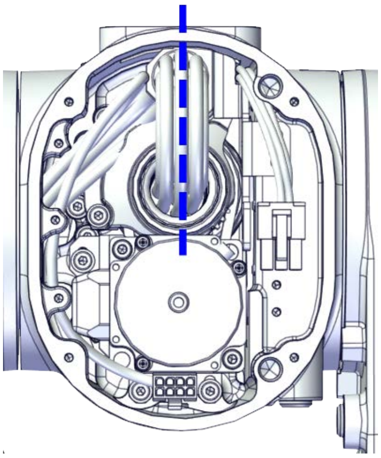
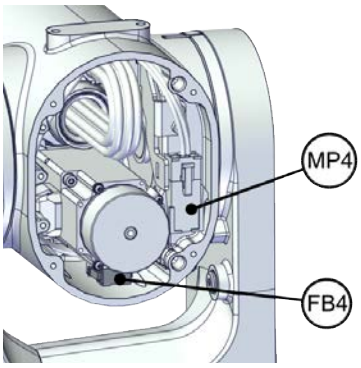
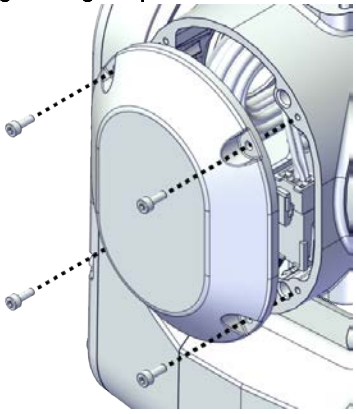
Reconnecting the axis-4 motor connectors

	Action	Note
1	Check the cabling status. Make sure the cabling is in vertical state and is not twisted.	 xx1800003618
2	Reconnect the connectors. • FB4 • MP4 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003012

Refitting the housing cover

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	

Continues on next page

	Action	Note
3	Refit the housing cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.2 Nm  xx1800003609

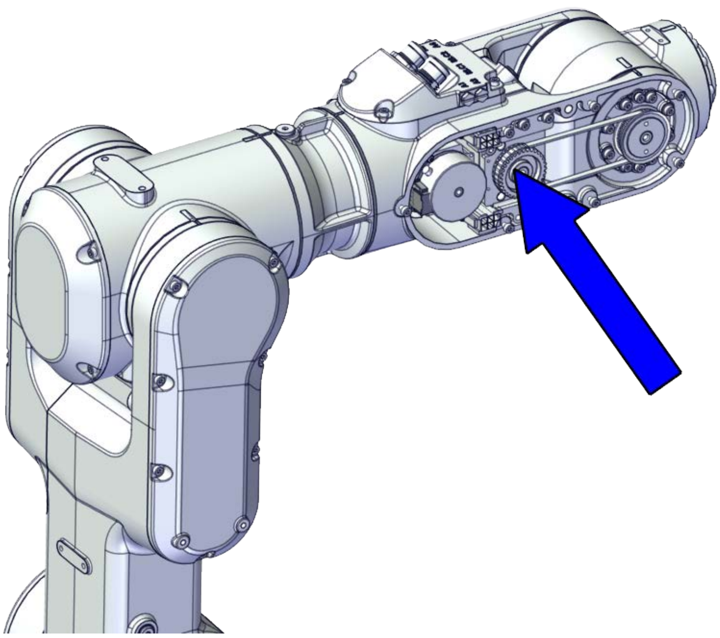
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

5.7.5 Replacing the axis-5 motor

Location of the axis-5 motor

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



xx1800002486

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 1100 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Motor with flange, axis 5	3HAC083585-001	
Timing belt, axis 5	3HAC061938-001	
Wrist cover	3HAC069061-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.

Continues on next page

Equipment	Article number	Note
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.
J5.C2 connector assembly tool	-	Included in the special toolkit 3HAC071022-001. Used to remove and refit the J5.C2 connector, if the Ethernet cabling is equipped.

Required consumables

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

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.

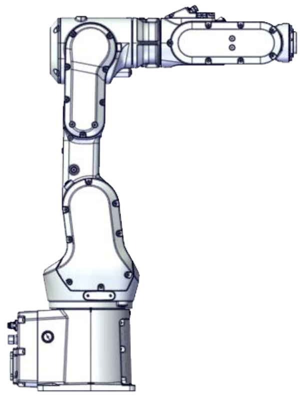
Continues on next page

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

Removing the motor

Use these procedures to remove the axis-5 motor.

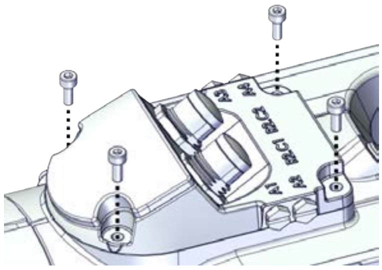
Preparations before removing the axis-5 motor

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx1800003288
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

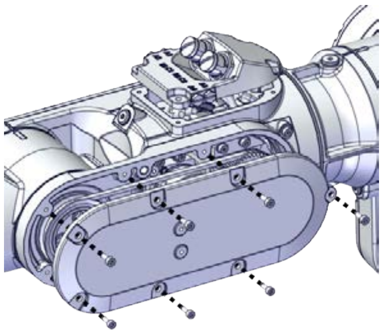
Opening the process hub

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

Continues on next page

	Action	Note
2	Remove the screws and carefully open the cover. **CAUTION** Be aware of the cabling that is attached to the cover!	 xx2000002219

Removing the wrist cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the wrist cover (right one when facing the robot rear).	 xx1800003315

Disconnecting the axis-5 motor connectors

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

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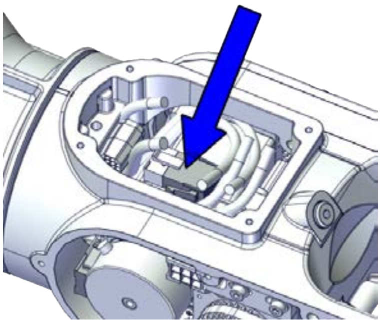
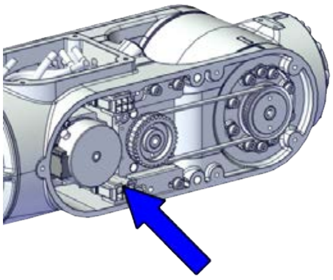
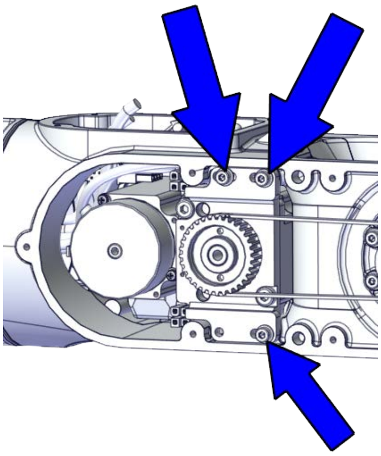
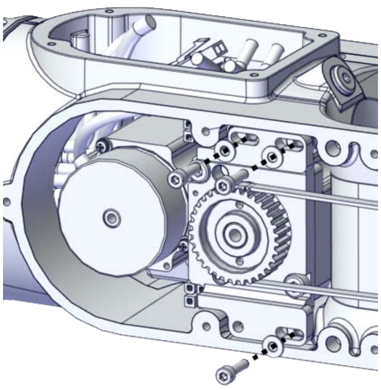
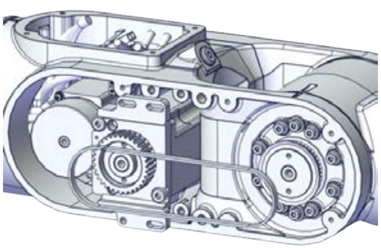
	Action	Note
2	Access the connector FB5 from the process hub and disconnect the connector.	 xx1800002950
3	Disconnect the connector. • MP5	 xx1800002993

Removing the axis-5 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	

Continues on next page

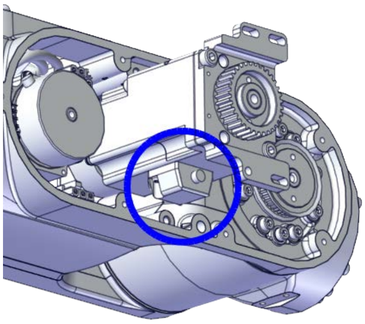
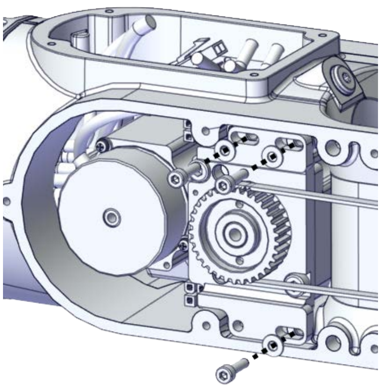
	Action	Note
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003290
4	Remove the screws and washers.	 xx1800003291
5	Carefully lift out the motor.	
6	Remove the timing belt from its groove on the motor.	 xx1800003292

Continues on next page

Refitting the motor

Use these procedures to refit the axis-5 motor.

Refitting the axis-5 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Orient the motor correctly and fit it into the wrist. **Tip** Leave the connectors FB5 and FB6 accessible from the process hub and the connectors MP5 and MP6 accessible from wrist side.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003296
3	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs)  xx1800003291

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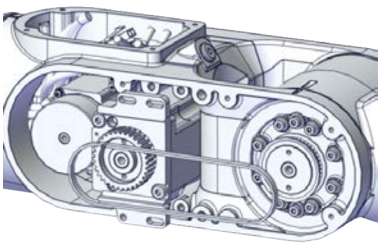
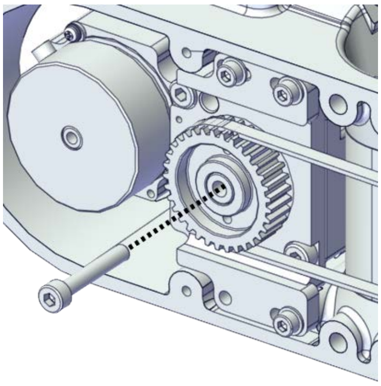
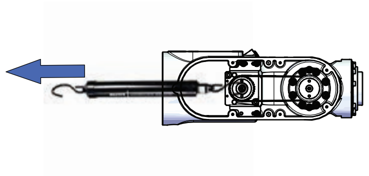
	Action	Note
4	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003292
5	Install an M4x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000008
6	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 13.58-14.84 N (for reference only) Initial referenced force for new belt: 19.4-21.2 N  xx1900000027

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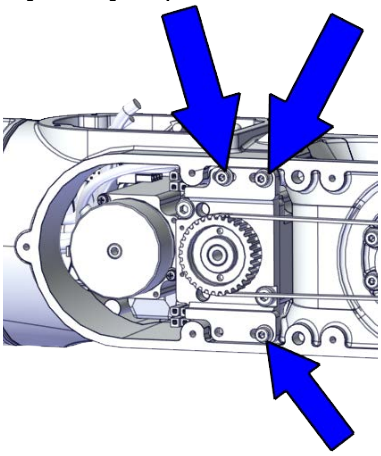
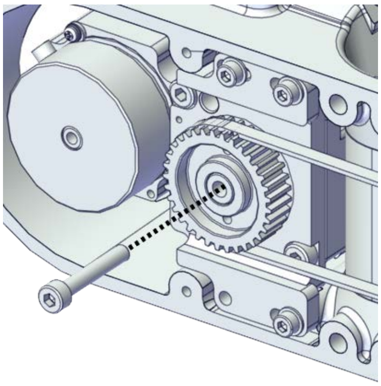
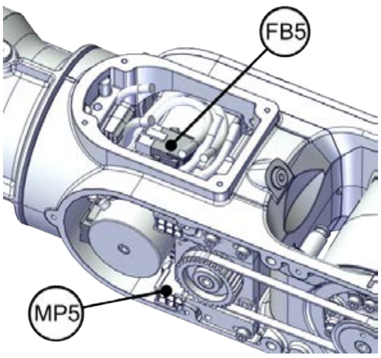
	Action	Note
7	Secure the motor with the screws.	Tightening torque: 1.4 Nm  xx1800003290
8	Use a sonic tension meter to measure the timing belt tension.	Used belt: 151-162 Hz New belt: 167-213 Hz (for reference only)
9	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	
10	Remove the adjustment screw from the motor.	 xx1900000008

Reconnecting the axis-5 motor connectors

	Action	Note
1	Reconnect the connectors. • FB5 • MP5 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003025

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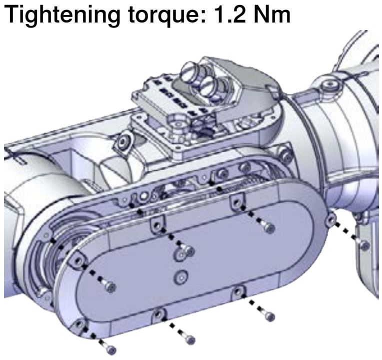
	Action	Note
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Insert the cabling and connectors into the wrist.	

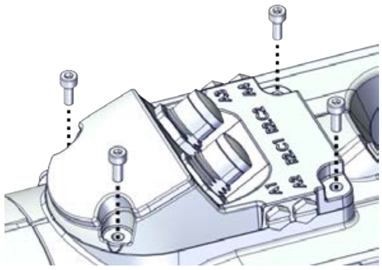
Refitting the wrist cover

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the cover that has contacting area with the cable package.	
3	Refit the wrist cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (7 pcs) Tightening torque: 1.2 Nm  xx1800003315

Refitting the process hub

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

Continues on next page

	Action	Note
2	Refit the cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.2 Nm  xx2000002219

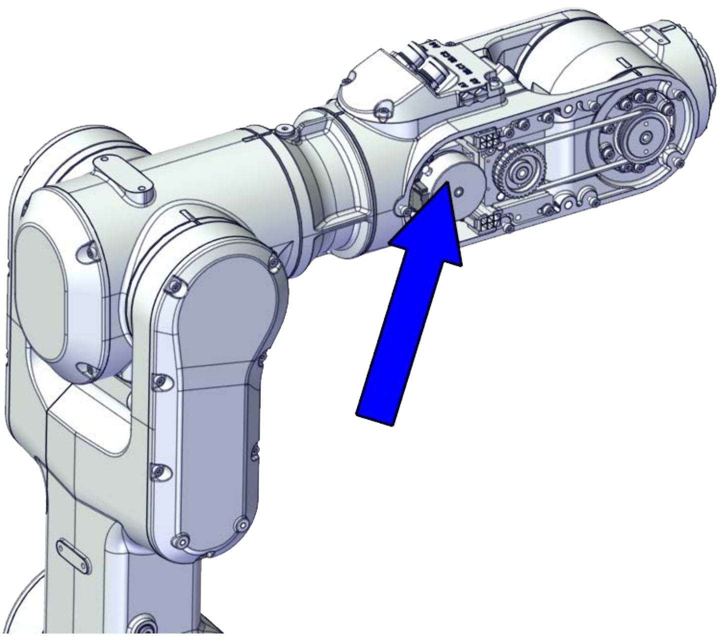
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

5.7.6 Replacing the axis-6 motor

Location of the axis-6 motor

The xx is located as shown in the figure.



xx1800002487

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 1100 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Motor with flange, axis 6	3HAC083584-001	
Timing belt, axis 6	3HAC061939-001	
Wrist cover	3HAC069061-001	

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.

Continues on next page

Equipment	Article number	Note
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.
J5.C2 connector assembly tool	-	Included in the special toolkit 3HAC071022-001. Used to remove and refit the J5.C2 connector, if the Ethernet cabling is equipped.

Required consumables

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

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.

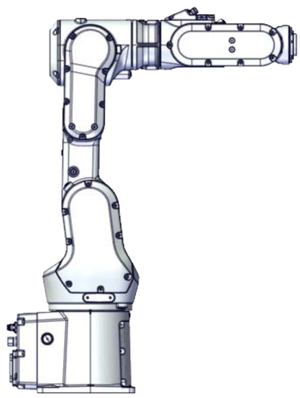
Continues on next page

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

Removing the motor

Use these procedures to remove the axis-6 motor.

Preparations before removing the axis-6 motor

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx1800003288
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Opening the process hub

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

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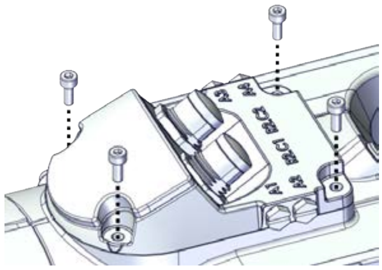
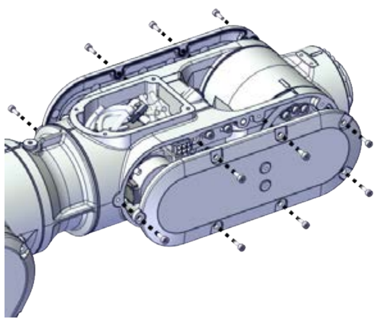
	Action	Note
2	Remove the screws and carefully open the cover. **CAUTION** Be aware of the cabling that is attached to the cover!	 xx2000002219

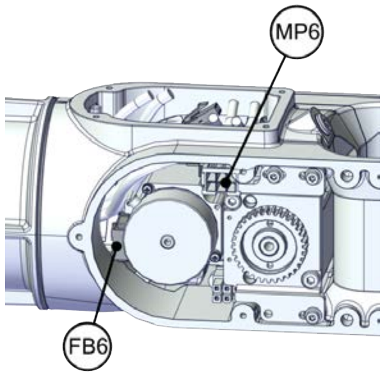
Removing the wrist covers

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the wrist covers from both sides.	 xx1800002949

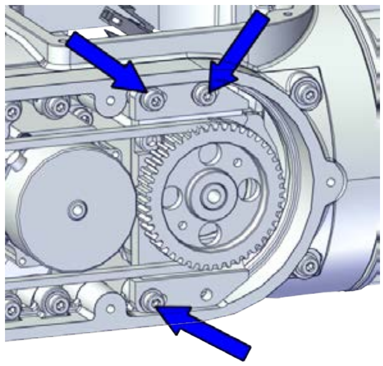
Disconnecting the axis-6 motor connectors

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

Continues on next page

	Action	Note
2	Disconnect the connectors. • MP6 • FB6	 xx1800002994

Removing the axis-6 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002995

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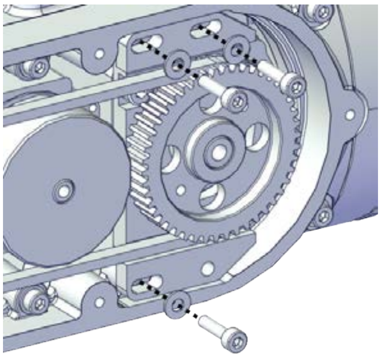
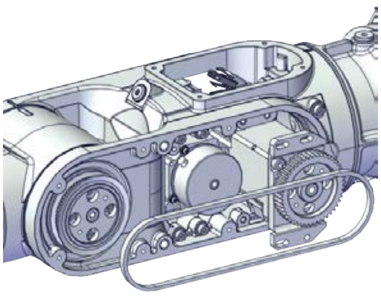
	Action	Note
4	Remove the screws and washers.	 xx1800002996
5	Carefully lift out the motor.	
6	Remove the timing belt from its groove on the motor.	 xx1800002997

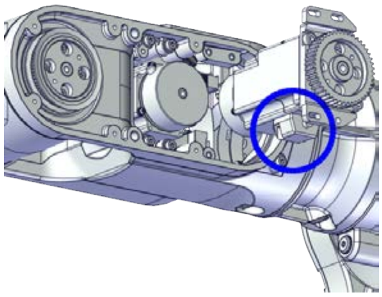
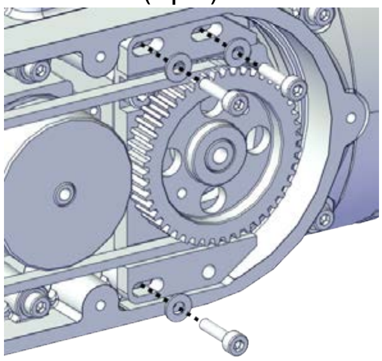
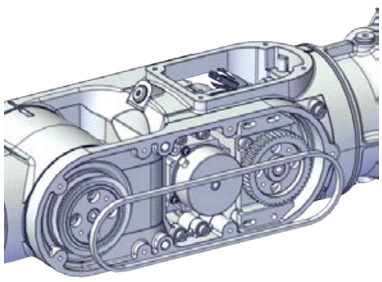
Refitting the motor

Use these procedures to refit the axis-6 motor.

Refitting the axis-6 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	

Continues on next page

	Action	Note
2	Orient the motor correctly and fit it into the lower arm. **Tip** Leave the connectors FB5 and FB6 accessible from the process hub and the connectors MP5 and MP6 accessible from wrist side.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003023
3	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs)  xx1800002996
4	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003024

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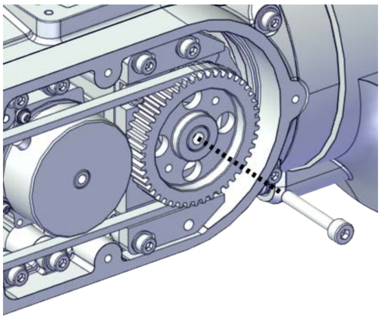
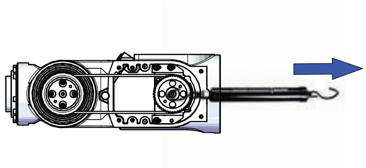
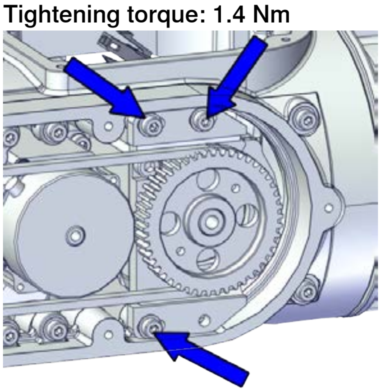
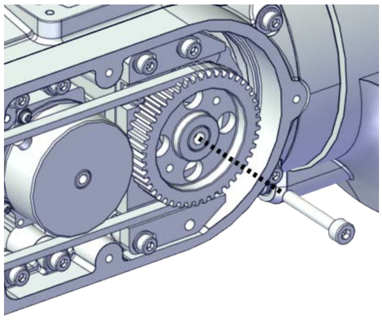
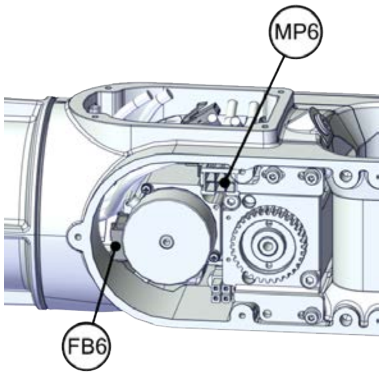
	Action	Note
5	Install an M4x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000007
6	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 8.96-9.8 N (for reference only) Initial referenced force for new belt: 12.8-14  xx1900000026
7	Secure the motor with the screws.	Tightening torque: 1.4 Nm  xx1800002995
8	Use a sonic tension meter to measure the timing belt tension.	Used belt: 81.3-86.9 Hz New belt:90-114 Hz (for reference only)
9	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	

Continues on next page

	Action	Note
10	Remove the adjustment screw from the motor.	 xx1900000007

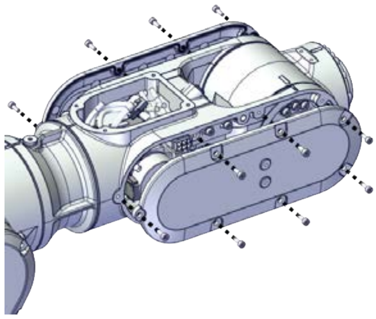
Reconnecting the axis-6 motor connectors

	Action	Note
1	Reconnect the connectors. • FB6 • MP6  **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002994
2	Route and secure the cabling with cable straps.  **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Insert the cabling and connectors into the wrist.	

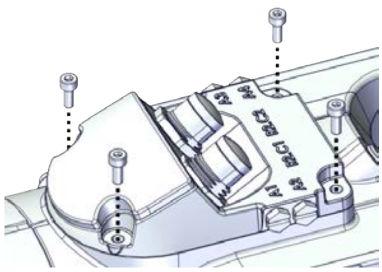
Refitting the wrist covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	

Continues on next page

	Action	Note
3	Refit the wrist covers.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (14 pcs) Tightening torque: 1.2 Nm  xx1800002949

Refitting the process hub

	Action	Note
1	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
2	Refit the cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.2 Nm  xx2000002219

Concluding procedure

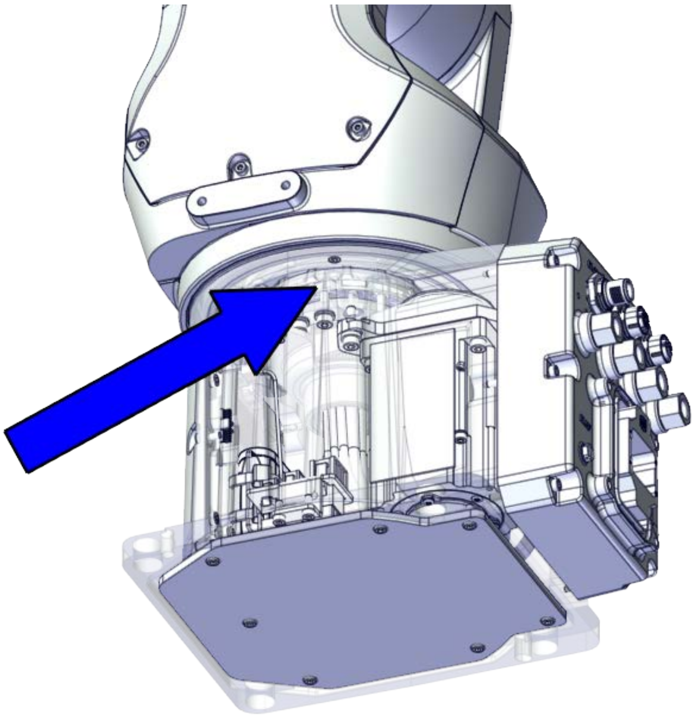
	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 163*.	

5.8 Gearboxes

5.8.1 Replacing the axis-1 gearbox

Location of the axis-1 gearbox

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



xx1800002478

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 1100 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Lower cable harness (CP/CS and air hose, with Ethernet)	3HAC075523-001	
Gear unit with pulley, axis 1	3HAC069062-001	
Base	3HAC069048-001	
Motor with flange, axis 1	3HAC083589-001	
Timing belt, axis 1	3HAC061934-001	
Motor with flange, axis 2	3HAC083588-001	.

Continues on next page

Spare part	Article number	Note
Timing belt, axis 2	3HAC061935-001	
Mechanical stop, axis 1	3HAC061947-001	Replace if damaged.
Base bottom cover	3HAC060463-001	Standard configuration, used for robots with rear connector interface.
Base rear cover	3HAC070312-001	Used for robots with bottom connector interface.
Base adapter	3HAC070313-001	Used for robots with bottom connector interface.
Swing cover	3HAC069051-001	
Swing support cover	3HAC069052-001	
Cooling pad for axis-1 and -2 motors	3HAC071020-001	Cooling pads are wear parts. One cooling pad sheet contains 6 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)

Continues on next page

Deciding calibration routine

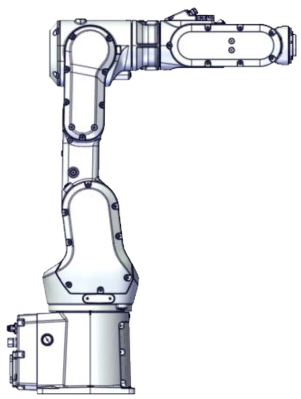
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the gearbox

Use these procedures to remove the axis-1 gearbox.

Preparations before removing the axis-1 gearbox

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog all axes to zero position.	 xx1800003288

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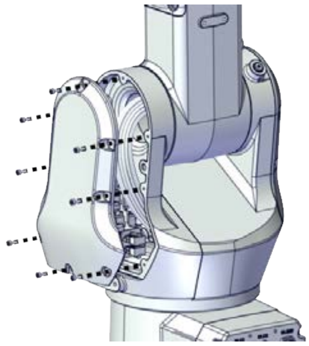
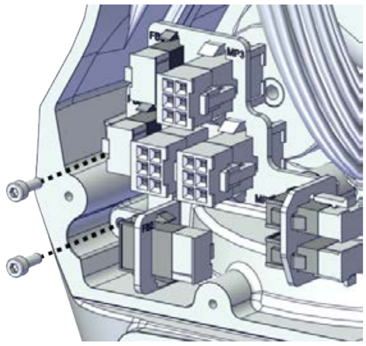
	Action	Note
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Remove the swing support cover.	 xx1800002488
4	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate.	 xx1800002489

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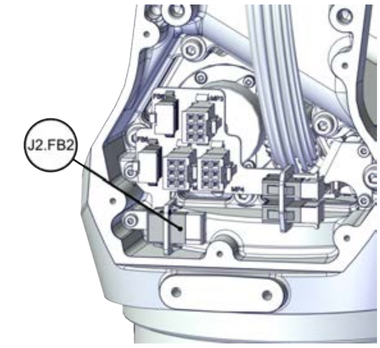
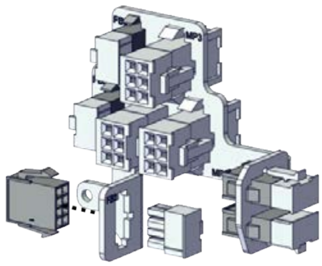
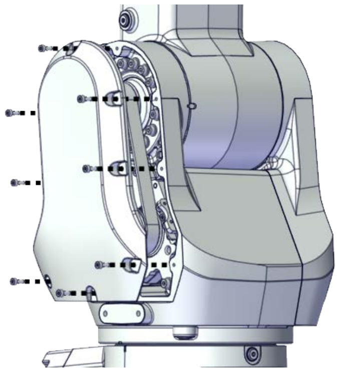
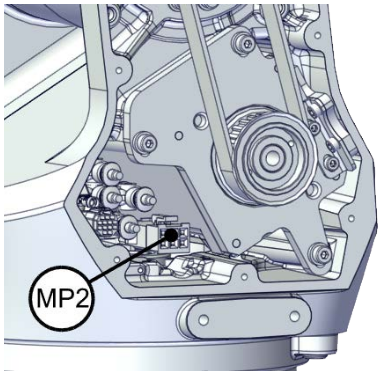
	Action	Note
5	Disconnect the connector. • J2.FB2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002490
6	Snap loose and remove the female head of the connector from the connector plate.	 xx1800002491
7	Remove the swing cover.	 xx1800002492
8	Disconnect the connector. • MP2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002495

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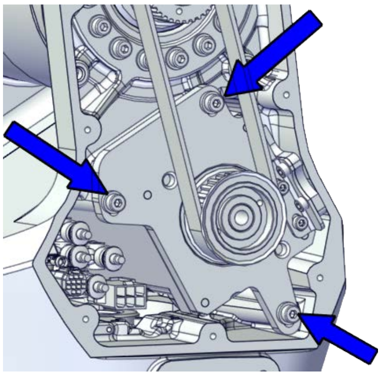
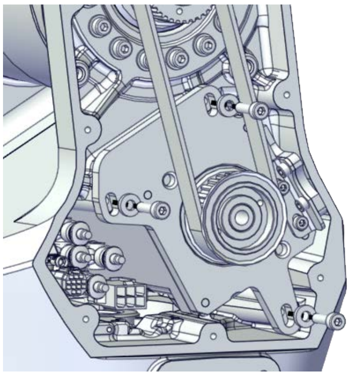
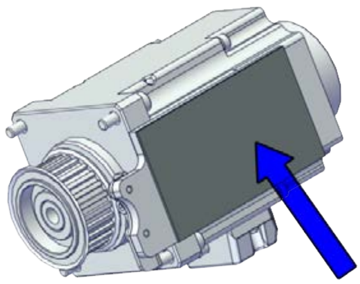
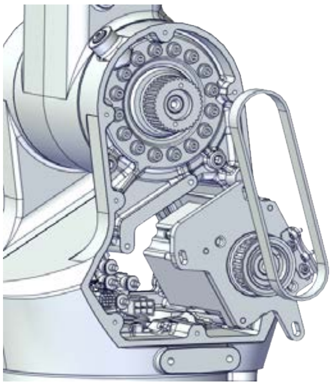
	Action	Note
9	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002493
10	Remove the screws and washers.	 xx1800002494
11	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad. **CAUTION** Be aware of the motor cabling. The motor cannot be removed completely until the connector is disconnected, as shown in following step.	Cooling pad location  xx1800003603
12	Remove the timing belt from its groove on the motor.	 xx1800002496

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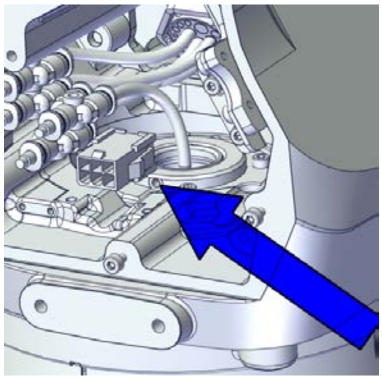
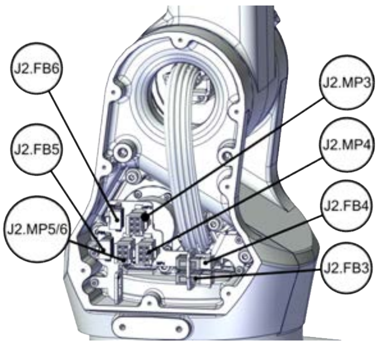
5.8.1 Replacing the axis-1 gearbox

Continued

Loosening the cable package from axis-1 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Access the cable package locking screw on the axis-1 gearbox from the swing and then loosen the locking screw.	 xx1800003032
3	Remove the locking screw.	

Disconnecting the connectors at the division point

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • J2.FB3,4,5,6 • J2.MP3,4,5/6 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002497

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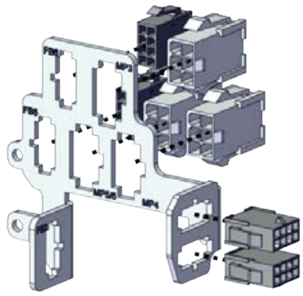
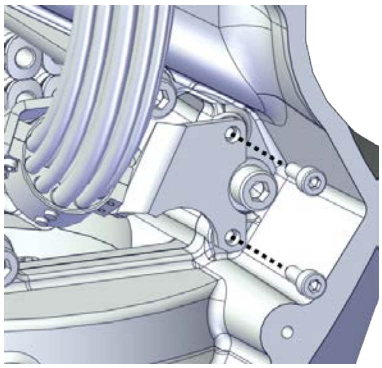
	Action	Note
3	Snap loose and remove the female head of the connectors from the connector plate.	 xx1800002498

Separating the cable package from the swing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable bracket.	 xx1800002499

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

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

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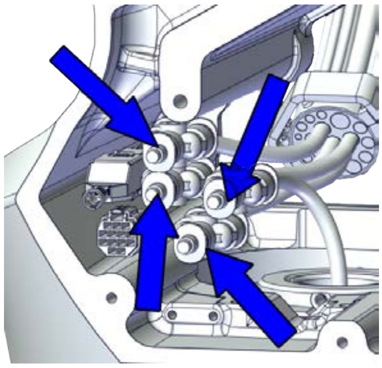
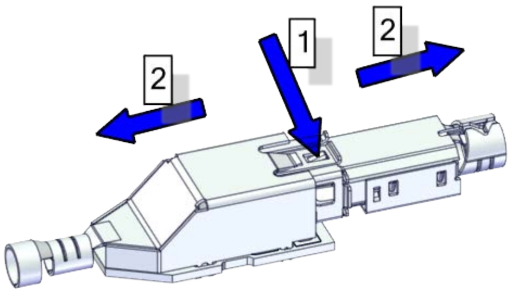
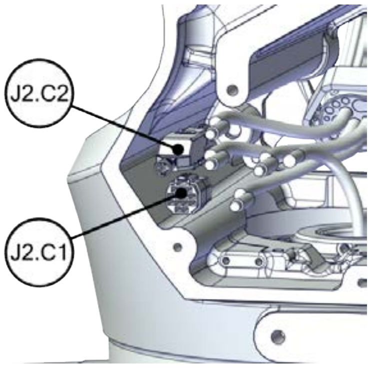
	Action	Note
2	Disconnect the air hoses from the Y-shaped connectors.	 xx1800002500
3	Disconnect the connectors. • J2.C1 • J2.C2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting. **Tip** The connector clip has to be pressed (1) and pushed forward (2) to separate the J2.C2 (for Ethernet cabling).  xx1800002943	 xx1800002501

Putting the robot on its side

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

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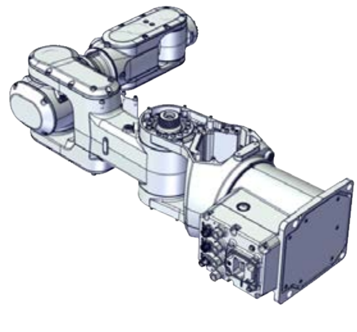
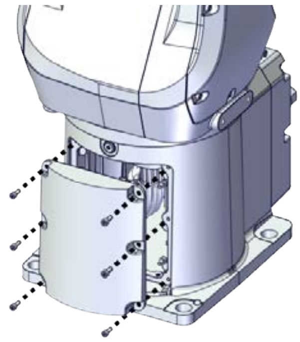
	Action	Note
2	**CAUTION** The CRB 1100 robot weighs 21.1 kg and can be lifted by one person.	
3	**WARNING** The robot is likely to be mechanically unstable if not secured to the foundation.	
4	Loosen the robot from the foundation by removing the foundation attachment screws and put the robot on its side.	 xx1800003033

Disconnecting the SMB connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 48*.	
3	Remove the SMB cover attachment screws and carefully open the cover. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures. **CAUTION** There are cabling attached to the cover. The cover cannot be removed completely until the connectors are removed.	 xx1800002467

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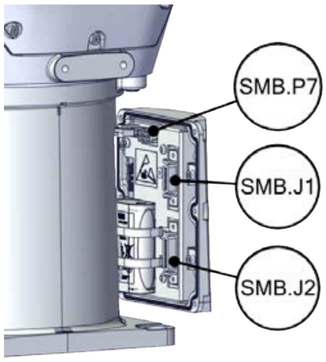
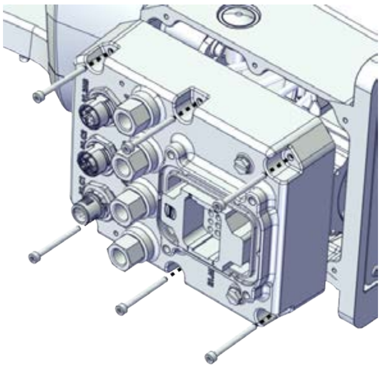
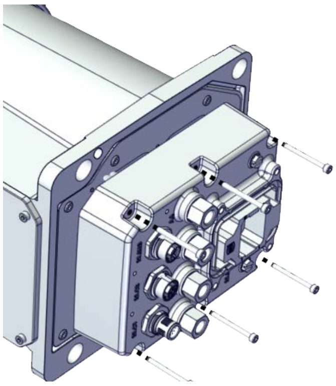
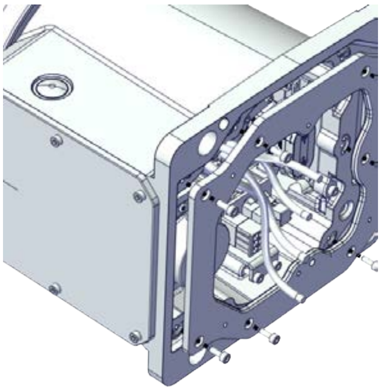
	Action	Note
4	Disconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002468
5	Remove the SMB cover completely from the base.	

Opening the connector interface plate

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

Continues on next page

	Action	Note
2	Remove the connector interface plate attachment screws and carefully open the plate. **CAUTION** There are cabling attached to the cover. The cover cannot be removed completely until the connectors are removed.	**Valid for cabling with rear interface**  xx1800003034 **Valid for cabling with bottom interface (option 3309-1)**  xx1800003055
3	**Valid for cabling with bottom interface (option 3309-1)** Remove the base adapter.	 xx1800003056

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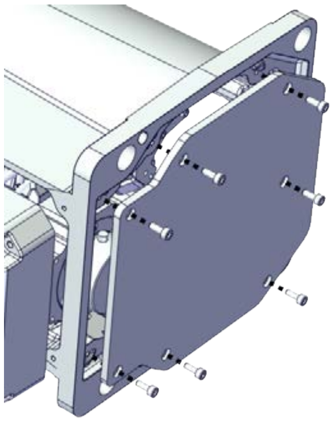
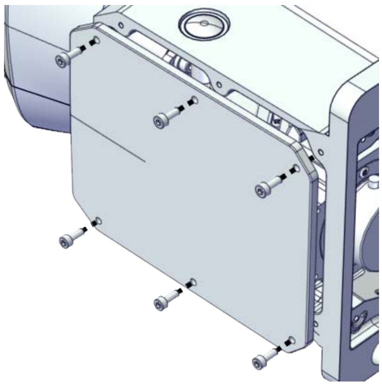
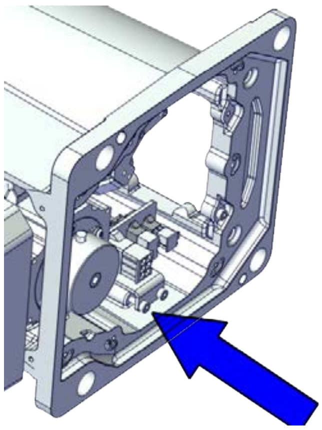
Removing the brake release button

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**Valid for cabling with rear interface** Remove the base bottom cover.	 xx1800003035
3	**Valid for cabling with bottom interface (option 3309-1)** Remove the base rear cover.	 xx1800003057
4	Disconnect the earth cable.	 xx1800003036

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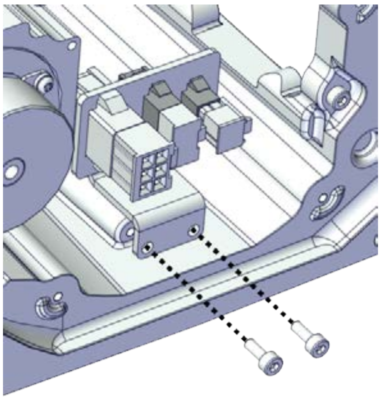
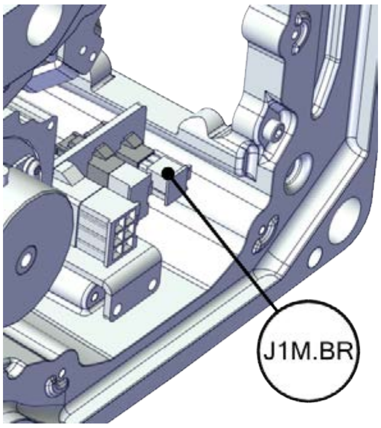
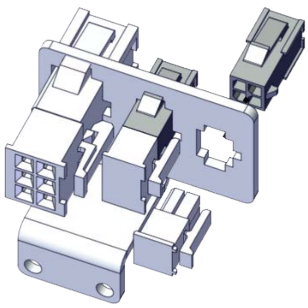
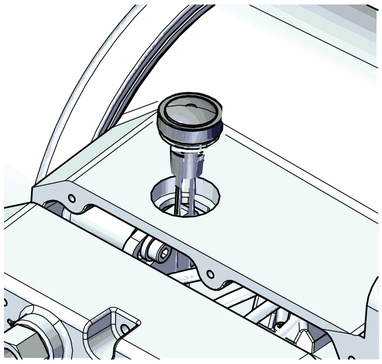
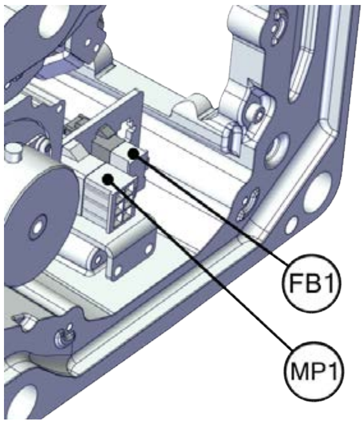
	Action	Note
5	Remove the connector plate.	 xx1800003037
6	Disconnect the connector. • J1M.BR **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003038
7	Remove the female header of the J1M.BR connector from the connector plate.	 xx1800003039

Continues on next page

	Action	Note
8	Remove the brake release button from the base using the tool.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

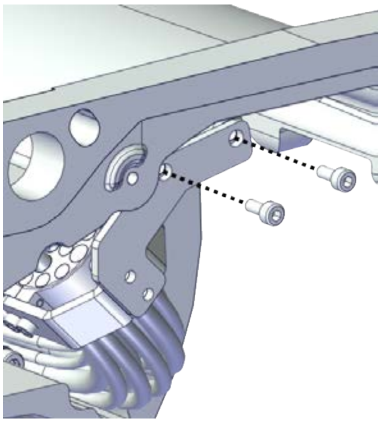
Disconnecting axis-1 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • FB1 • MP1 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003041

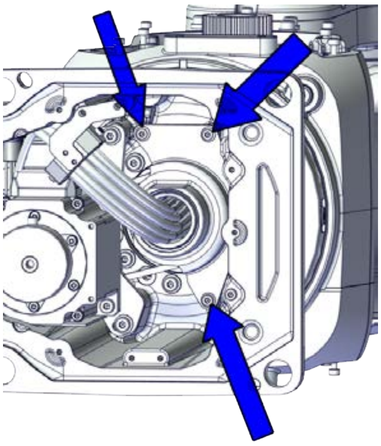
Separating the cable package from the base

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

Continues on next page

	Action	Note
2	Remove the cable bracket.	 xx1800003042

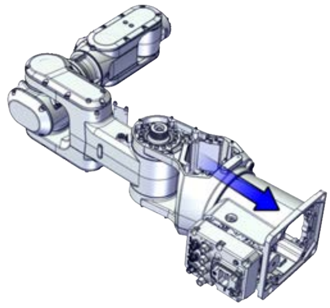
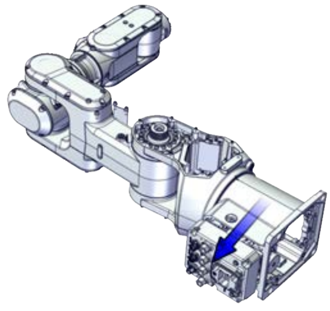
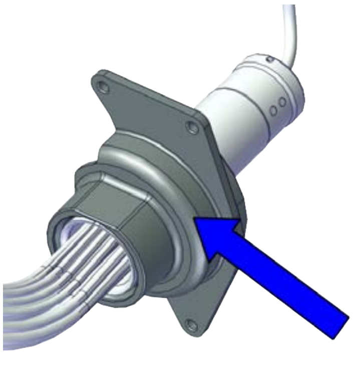
Separating the cable package from the axis-1 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the pulley cover.	 xx1800003043

Pulling out the cable package

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

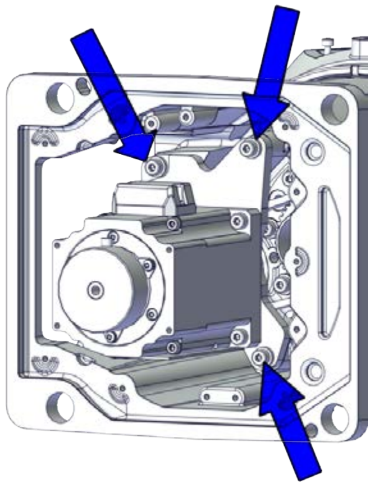
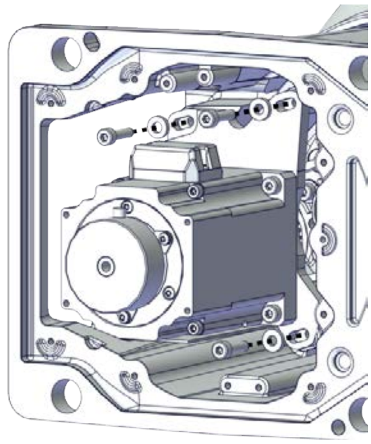
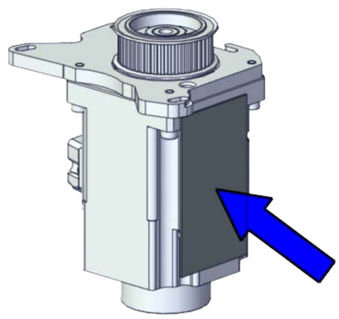
Continues on next page

	Action	Note
2	Pull out the lower cable package from the axis-1 gearbox.	 xx1800003044
3	Pull out the lower cable package from the base.	 xx1800003045
4	Remove the pulley cover from the lower cable package.	 xx1800003046

Removing the axis-1 motor

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

Continues on next page

	Action	Note
2	 **CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003064
4	Remove the screws and washers.	 xx1800003065
5	Carefully lift out the motor.  **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad.	Cooling pad location  xx1800003602

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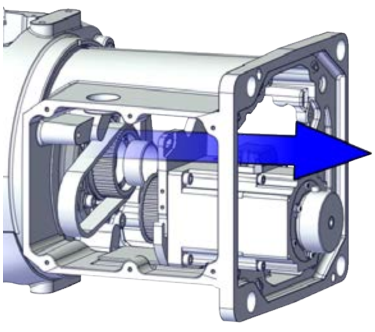
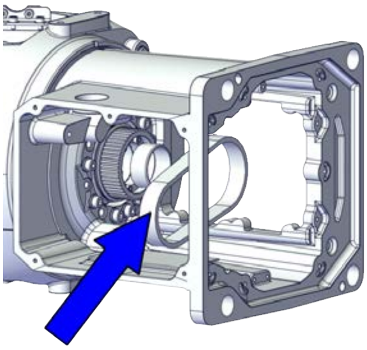
	Action	Note
6	Remove the timing belt from its groove on the motor.	 xx1800003066

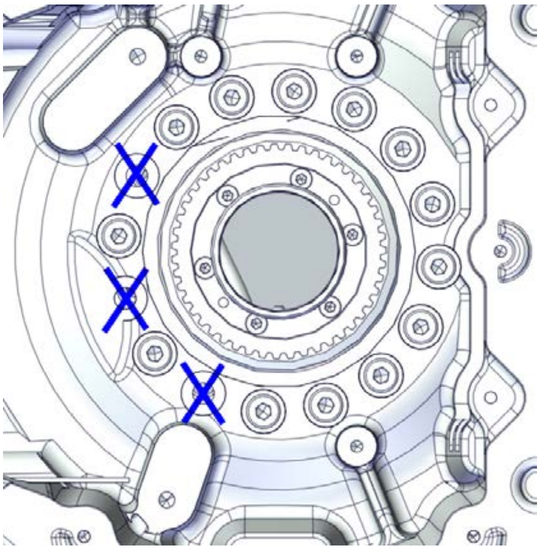
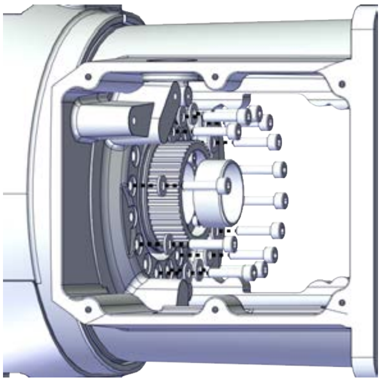
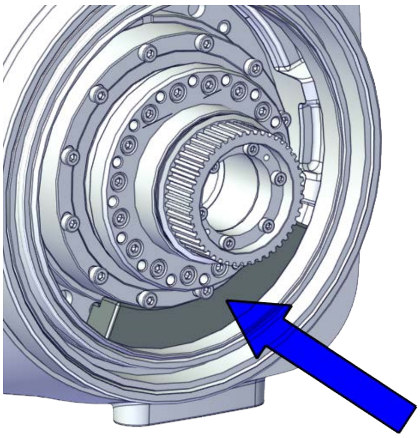
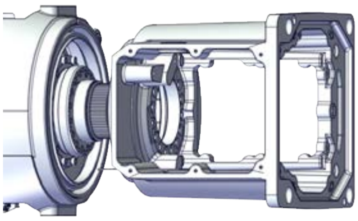
Removing the axis-1 timing belt

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Loosening timing belts will release axes. This means the axes can fall down. Make sure axes are well supported before loosening timing belts.	
3	Remove the timing belt from its groove on the gearbox.	 xx1800003067

Separating the base from the swing

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

Continues on next page

	Action	Note
2	Remove the screws and washers. **Tip** Three screw holes have no screws fitted in. Take photos of the screw and washer position before removing them, to have as a reference when refitting.  xx1800003068	 xx1800003069
3	Separate the base from the swing. **CAUTION** The axis-1 mechanical stop is accessible now. Put it aside for later refitting.  xx1800003071	 xx1800003070

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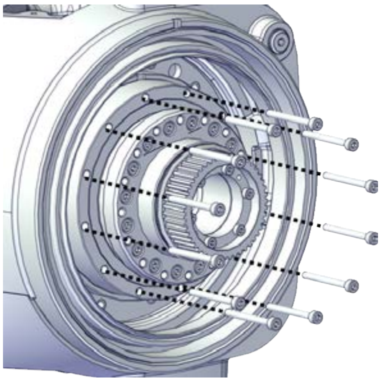
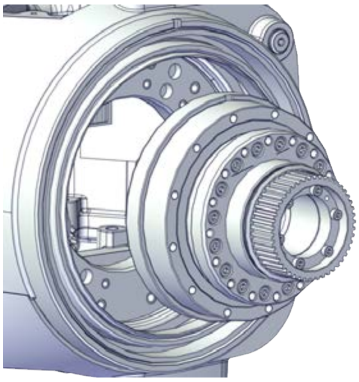
Removing the axis-1 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing gearboxes will release axes. This means the axes can fall down. Make sure axes are well supported before removing gearboxes.	
3	Remove the screws.	 xx1800003073
4	Pull out the gearbox.	 xx1800003074

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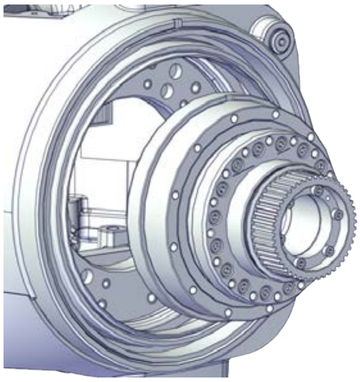
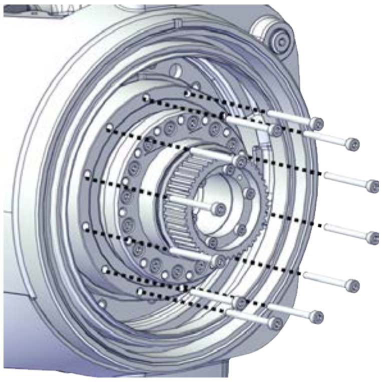
Refitting the gearbox

Use these procedures to refit the axis-1 gearbox.

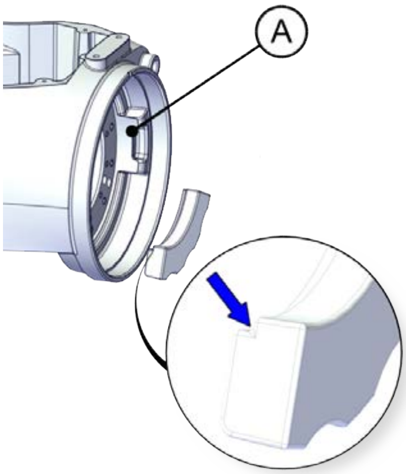
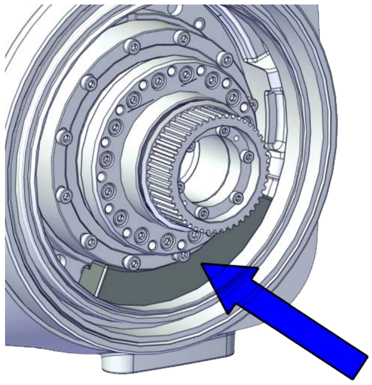
Refitting the axis-1 gearbox

	Action	Note
1	Refit the axis-1 gearbox. Make sure the locking screw hole on the gearbox is aligned with the notch on the swing casting.	 xx1800003074
2	Secure with screws.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (12 pcs) Tightening torque: 1.6 Nm  xx1800003073

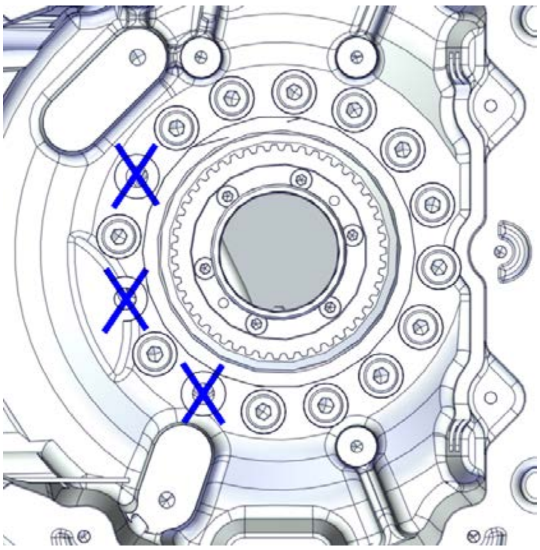
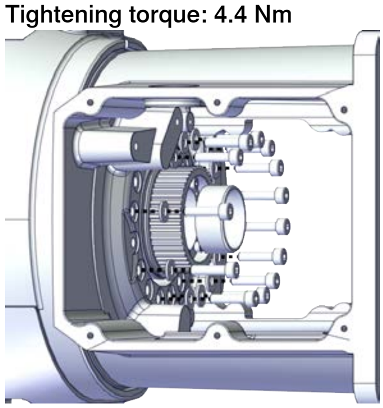
Placing the axis-1 mechanical stop

	Action	Note
1	Check the axis-1 mechanical stop. Replace if damaged.	Mechanical stop, axis 1: 3HAC061947-001

Continues on next page

	Action	Note
2	Put the axis-1 mechanical stop in place in the swing. **Note** The mechanical stop can be placed in any place except the block (A) on the swing. Make sure the mechanical stop step pointed in the figure is facing the swing when putting.  xx1800003619	 xx1800003071

Refitting the base to the swing

	Action	Note
1	Refit the base to the swing. **Note** Pay attention to the screw and washer location.  xx1800003068	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (13 pcs) Tightening torque: 4.4 Nm  xx1800003069

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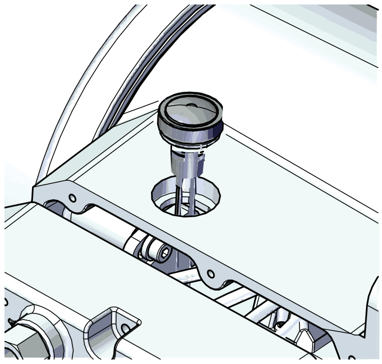
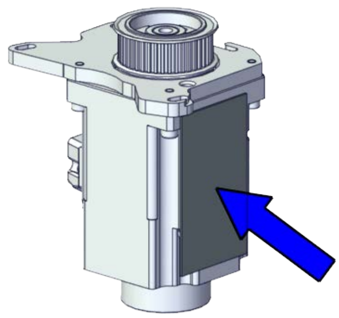
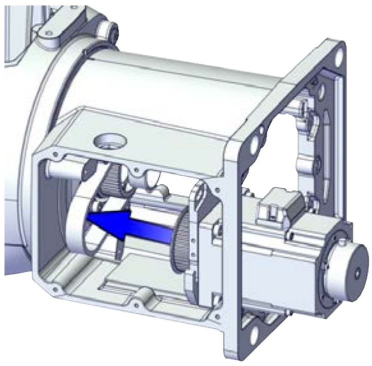
Refitting the brake release button

	Action	Note
1	Refit the brake release button. **Note** Do not reconnect the connector yet. Do not tighten the button yet.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

Refitting the axis-1 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001  xx1800003602
3	Install the timing belt to the motor pulley and verify that the belt runs correctly in the groove of the pulley.	 xx1800003085

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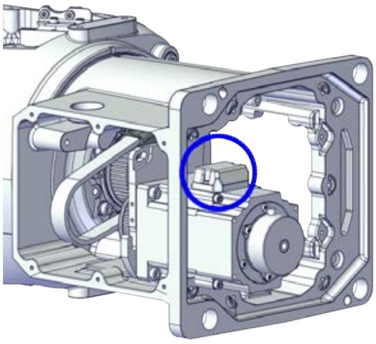
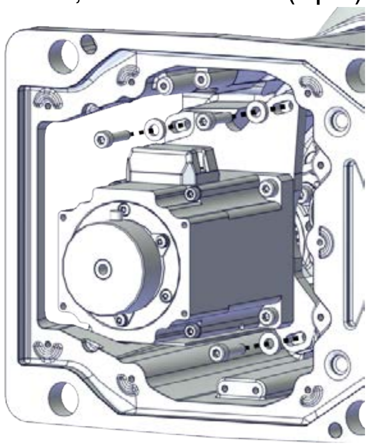
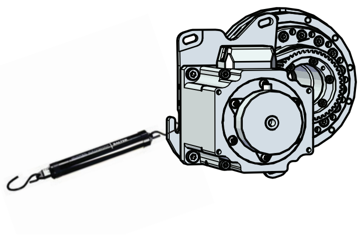
	Action	Note
4	Orient the motor correctly and fit it into the base. At the same time, install the timing belt to the gearbox pulley and verify that the belt runs correctly in the groove of the pulley.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003072
5	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800003065

Adjusting the axis-1 timing belt tension

	Action	Note
1	Use a handheld dynamometer hooking to the motor.	 xx1900000040

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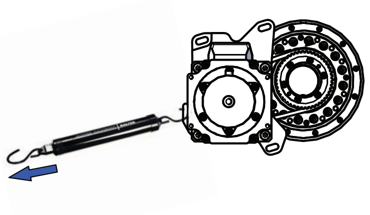
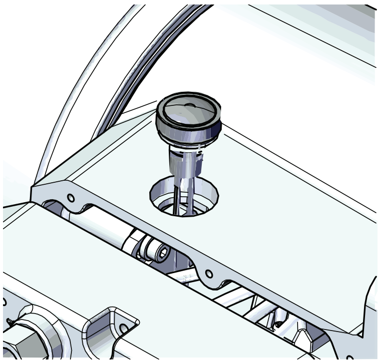
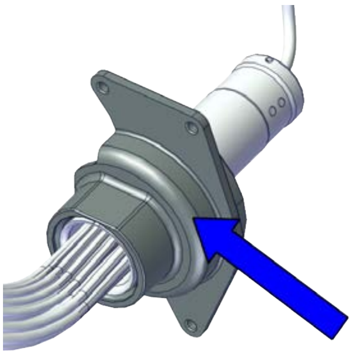
	Action	Note
2	Pull the dynamometer to make the tension falling in the allowed force range. **Note** During the measurement, make sure that all interferences that may affect the force are removed. Pay attention to the force application direction.	Used belt: 58.24-63.56 N New belt:83.2-90.8 N (for reference only)  xx1900000041
3	Secure the motor with the screws.	Tightening torque: 3 Nm

Securing the brake release button

	Action	Note
1	Tighten the brake release button using the tool.	brake release button assembly tool, included in the special toolkit 3HAC071022-001  xx1800003040

Refitting the lower cable package through the axis-1 gearbox

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	Refit the pulley cover to the lower cable package.	 xx1800003046

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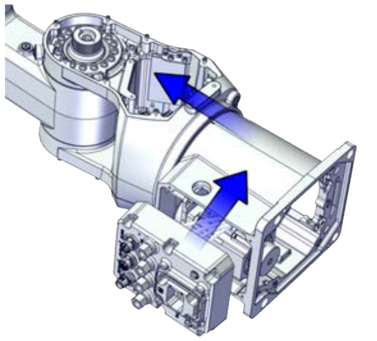
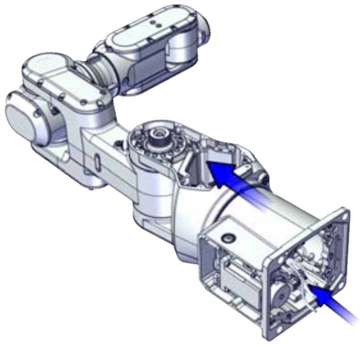
	Action	Note
2	**Valid for cabling with rear interface** Insert the cable package in the base and up through the axis-1 gearbox, through the rear. **Tip** Wrap the connectors with the masking tape. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	 xx1800003047 Cable protection tube orientation: use the encircled notch on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole on the gearbox.  xx1800003048

Continues on next page

	Action	Note
3	**Valid for cabling with bottom interface (option 3309-1)** Insert the cable package in the base and up through the axis-1 gearbox, through the bottom. **Tip** Wrap the connectors with the masking tape. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	 xx1800003060 Cable protection tube orientation: use the encircled notch on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole on the gearbox.  xx1800003048

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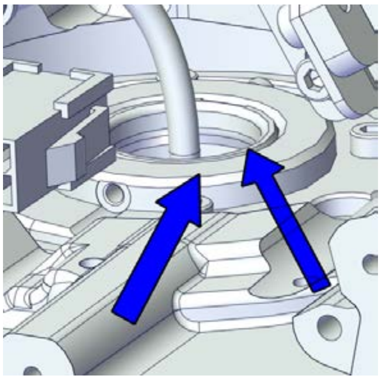
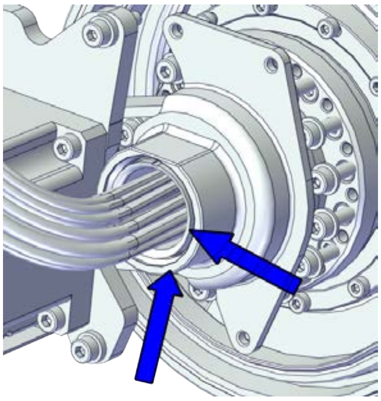
Securing the lower cable package to the axis-1 gearbox

	Action	Note
1	Make sure that: • The hole on the cable protection tube is aligned with the locking screw hole on the gearbox. • The cable protection tube surface is completely parallel with the pulley cover at one side and with the flange at the other side.	 xx1800003063  xx1800003049  xx1800003050

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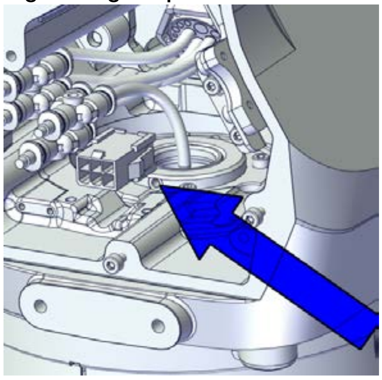
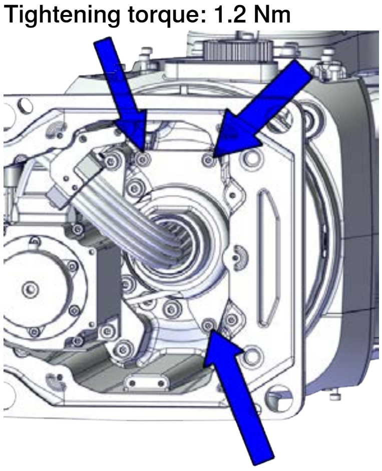
	Action	Note
2	Apply a little Loctite 243 to the locking screw and refit the locking screw. **Note** Make sure the locking screw header is parallel with flange surface. **Note** If there is locking liquid residues on the screw or screw hole, please clean it before refitting. Remove residual locking liquid after refitting.	Screw: M3x8 (1 pcs) Tightening torque: 0.4 Nm  xx1800003032

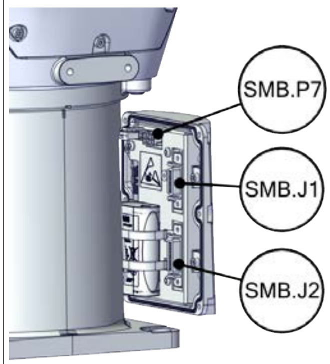
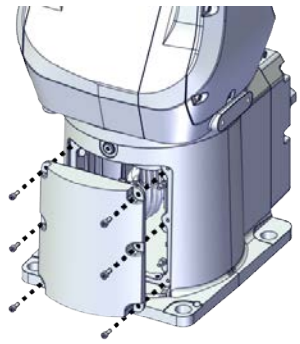
Refitting the pulley cover

	Action	Note
1	Refit the puller cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.2 Nm  xx1800003043

Reconnecting the SMB connectors

	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 48*.	

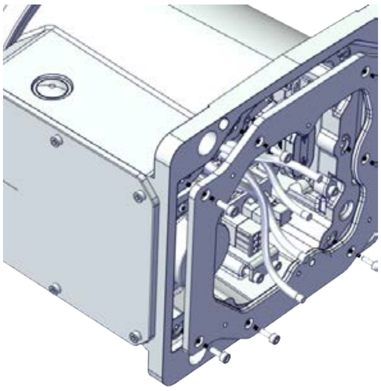
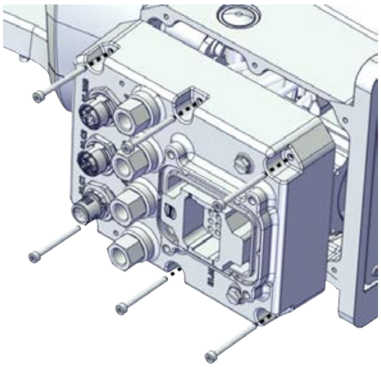
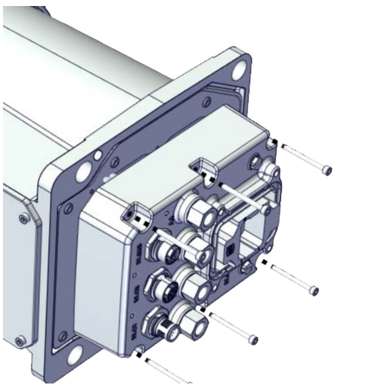
Continues on next page

	Action	Note
2	Reconnect the connectors. • SMB.P7 • SMB.J1 • SMB.J2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	Tightening torque: 0.3 Nm  xx1800002468
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the SMB cover to the base.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm  xx1800002467

Refitting the connector interface plate

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

Continues on next page

	Action	Note
2	**Valid for cabling with bottom interface (option 3309-1)** Refit the base adapter.	Screw: M3x8 Steel 8.8-A2F (7 pcs) Tightening torque: 1.2 Nm  xx1800003056
3	Refit the connector interface plate to the base.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm **Valid for cabling with rear interface**  xx1800003034 **Valid for cabling with bottom interface (option 3309-1)**  xx1800003055

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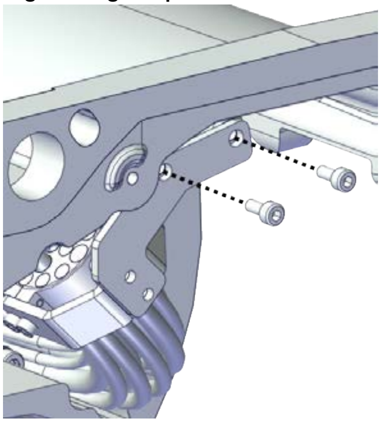
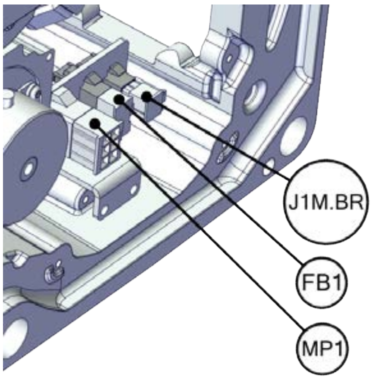
Securing the lower cable package to the base

	Action	Note
1	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003042

Reconnecting the brake release cabling and axis-1 motor connectors

	Action	Note
1	Reconnect the connectors. • J1M.BR • MP1 • FB1  **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003054

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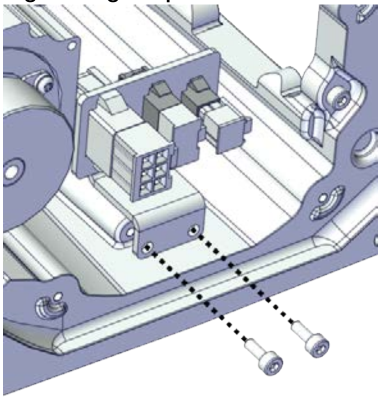
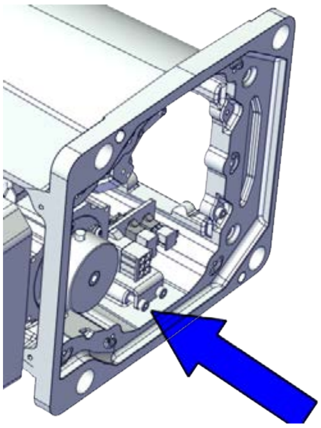
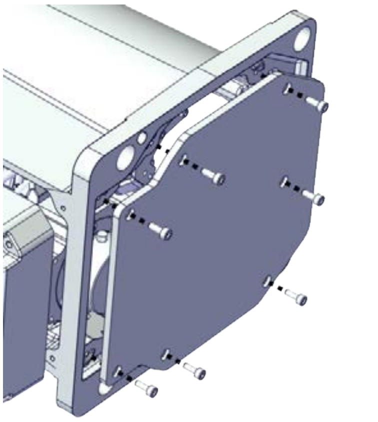
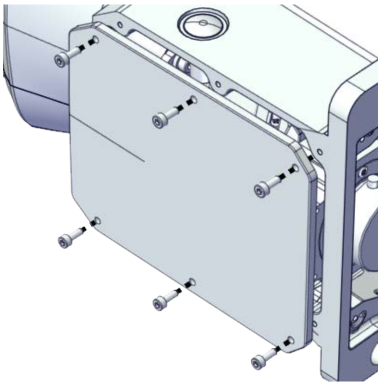
	Action	Note
2	Reconnect the floor cable together with the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800003037  xx1800003036

Refitting the base cover

Notice that the procedure differs depending on if the connector interface is located either at the rear or at the bottom of the base.

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	

Continues on next page

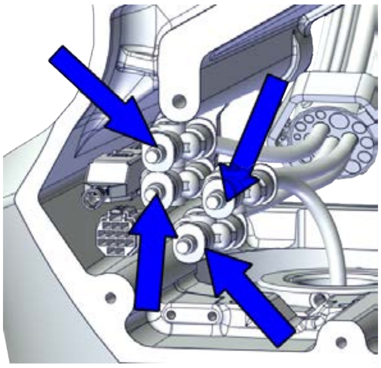
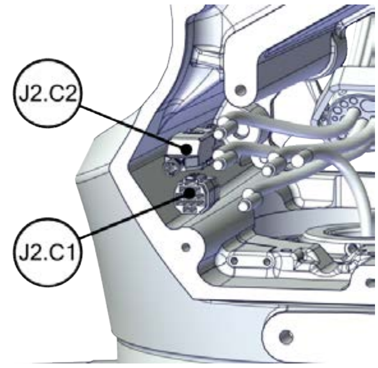
	Action	Note
4	**Valid for cabling with rear interface** Refit the bottom cover.	Screw: M3x8 Steel 8.8-A2F (7 pcs) Tightening torque: 1.2 Nm  xx1800003035
5	Refit the rear cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 1.2 Nm  xx1800003057

Securing the robot to the foundation

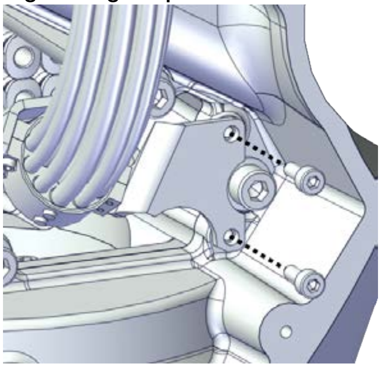
	Action	Note
1	**CAUTION** The CRB 1100 robot weighs 21.1 kg and can be lifted by one person.	
2	Raise the robot to standing and secure to the foundation with the attachment screws and washers.	Attachment screws: M12x25 (robot installation directly on foundation), quality: 8.8. Washers: 4 pcs, 24 x 13 x 2.5. Tightening Torque: 50 Nm±5 Nm.

Continues on next page

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

	Action	Note
1	Reconnect the air hoses in a cross pattern to the Y-shaped connectors. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	 xx1800002500
2	Reconnect the connectors. • J2.C1 • J2.C2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002501

Securing the cable package to the swing

	Action	Note
1	Refit the cable bracket.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002499

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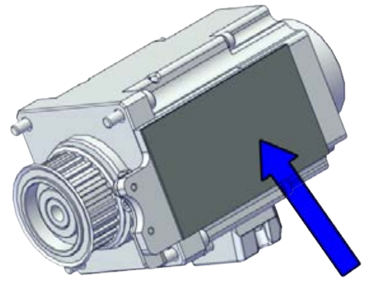
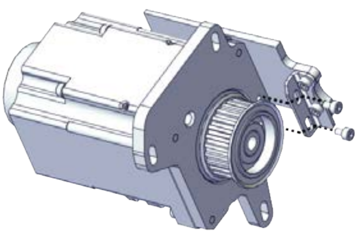
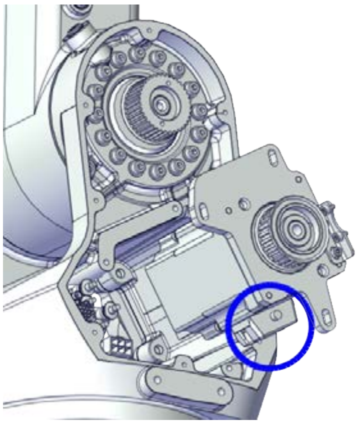
Refitting the axis-2 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged, as shown in the following step.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001  xx1800003603
3	Remove the screws. Replace with a new cooling pad and then refit the screws.	Screw: M3x5 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 1.2 Nm  xx1800003026
4	Orient the motor correctly and fit it into the swing. **Tip** Bend the motor signal cable back towards the swing support.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003027

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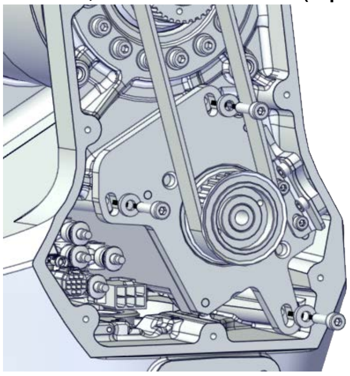
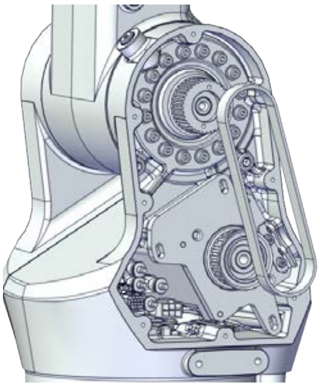
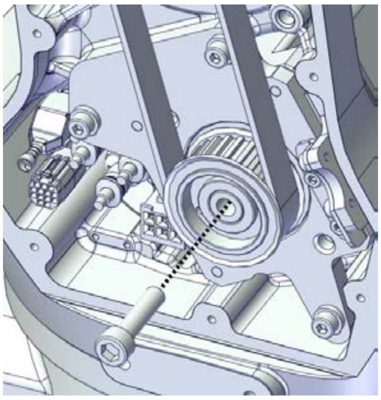
	Action	Note
5	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800002494
6	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003028
7	Install an M6x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000010

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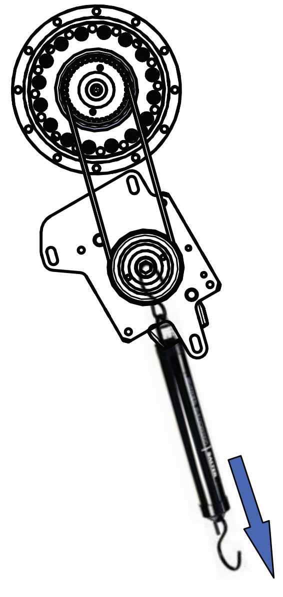
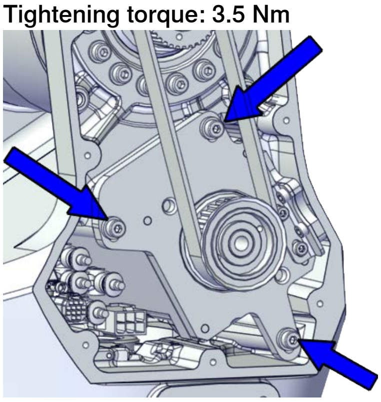
	Action	Note
8	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 68.18-75.04 N (for reference only) Initial referenced force for new belt: 97.4-107.2 N  xx1900000029
9	Secure the motor with the screws.	Tightening torque: 3.5 Nm  xx1800002493
10	Use a sonic tension meter to measure the timing belt tension.	Used belt: 163-174 Hz New belt:180-229 Hz (for reference only)
11	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	

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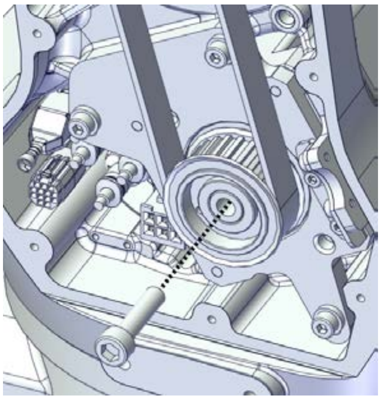
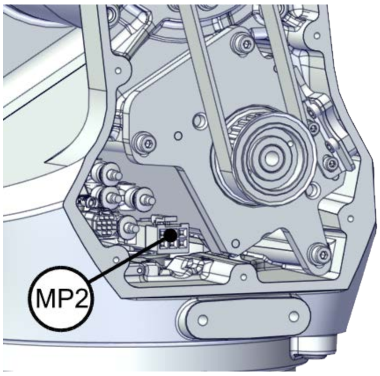
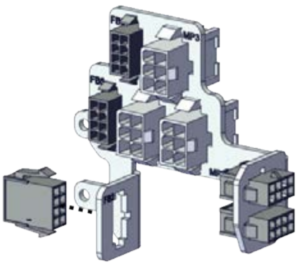
	Action	Note
12	Remove the adjustment screw from the motor.	 xx1900000010
13	Reconnect the connector. • MP2  **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002495

Reconnecting the connectors at the division point

	Action	Note
1	Insert the female header of the connectors to the connector plate.	 xx1800003029

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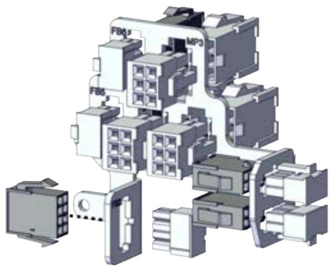
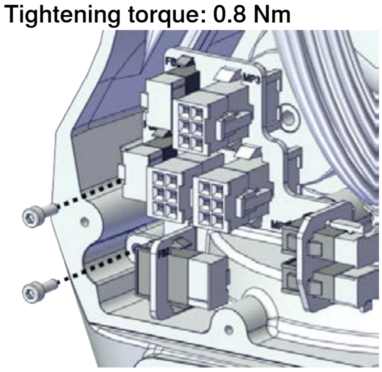
	Action	Note
2	Reconnect the connectors. • J2.FB2,3,4,5,6 • J2.MP3,4,5/6 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003030
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002489

Refitting the swing covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	

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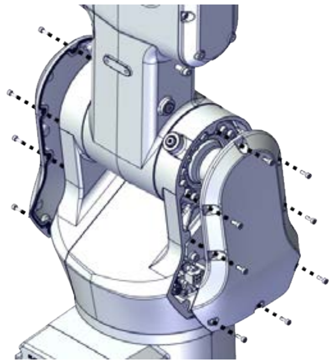
	Action	Note
3	Refit the covers. • Swing cover • Swing support cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003607

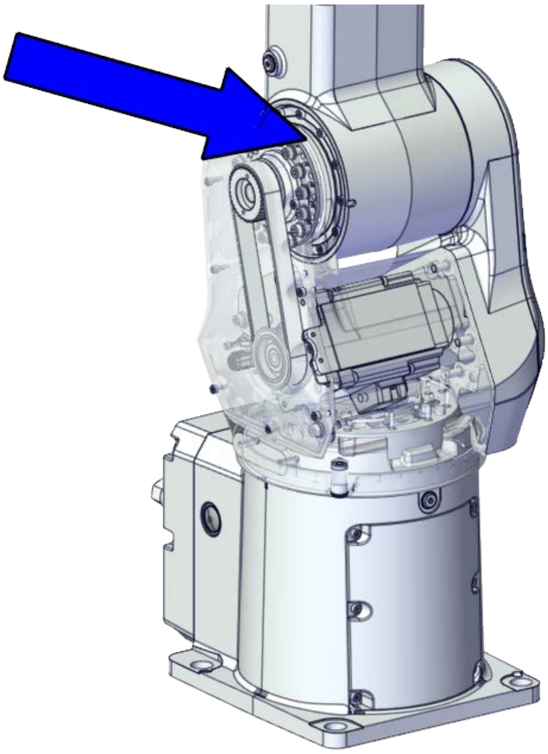
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

5.8.2 Replacing the axis-2 gearbox

Location of the axis-2 gearbox

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



xx1800002479

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 1100 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Gear unit with pulley, axis 2	3HAC073517-001	
Motor with flange, axis 2	3HAC083588-001	.
Timing belt, axis 2	3HAC061935-001	
Swing cover	3HAC069051-001	
Swing support cover	3HAC069052-001	
Cooling pad for axis-1 and -2 motors	3HAC071020-001	Cooling pads are wear parts. One cooling pad sheet contains 6 pieces of small pad. Replace if damaged with one piece each time.

Continues on next page

Spare part	Article number	Note
Washer	3HAC063985-001	9x4.3x1, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222
Grease	-	Castrol Molub. Alloy 777-1 NG Used to lubricate bearings on the swing support and lower arm support.

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.

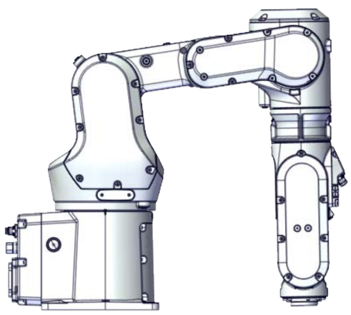
Continues on next page

	Action	Note
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the gearbox

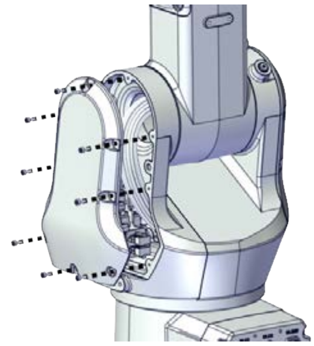
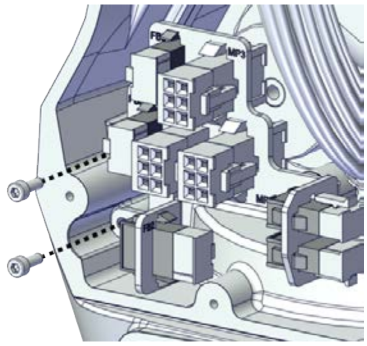
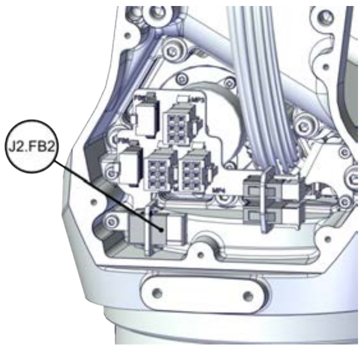
Use these procedures to remove the axis-2 gearbox.

Preparations before removing the axis-2 gearbox

	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: 0° • Axis 2: 110° (CRB 1100-4/0.475) /95° (CRB 1100-4/0.58) • Axis 3: -20° (CRB 1100-4/0.475)/ -6° (CRB 1100-4/0.58) • Axis 4: 0° • Axis 5: 0° • Axis 6: No significance.	 xx1800003289
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Continues on next page

Removing the axis-2 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Remove the swing support cover.	 xx1800002488
4	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate.	 xx1800002489
5	Disconnect the connector. • J2.FB2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002490

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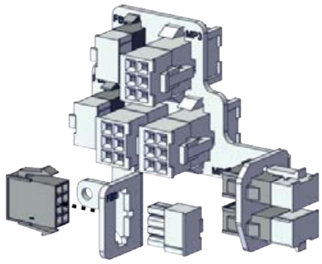
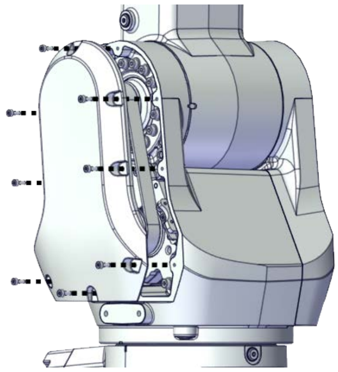
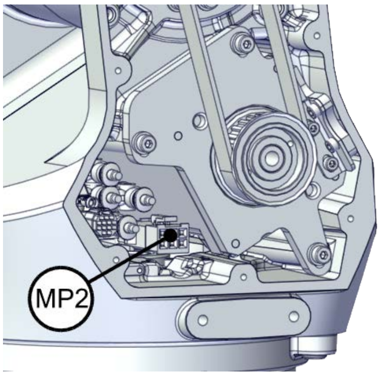
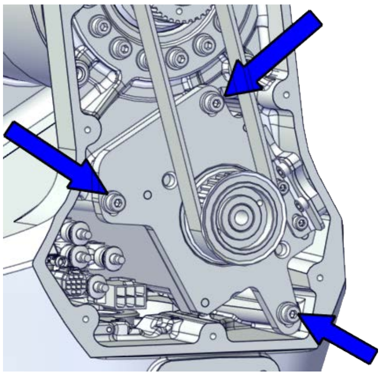
	Action	Note
6	Snap loose and remove the female head of the connector from the connector plate.	 xx1800002491
7	Remove the swing cover.	 xx1800002492
8	Disconnect the connector. • MP2 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800002495
9	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002493

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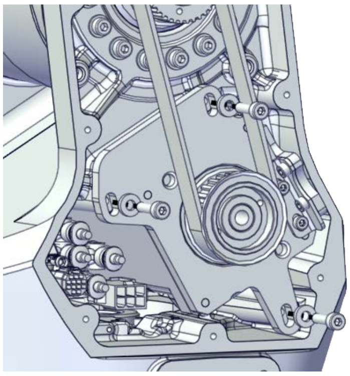
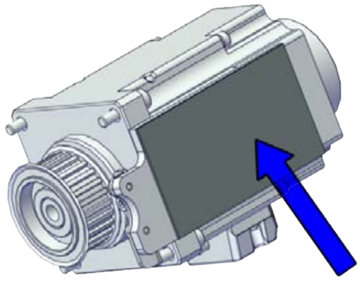
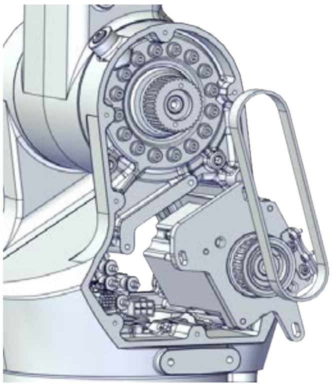
	Action	Note
10	Remove the screws and washers.	 xx1800002494
11	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad. **CAUTION** Be aware of the motor cabling. The motor cannot be removed completely until the connector is disconnected, as shown in following step.	Cooling pad location  xx1800003603
12	Remove the timing belt from its groove on the motor.	 xx1800002496

Separating the upper cable harness from the axis-2 gearbox

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

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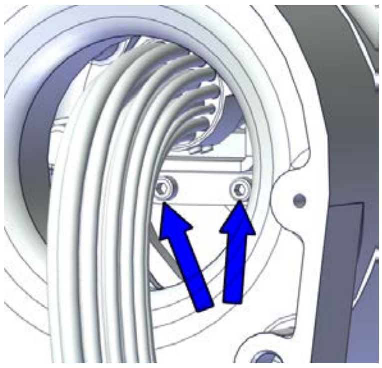
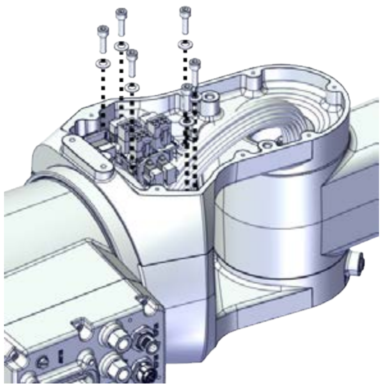
	Action	Note
2	Remove the cable bracket.	 xx1800003002

Loosening the swing support

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Loosen the swing support screws. **Tip** If the swing support is hard to loosen from the lower arm, use a plastic hammer to knock on the swing support lightly. **CAUTION** The support cannot be removed completely. Make sure the hanging support will not wear or damage the cable harness.	 xx1800003079

Separating the swing from the lower arm

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

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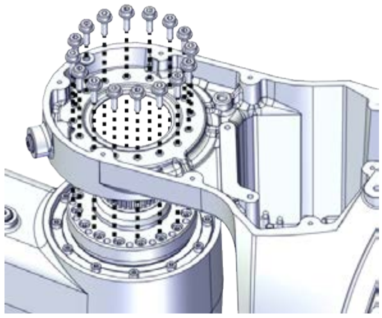
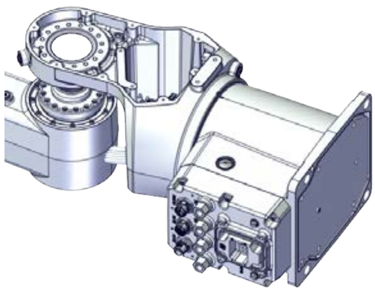
	Action	Note
2	Remove the screws. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	 xx1900002203
3	Separate the swing from the lower arm. **Tip** If the swing is hard to loosen from the housing, use a plastic hammer to knock on the swing lightly.	 xx1800003081

Removing the axis-2 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing gearboxes will release axes. This means the axes can fall down. Make sure axes are well supported before removing gearboxes.	
3	Move the lower arm aside a little to access the gearbox screws.	

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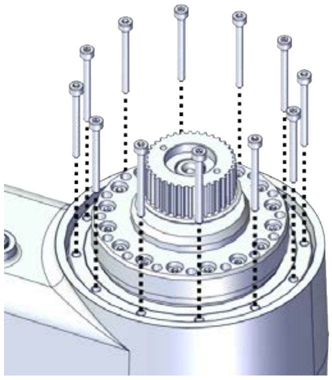
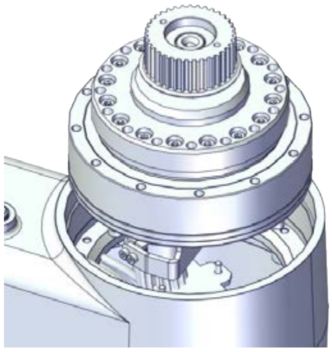
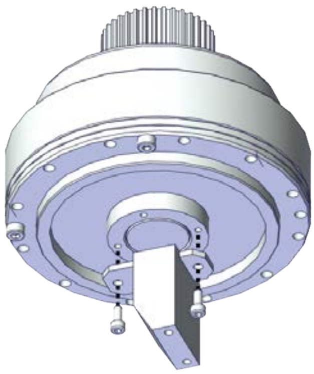
	Action	Note
4	Remove the screws.	 xx1800003082
5	Pull out the gearbox.	 xx1800003083

Removing the cable block

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the cable block from the gearbox.	 xx1800003084

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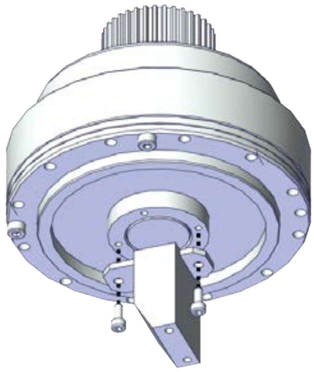
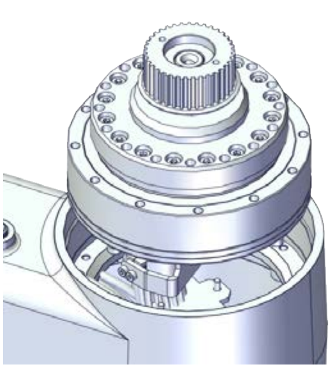
Refitting the gearbox

Use these procedures to refit the axis-2 gearbox.

Refitting the cable block

	Action	Note
1	Refit the cable block to the axis-2 gearbox.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003084

Refitting the axis-2 gearbox

	Action	Note
1	Refit the axis-2 gearbox.	 xx1800003083

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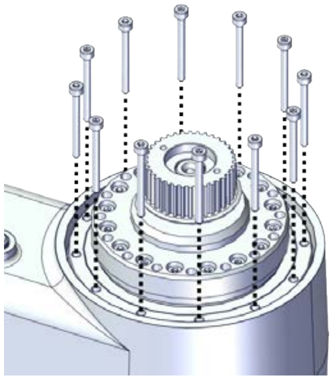
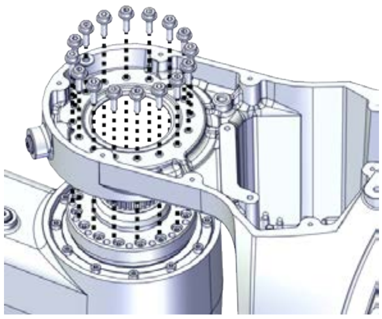
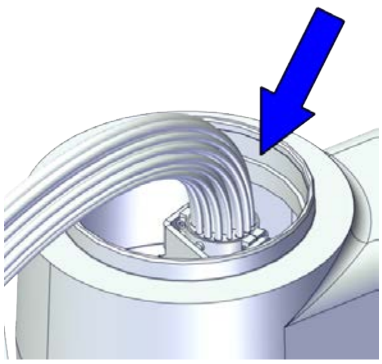
	Action	Note
2	Secure with screws.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (12 pcs) Tightening torque: 1.9 Nm  xx1800003082

Refitting the swing to the lower arm

	Action	Note
1	Refit the swing to the lower arm. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	Flange screws (16 pcs) Tightening torque: 4.2 Nm  xx1900002203

Securing the swing support

	Action	Note
1	Apply grease Castrol Molub-Alloy 777-1 NG to the inner surface of the lower arm, where contacts the bearing on the swing support.	 xx2000000058

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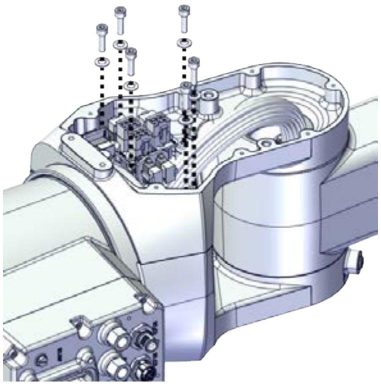
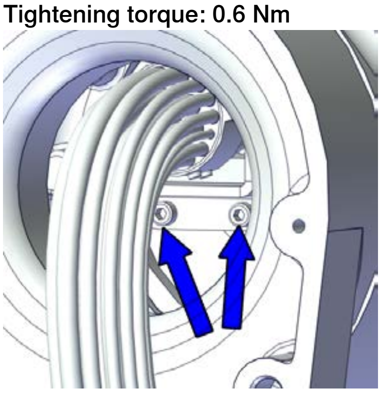
	Action	Note
2	Refit the swing support. **Tip** If the swing support is hard to closely fit to the lower arm, use a plastic hammer to knock on the swing support lightly.	Screw: M5x16 12.9 Lafre 2C2B/FC6.9 (6 pcs) Tightening torque: 6 Nm  xx1800003079

Securing the upper cable package to the axis-2 gearbox

	Action	Note
1	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003002

Refitting the axis-2 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	

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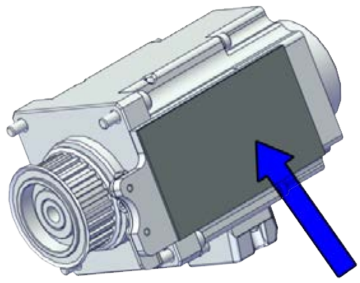
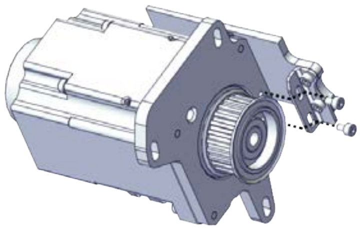
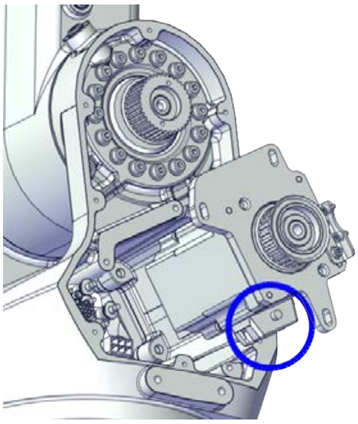
	Action	Note
2	Check the cooling pad. Replace if damaged, as shown in the following step.	Cooling pad for axis-1 and -2 motors: 3HAC071020-001  xx1800003603
3	Remove the screws. Replace with a new cooling pad and then refit the screws.	Screw: M3x5 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 1.2 Nm  xx1800003026
4	Orient the motor correctly and fit it into the swing. **Tip** Bend the motor signal cable back towards the swing support.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003027

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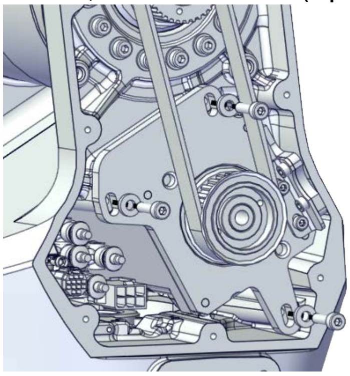
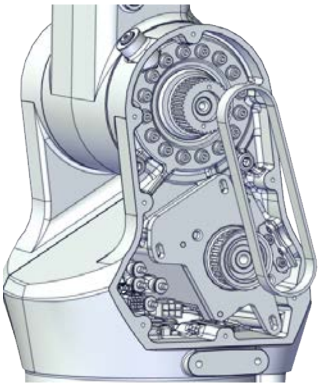
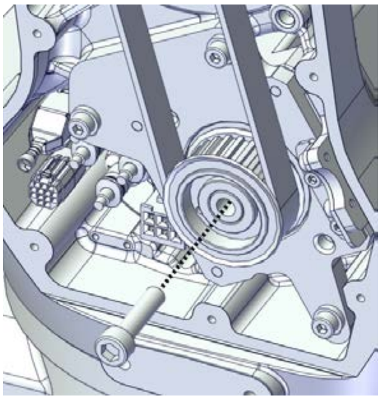
	Action	Note
5	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs)  xx1800002494
6	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003028
7	Install an M6x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000010

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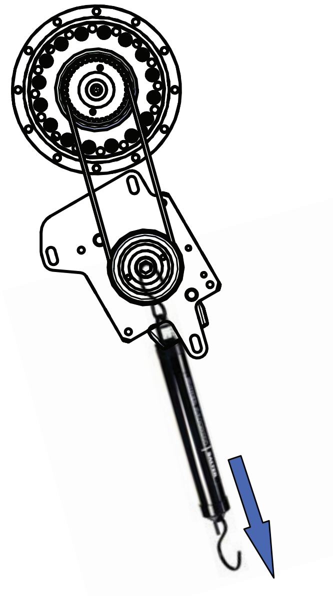
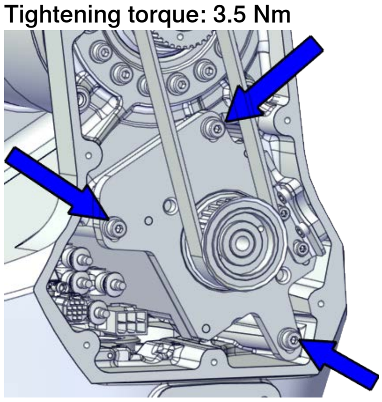
	Action	Note
8	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 68.18-75.04 N (for reference only) Initial referenced force for new belt: 97.4-107.2 N  xx1900000029
9	Secure the motor with the screws.	Tightening torque: 3.5 Nm  xx1800002493
10	Use a sonic tension meter to measure the timing belt tension.	Used belt: 163-174 Hz New belt:180-229 Hz (for reference only)
11	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	

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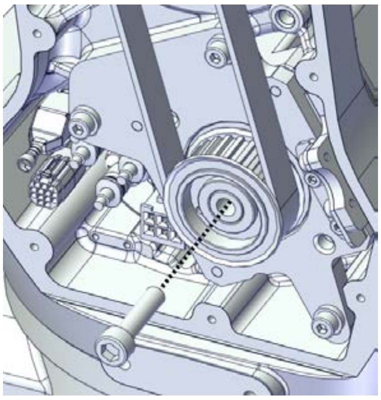
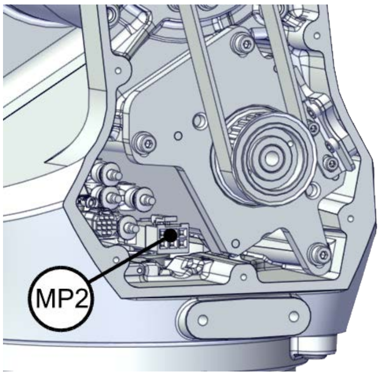
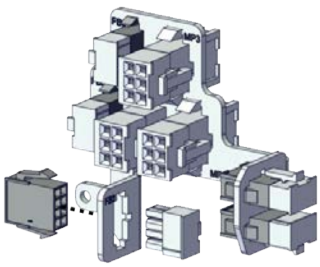
	Action	Note
12	Remove the adjustment screw from the motor.	 xx1900000010
13	Reconnect the connector. • MP2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002495

Reconnecting the connector at the division point

	Action	Note
1	Insert the female header of the connector to the connector plate.	 xx1800002491

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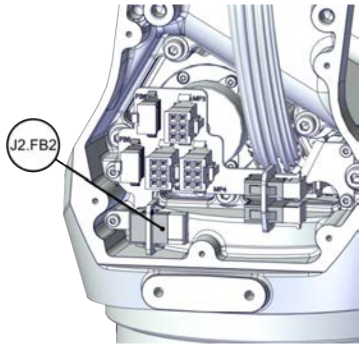
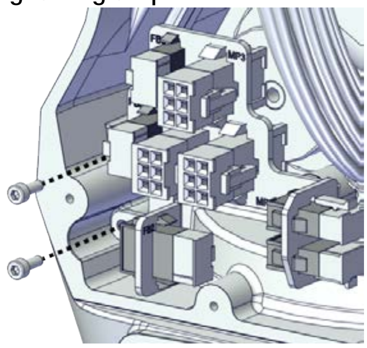
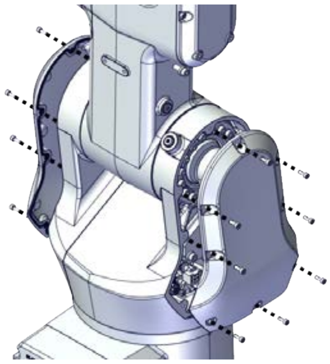
	Action	Note
2	Reconnect the connector. • J2.FB2 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002490
3	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
4	Refit the connector plate.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.8 Nm  xx1800002489

Refitting the swing covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	

Continues on next page

	Action	Note
3	Refit the covers. • Swing cover • Swing support cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003607

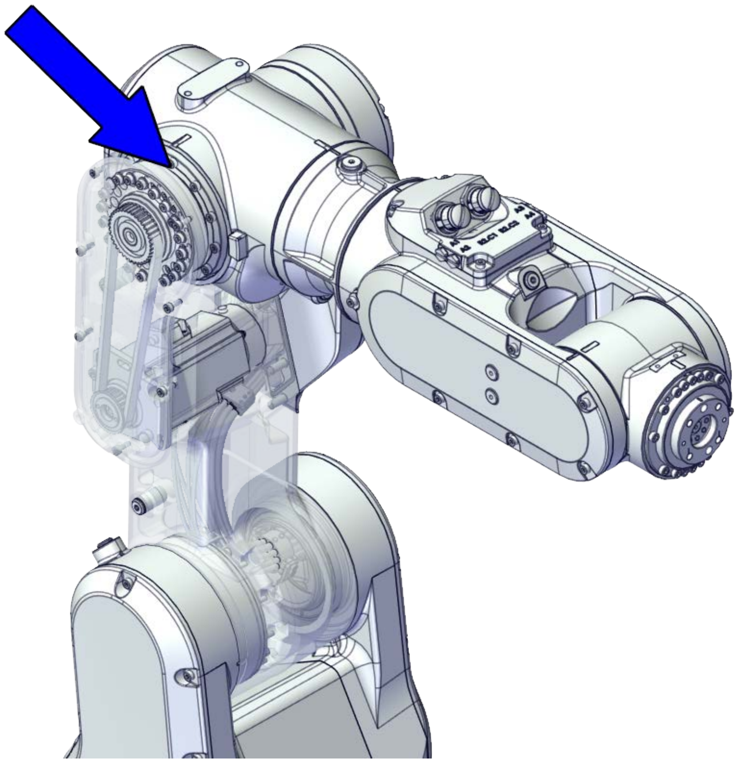
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

5.8.3 Replacing the axis-3 gearbox

Location of the axis-3 gearbox

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



xx1800002480

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 1100 via myABB Business Portal, *www.abb.com/myABB*.

Spare part	Article number	Note
Gear unit with pulley, axis 3	3HAC073518-001	
Labyrinth sealing ring	3HAC073218-001	
Motor with flange, axis 3	3HAC083587-001	
Timing belt, axis 3	3HAC061936-001	
Lower arm cover	3HAC069057-001	
Lower arm support cover	3HAC069059-001	

Continues on next page

Spare part	Article number	Note
Cooling pad for axis-3 and -4 motors	3HAC071021-001	Cooling pads are wear parts. One cooling pad sheet includes 10 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC063985-001	9x4.3x1, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
Sonic tension meter	-	Used for measuring the timing belt tension.
Dynamometer	-	Used for measuring the timing belt tension.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222
Grease	-	Castrol Molub. Alloy 777-1 NG Used to lubricate bearings on the swing support and lower arm support.
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)

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Deciding calibration routine

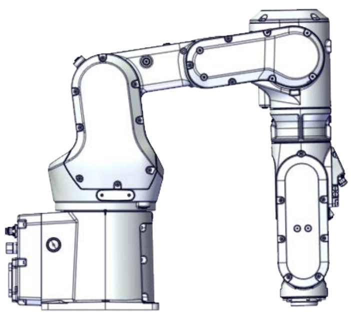
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the gearbox

Use these procedures to remove the axis-3 gearbox.

Preparations before removing the axis-3 gearbox

	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: 0° • Axis 2: 110° (CRB 1100-4/0.475) /95° (CRB 1100-4/0.58) • Axis 3: -20° (CRB 1100-4/0.475)/ -6° (CRB 1100-4/0.58) • Axis 4: 0° • Axis 5: 0° • Axis 6: No significance.	 xx1800003289

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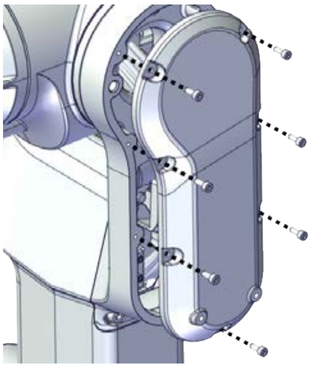
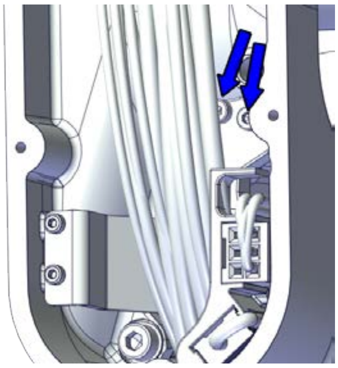
	Action	Note
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Disconnecting the axis-3 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the lower arm support cover.	 xx1800003003
3	Remove the connector plate. **CAUTION** Be aware of the cablings that are attached to the connector plate! The connector plate cannot be removed completely until the connectors are remove from the plate, as shown in following step.	 xx1800003004

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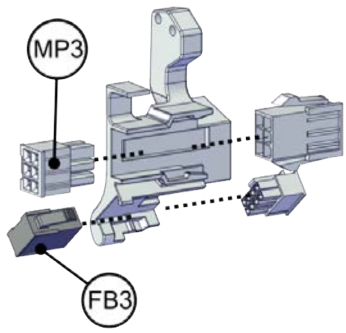
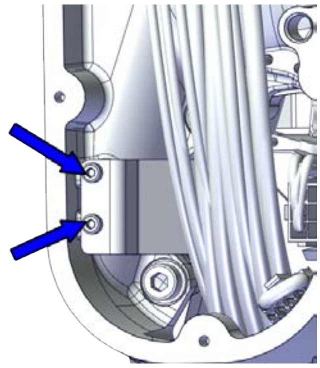
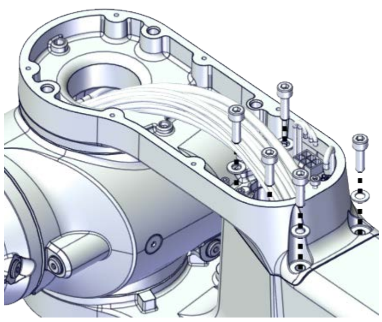
	Action	Note
4	Slide the connectors out of the connector plate and disconnect the connectors. • FB3 • MP3 **Tip** Take photos of the connector and cable position before disconnecting them, to have as a reference when reconnecting.	 xx1800003005
5	Remove the cable bracket.	 xx1800003006

Loosening the lower arm support

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Loosen the lower arm support screws. **Tip** If the lower arm support is hard to loosen from the housing, use a plastic hammer to knock on the lower arm support lightly. **CAUTION** The support cannot be removed completely. Make sure the hanging support will not wear or damage the cable harness.	 xx1800003286

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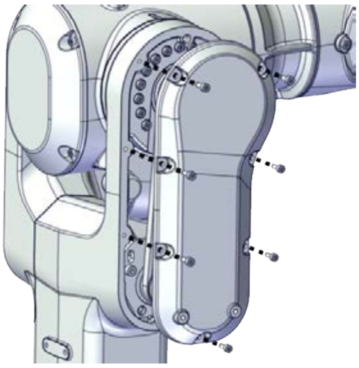
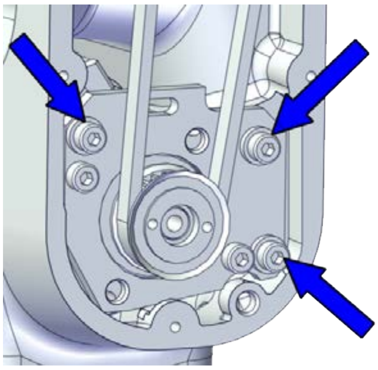
Loosening the axis-3 motor

	Action	Note
1	 **DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	 **CAUTION** Loosening timing belts will release axes. This means the axes can fall down. Make sure axes are well supported before loosening timing belts.	
3	Remove the lower arm cover.	 xx1800003007
4	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003008

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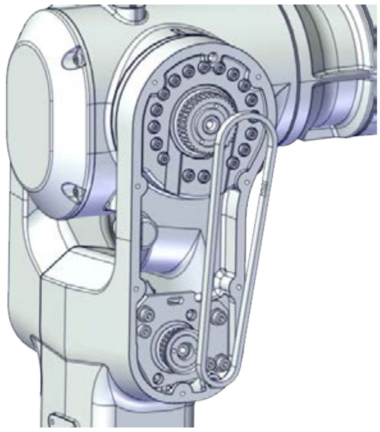
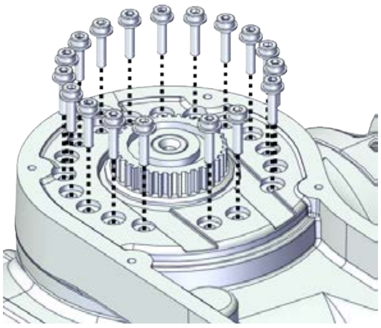
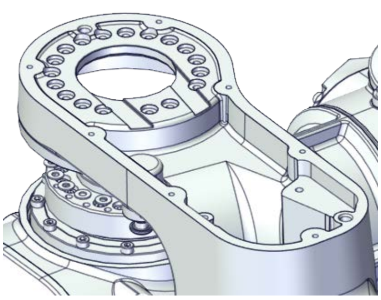
	Action	Note
5	Remove the timing belt from its grooves on the motor and gearbox.	 xx1800003022

Separating the lower arm from the housing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	 xx1900002190
3	Separate the lower arm from the housing. **Tip** If the lower arm is hard to loosen from the housing, use a plastic hammer to knock on the lower arm lightly.	 xx1800003090

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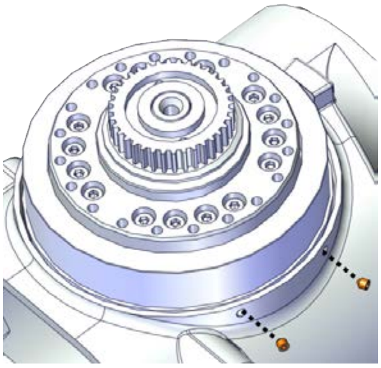
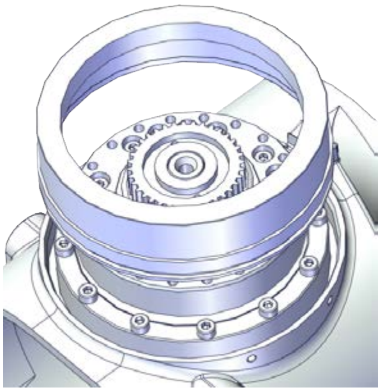
Removing the axis-3 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing gearboxes will release axes. This means the axes can fall down. Make sure axes are well supported before removing gearboxes.	
3	Remove the screws on the labyrinth sealing ring.	 xx1900001425
4	Remove the labyrinth sealing ring lightly and evenly.	 xx1900001417

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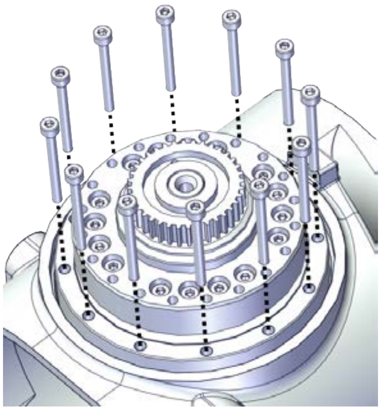
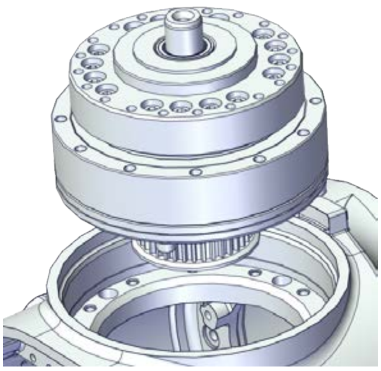
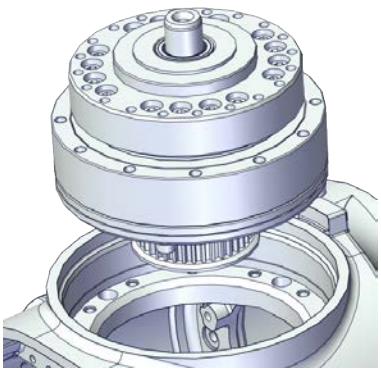
	Action	Note
5	Remove the screws.	 xx1800003284
6	Pull out the gearbox.	 xx1800003285

Refitting the gearbox

Use these procedures to refit the axis-3 gearbox.

Refitting the axis-3 gearbox

	Action	Note
1	Refit the axis-3 gearbox.	 xx1800003285

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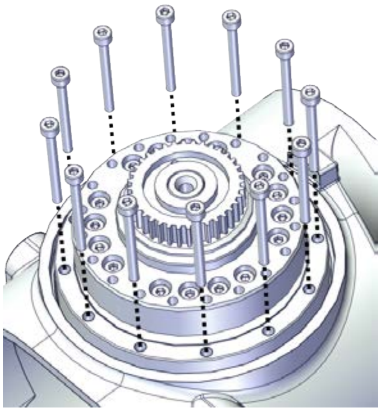
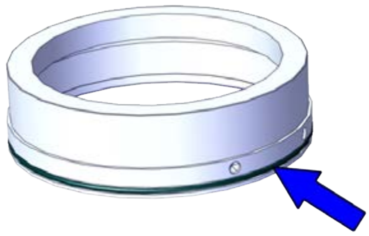
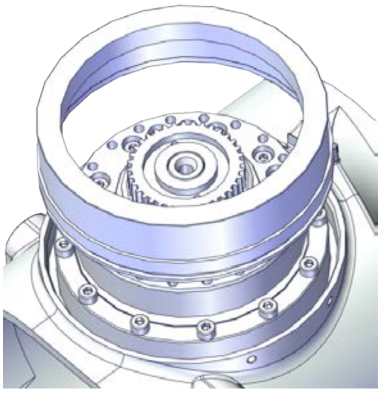
	Action	Note
2	Secure with screws.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (12 pcs) Tightening torque: 1.8 Nm  xx1800003284
3	Check the O-ring. Replace if damaged.	 xx1900001424
4	Refit the labyrinth sealing ring lightly and evenly. **Note** Make sure the labyrinth sealing ring is well fitted to the axis-3 gearbox without any deflection.	 xx1900001417

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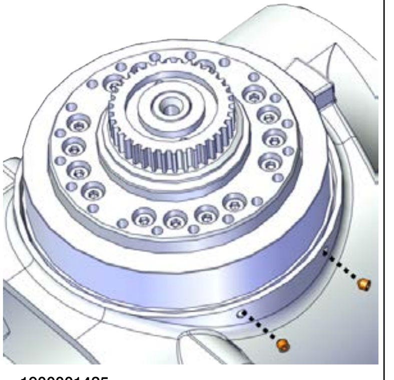
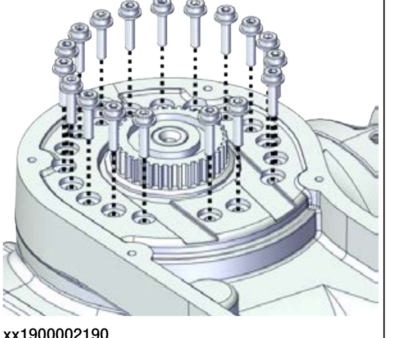
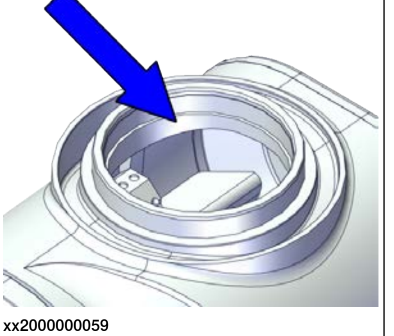
	Action	Note
5	Apply a little Loctite 243 to the screws and secure the labyrinth sealing ring with the screws.	Screw: M3x4 (2 pcs) Tightening torque: 0.8 Nm  xx1900001425

Refitting the lower arm to the housing

	Action	Note
1	Refit the lower arm to the housing. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	Flange screws (16 pcs) Tightening torque: 1.9 Nm  xx1900002190

Securing the lower arm support

	Action	Note
1	Apply grease Castrol Molub-Alloy 777-1 NG to the inner surface of the housing, where contacts the bearing on the lower arm support.	 xx2000000059

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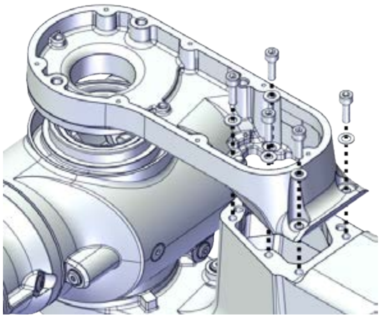
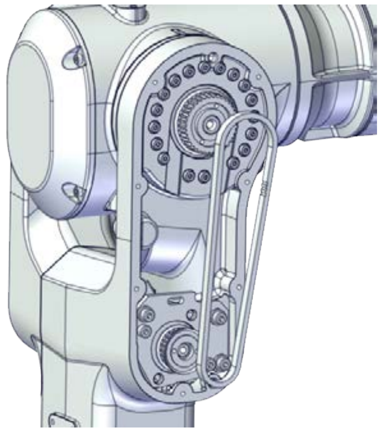
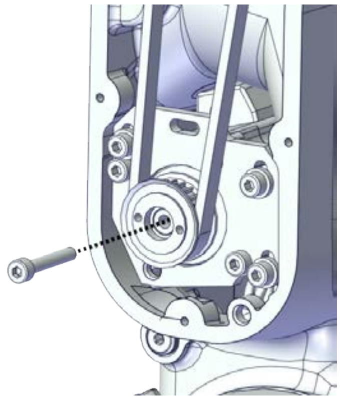
	Action	Note
2	Refit the lower arm support.	Screw: M5x16 12.9 Lafre 2C2B/FC6.9 (5 pcs) Tightening torque: 8 Nm  xx1800003088
3	Route the cable package through the lower arm support.	

Securing the axis-3 motor

	Action	Note
1	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003022
2	Install an M4x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000009

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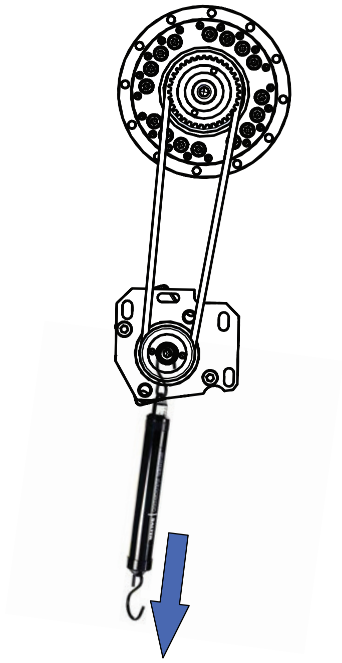
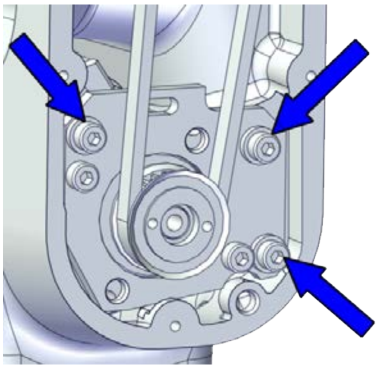
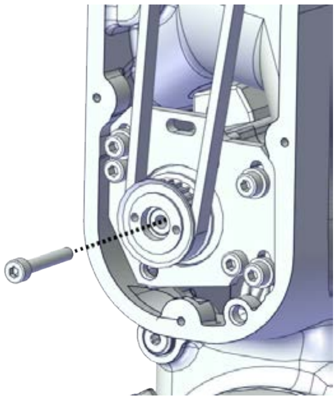
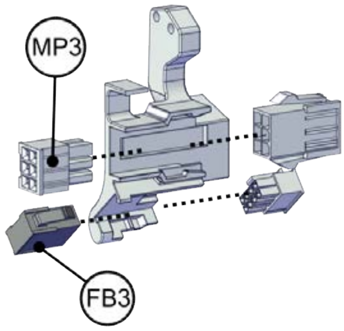
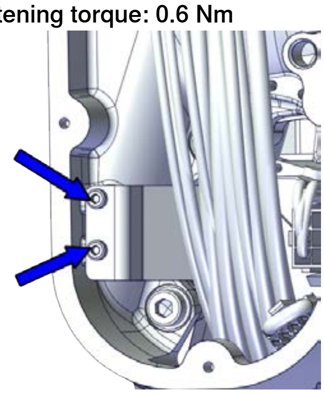
	Action	Note
3	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 21.7-23.94 N (for reference only) Initial referenced force for new belt: 31-34.2 N  xx1900000028
4	Secure the motor with the screws.	Screw: M4x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC063985-001 (3 pcs) Tightening torque: 3 Nm  xx1800003008
5	Use a sonic tension meter to measure the timing belt tension.	Used belt: 102-109 Hz New belt: 113-143 Hz (for reference only)
6	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	

Continues on next page

	Action	Note
7	Remove the adjustment screw from the motor.	 xx1900000009

Reconnecting the axis-3 motor connectors

	Action	Note
1	Slide the connectors into the connector plate and reconnect the connectors. • FB3 • MP3 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003005
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Refit the cable bracket.	Screw: M2.5x6 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.6 Nm  xx1800003006

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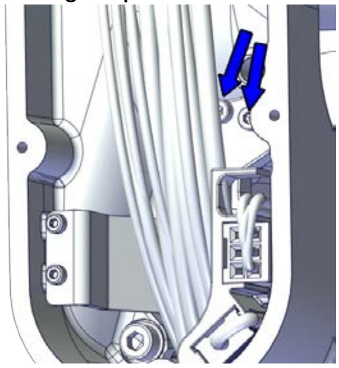
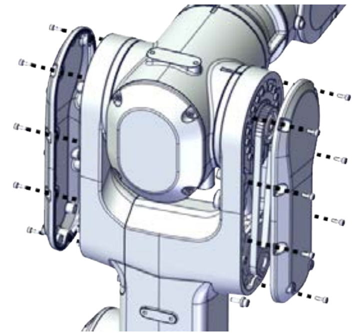
	Action	Note
4	Refit the connector plate.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (2 pcs) Tightening torque: 0.4 Nm  xx1800003004

Refitting the lower arm covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	
3	Refit the covers. • Lower arm cover • Lower arm support cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx1800003608

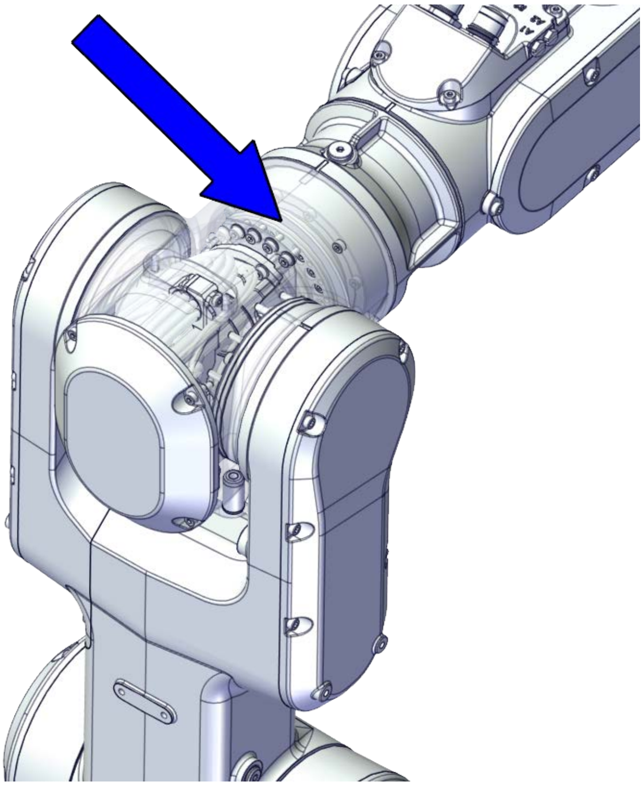
Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

5.8.4 Replacing the axis-4 gearbox

Location of the axis-4 gearbox

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



xx1800002481

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 1100 via myABB Business Portal, www.abb.com/myABB.

Spare part	Article number	Note
Process hub with lamp unit (CP/CS and air hose, with Ethernet)	3HAC077335-001	
Gear unit with pulley, axis 4	3HAC073519-001	
Motor with flange, axis 4	3HAC083586-001	
Timing belt, axis 4	3HAC061937-001	
Motor with flange, axis 6	3HAC083584-001	
Timing belt, axis 6	3HAC061939-001	
Housing cover	3HAC069054-001	
Wrist cover	3HAC069061-001	

Continues on next page

Spare part	Article number	Note
Cooling pad for axis-3 and -4 motors	3HAC071021-001	Cooling pads are wear parts. One cooling pad sheet includes 10 pieces of small pad. Replace if damaged with one piece each time.
Washer	3HAC064765-001	7x3.2x1.5, Steel

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 712*.
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
24 VDC power supply	-	Used to release the motor brakes.
M3x25 eye bolt	-	Included in the special toolkit 3HAC071022-001.
Dynamometer	-	Used for measuring the timing belt tension.
J5.C2 connector assembly tool	-	Included in the special toolkit 3HAC071022-001. Used to remove and refit the J5.C2 connector, if the Ethernet cabling is equipped.
axis-4 motor fitting tool	-	Included in the special toolkit 3HAC071022-001. Used to refit the axis-4 motor.

Required consumables

Consumable	Article number	Note
Cable straps	-	
Grease	3HAC029132-001	FM 222
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)

Continues on next page

Deciding calibration routine

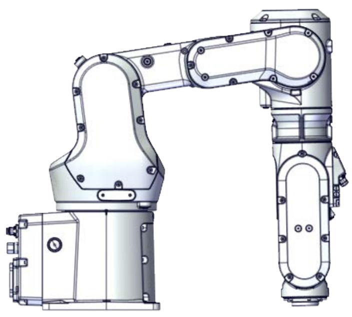
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	**Note** Calibrating axis 6 always requires tools to be removed from the mounting flange (also for reference calibration) since the mounting flange is used for installation of the calibration tool.
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 666*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the gearbox

Use these procedures to remove the axis-4 gearbox.

Preparations before removing the axis-4 gearbox

	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: 0° • Axis 2: 110° (CRB 1100-4/0.475) /95° (CRB 1100-4/0.58) • Axis 3: -20° (CRB 1100-4/0.475)/ -6° (CRB 1100-4/0.58) • Axis 4: 0° • Axis 5: 0° • Axis 6: No significance.	 xx1800003289

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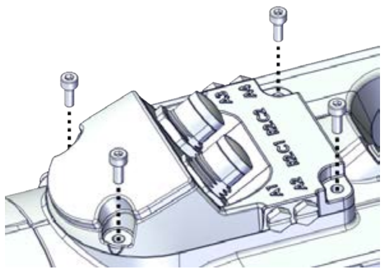
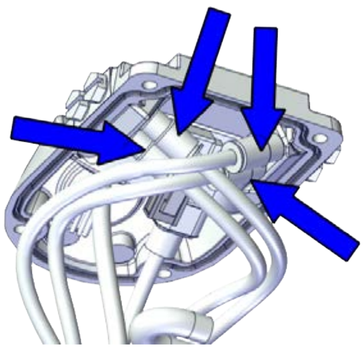
	Action	Note
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Removing the process hub

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws and carefully open the cover. **CAUTION** Be aware of the cabling that is attached to the cover! The cover can not be removed completely until the connectors are disconnected, as shown in following steps.	 xx2000002219
3	Disconnect the air hoses.	 xx1800002945

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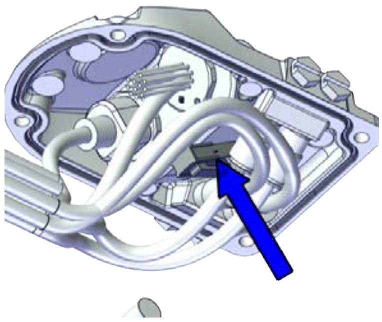
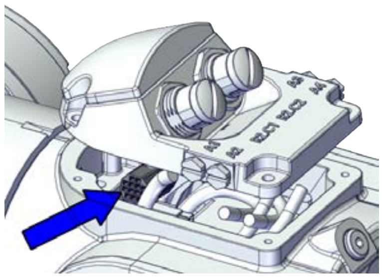
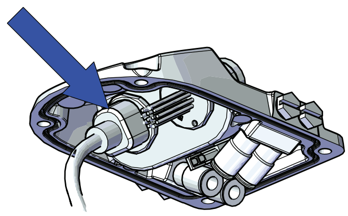
	Action	Note
4	Carefully pull out lamp unit connector behind the air hose connectors and disconnect the connector J5.UL.	 xx1800002946
5	**For robots with CP/CS cabling** Disconnect the connector. • J5.C1	 xx2100000293
6	**For robots with Ethernet cabling** Disconnect the connector J5.C2 using the tool.	J5.C2 connector assembly tool: -  xx1800002948

Removing the wrist covers

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

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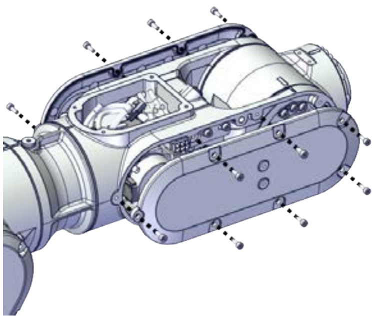
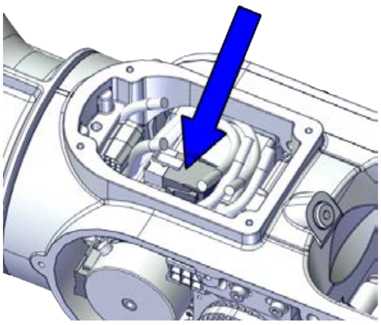
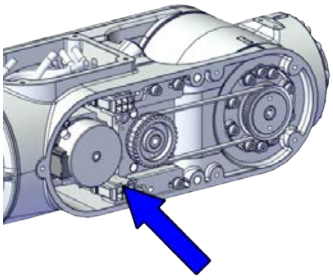
	Action	Note
2	Remove the wrist covers from both sides.	 xx1800002949

Disconnecting the axis-5 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Access the connector FB5 from the process hub and disconnect the connector.	 xx1800002950
3	Disconnect the connector. • MP5	 xx1800002993

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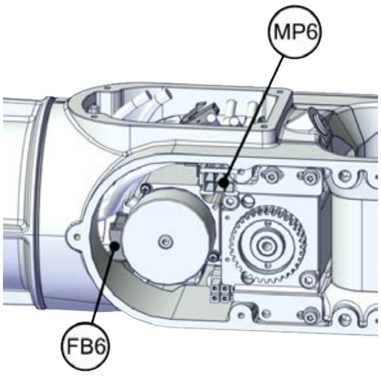
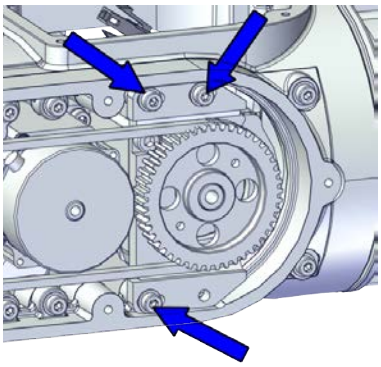
Disconnecting the axis-6 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Disconnect the connectors. • MP6 • FB6	 xx1800002994

Removing the axis-6 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800002995

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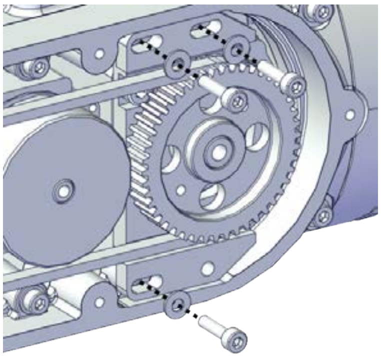
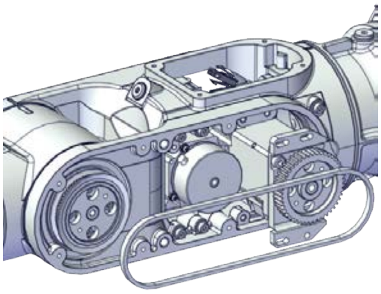
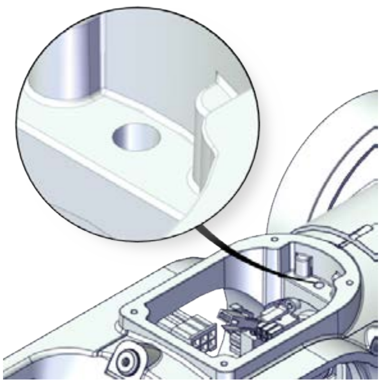
	Action	Note
4	Remove the screws and washers.	 xx1800002996
5	Carefully lift out the motor.	
6	Remove the timing belt from its groove on the motor.	 xx1800002997

Loosening the cable package from axis-4 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**Valid for CRB 1100-4/0.475** Access the cable package locking screw on the axis-4 gearbox from the wrist and then loosen the locking screw.	 xx1800003031

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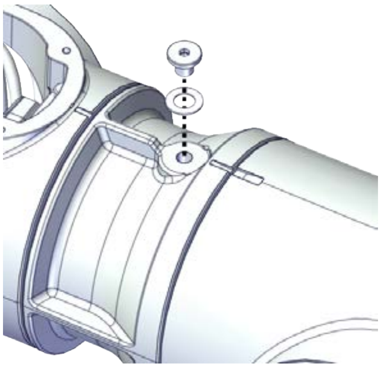
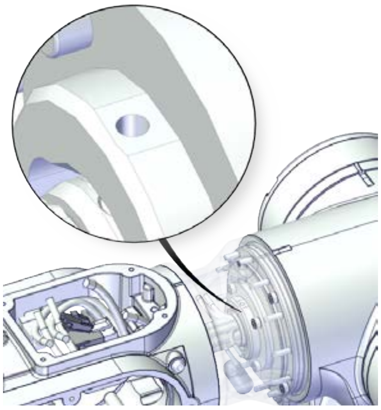
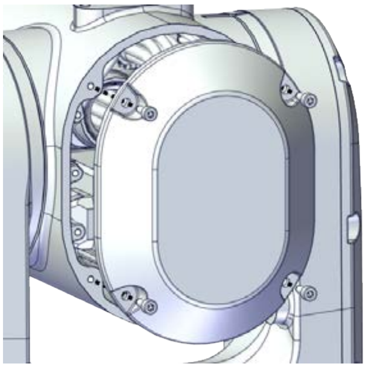
	Action	Note
3	Remove the plug screw and washer on the extender unit to access the cable package locking screw on the axis-4 gearbox and then loosen the locking screw.	 xx1800003000  xx1800003001

Disconnecting the axis-4 motor connectors

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the housing cover.	 xx1800003011

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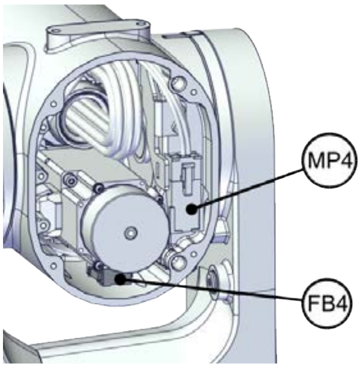
	Action	Note
3	Disconnect the motor connectors. • FB4 • MP4	 xx1800003012

Pulling out the upper cable harness

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Pull out the upper cable harness from the housing.	

Removing the axis-4 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing motors will release axes. This means the axes can fall down. Make sure axes are well supported before removing motors.	

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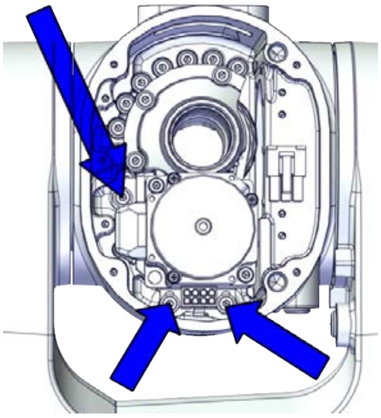
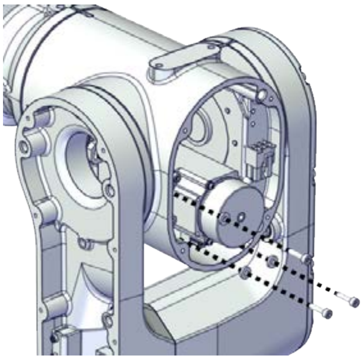
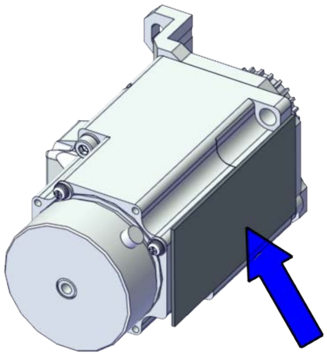
	Action	Note
3	Loosen the screws and move the motor slightly to slacken the timing belt.	 xx1800003094
4	Remove the screws and washers.	 xx1800003095
5	Carefully lift out the motor. **CAUTION** A cooling pad is attached to the motor, which may stick to the casting. Always use a plastic sheet with caution to remove the pad from the casting. Pay attention not to scratch the casting or damage the pad.	Cooling pad location  xx1800003605

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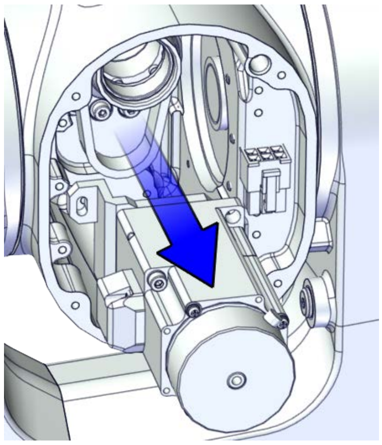
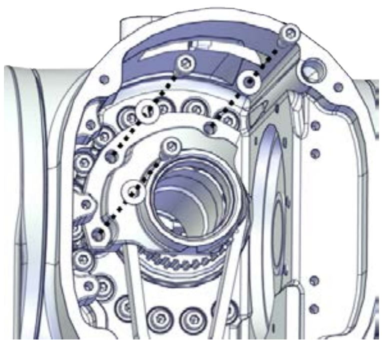
	Action	Note
6	Remove the timing belt from its groove on the motor.	 xx1800003096

Removing the pulley cover and axis-4 timing belt

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Loosening timing belts will release axes. This means the axes can fall down. Make sure axes are well supported before loosening timing belts.	
3	Remove the pulley cover.	 xx1800003097

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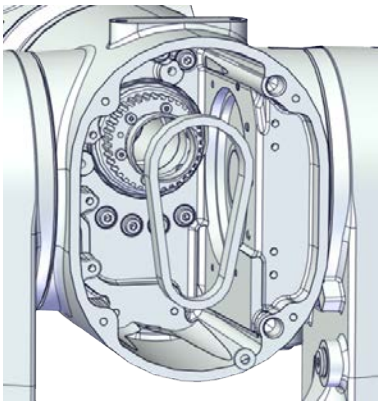
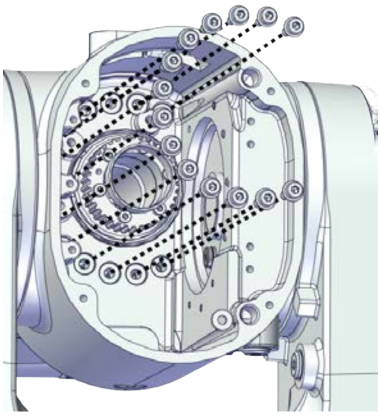
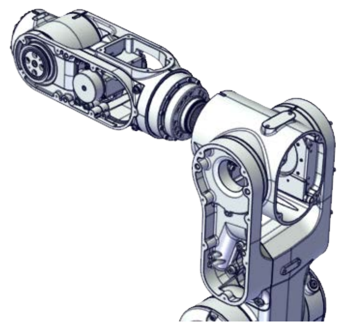
	Action	Note
4	Remove the timing belt from its groove on the gearbox.	 xx1800003098

Separating the housing

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	Remove the screws. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	 xx1900002191
3	**Valid for CRB 1100-4/0.475** Separate the wrist from the housing.	 xx1800003075

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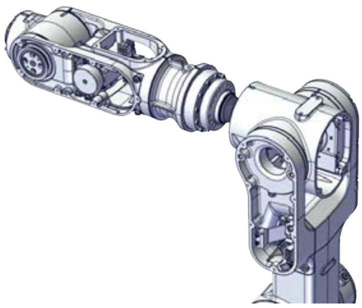
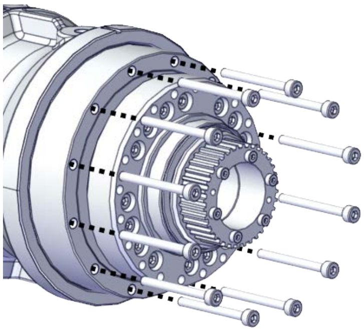
	Action	Note
4	Separate the extender unit and wrist from the housing.	 xx1800003100

Removing the axis-4 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power, hydraulic pressure, and air pressure are turned off.	
2	**CAUTION** Removing gearboxes will release axes. This means the axes can fall down. Make sure axes are well supported before removing gearboxes.	
3	Remove the screws.	 xx1800003300

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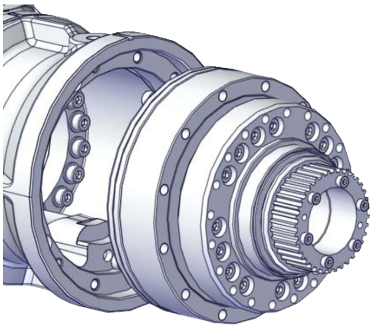
	Action	Note
4	Pull out the gearbox.	 xx1800003310

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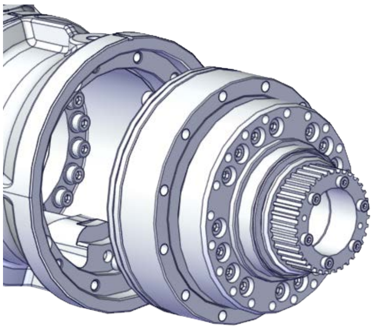
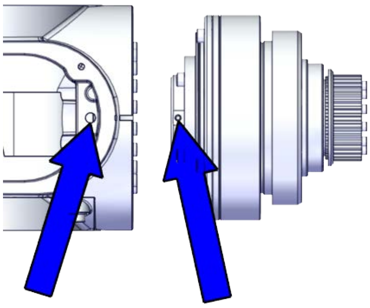
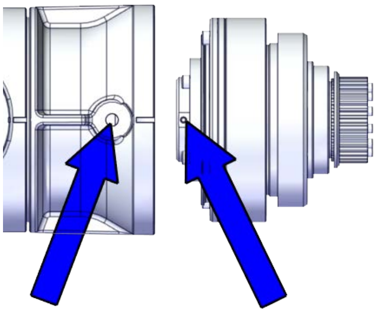
Refitting the gearbox

Use these procedures to refit the axis-4 gearbox.

Refitting the axis-4 gearbox

	Action	Note
1	Refit the axis-4 gearbox. Make sure the locking screw holes on the gearbox and extender unit or wrist are aligned with each other.	 xx1800003310 **Valid for CRB 1100-4/0.475**  xx1800003313  xx1800003312

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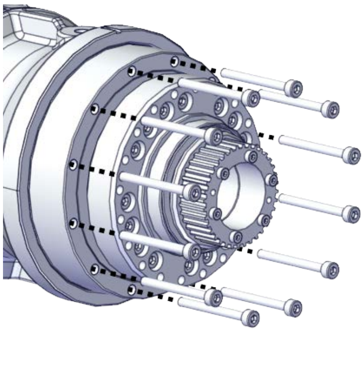
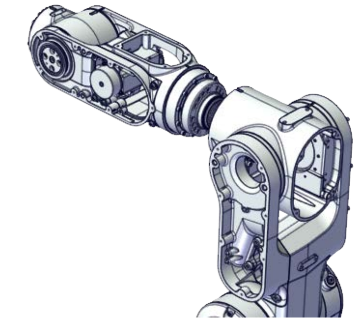
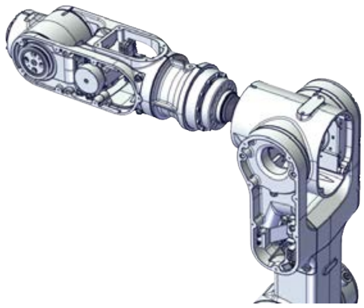
	Action	Note
2	Secure with screws.	Screw: M3x30 12.9 Lafre 2C2B/FC6.9 (12 pcs) Tightening torque: 1.8 Nm  xx1800003300

Refitting the housing

	Action	Note
1	**Valid for CRB 1100-4/0.475** Refit the the wrist to the housing.	 xx1800003075
2	Refit the extender unit and wrist to the housing.	 xx1800003100

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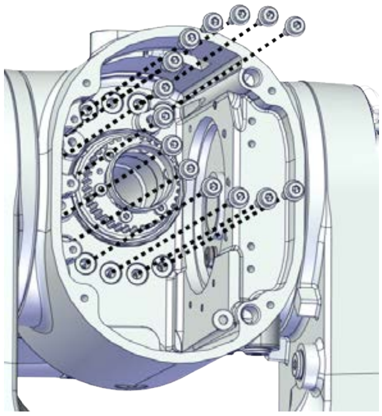
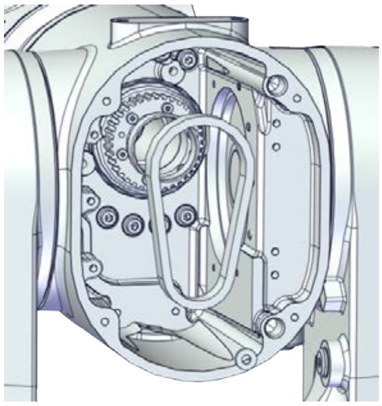
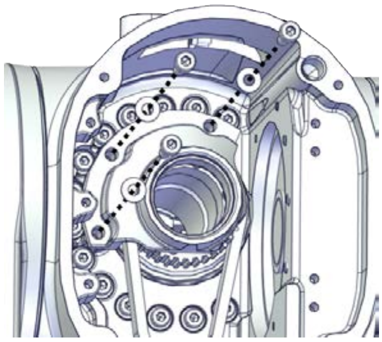
	Action	Note
3	Refit the screws and washers. **Note** Some robots may be fitted with separate screws and washers. During replacement, always use the same screws (and washers) that are fitted on the robot at delivery. Contact ABB for more information.	Flange screws (14 pcs) Tightening torque: 1.9 Nm  xx1900002191

Refitting the axis-4 timing belt and pulley cover

	Action	Note
1	Install the timing belt to the gearbox pulley and verify that the belt runs correctly in the groove of the pulley.	 xx1800003098
2	Refit the pulley cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (3 pcs) Tightening torque: 1.2 Nm  xx1800003097

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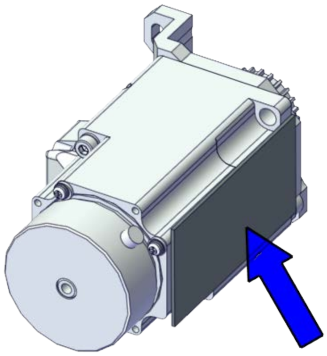
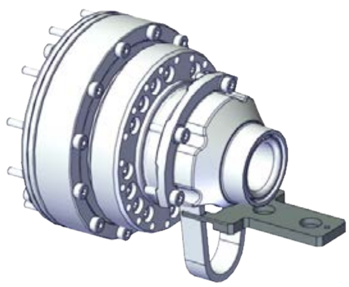
Refitting the axis-4 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	
2	Check the cooling pad. Replace if damaged.	Cooling pad for axis-3 and -4 motors: 3HAC071021-001  xx1800003605
3	Use the motor fitting tool to fix the timing belt.	axis-4 motor fitting tool, included in the special toolkit 3HAC071022-001.  xx1900000044

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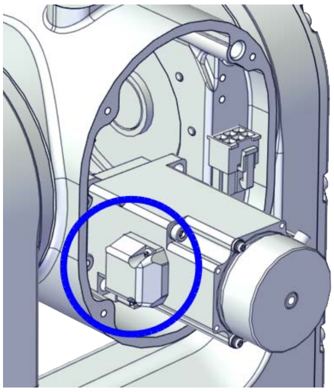
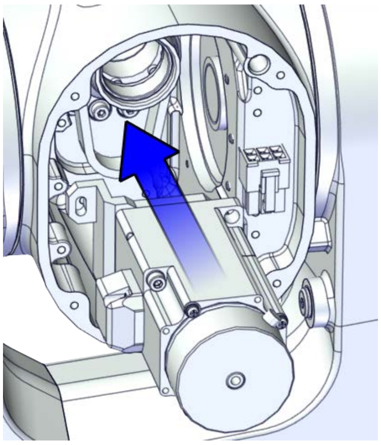
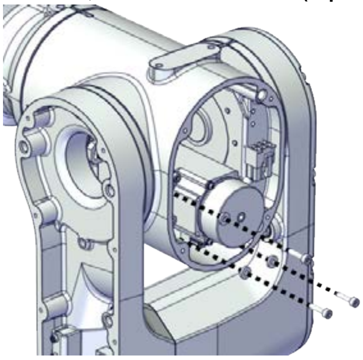
	Action	Note
4	Orient the motor correctly and fit it into the housing. **Note** Make sure the motor flange does not press on the timing belt.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003287
5	Install the timing belt to the motor pulley.	 xx1800003617
6	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs) Washer, 3HAC064765-001 (3 pcs)  xx1800003095
7	Remove the motor fitting tool.	

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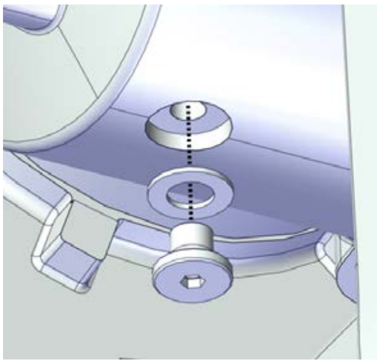
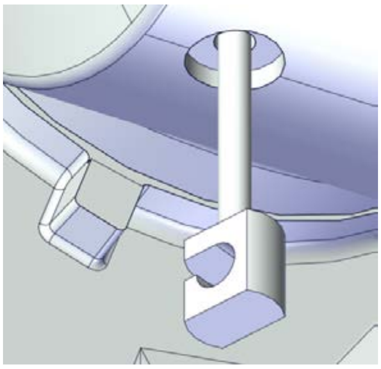
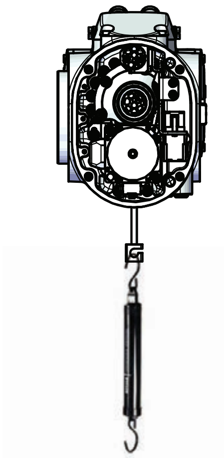
Adjusting the axis-4 timing belt tension

	Action	Note
1	Remove the screw and washer below the housing.	 xx1900000036
2	Fit an M3x25 eye bolt o the screw hole.	 xx1900000037
3	Use a handheld dynamometer hooking to the eye bolt.	 xx1900000038

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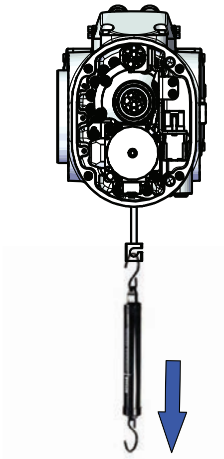
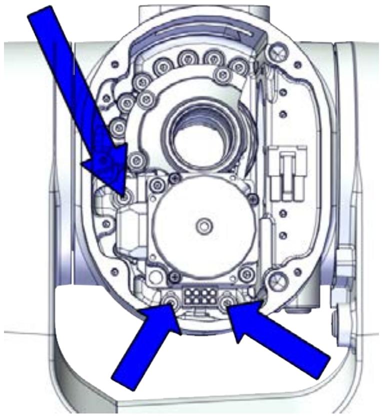
	Action	Note
4	Pull the dynamometer to make the tension falling in the allowed force range. **Note** Pay attention to the force application direction.	Used belt: 20.09-22.05 N New belt:28.7-31.5 N  xx1900000039
5	Secure the motor with the screws.	Tightening torque: 1.4 Nm  xx1800003094
6	Remove eye bolt and refit the screw and washer below the housing.	Plug screw: 3HAC064146-001 Tightening torque: 2 Nm

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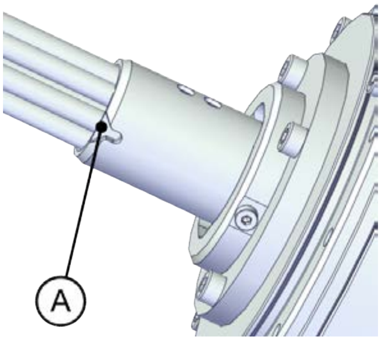
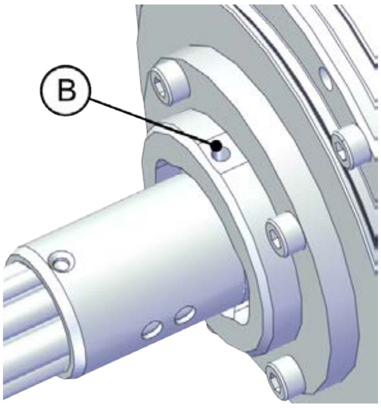
Refitting the upper cable harness through the axis-4 gearbox

	Action	Note
1	Insert the cable package in the housing and through the axis-4 gearbox. **Tip** Wrap the connectors with the masking tape. **CAUTION** Make sure that no cables or hoses are twisted or strained. Reroute if necessary.	Cable protection tube orientation: use the notch (A) on the cable protection tube as a reference when inserting the cable package, which should be at the opposite direction to the locking screw hole (B) on the gearbox.  xx1800003017  xx1800003601

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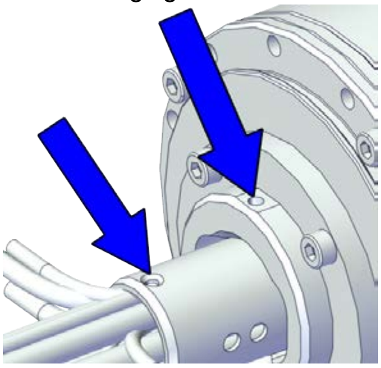
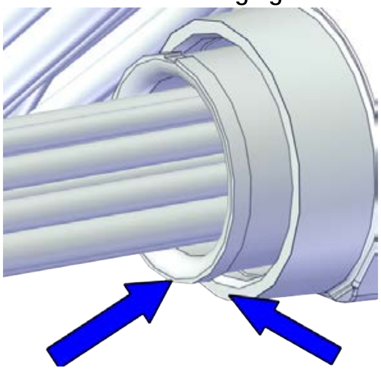
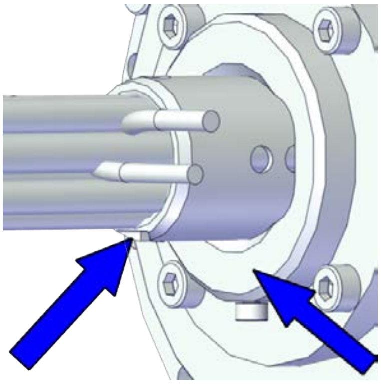
Securing the upper cable package to the axis-4 gearbox

	Action	Note
1	Make sure that: • The hole on the cable protection tube is aligned with the locking screw hole on the gearbox. • The cable protection tube surface is completely parallel with the pulley cover at one side and with the flange at the other side.	Holes to be aligned are shown in the following figure.  xx1800003018 Surfaces to be paralleled are shown in the following figures.  xx1800003019  xx1800003020

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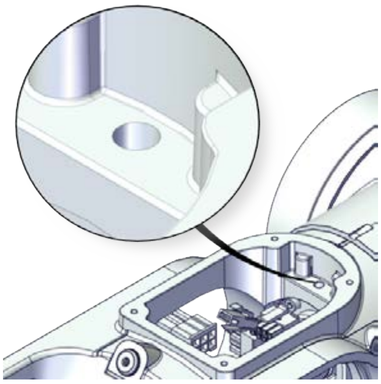
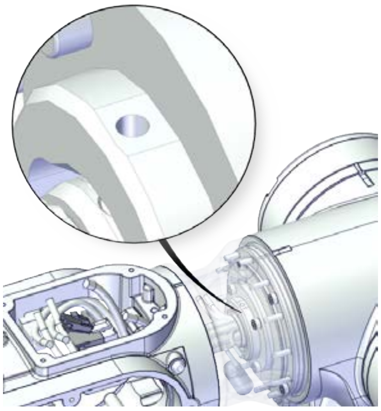
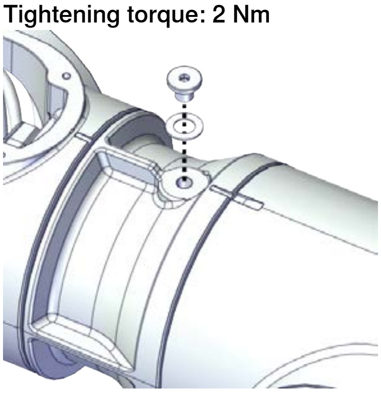
	Action	Note
2	Apply a little Loctite 243 to the locking screw and refit the locking screw. **Note** Make sure the locking screw header is parallel with flange surface. **Note** If there is locking liquid residues on the screw or screw hole, please clean it before refitting. Remove residual locking liquid after refitting.	Screw: M3x8 (1 pcs) Tightening torque: 0.4 Nm **Valid for CRB 1100-4/0.475**  xx1800003031  xx1800003001
3	Refit the plug screw and washer on the extender unit.	Plug screw: 3HAC064146-001 Tightening torque: 2 Nm  xx1800003000

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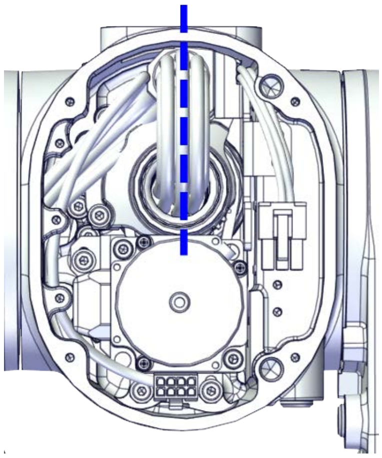
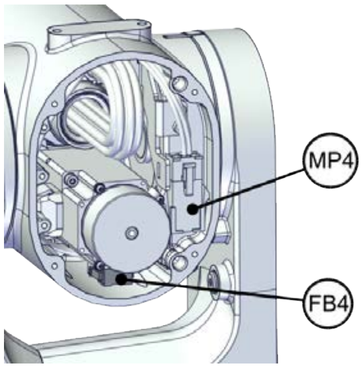
Reconnecting the axis-4 motor connectors

	Action	Note
1	Check the cabling status. Make sure the cabling is in vertical state and is not twisted.	 xx1800003618
2	Reconnect the connectors. • FB4 • MP4 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003012

Refitting the axis-6 motor

	Action	Note
1	Check that: • all assembly surfaces are clean and without damages • the motor is clean and undamaged.	

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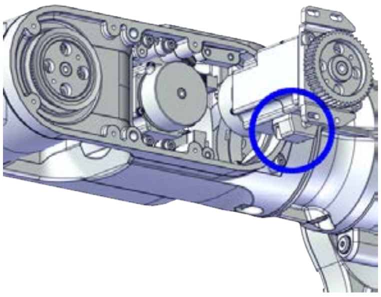
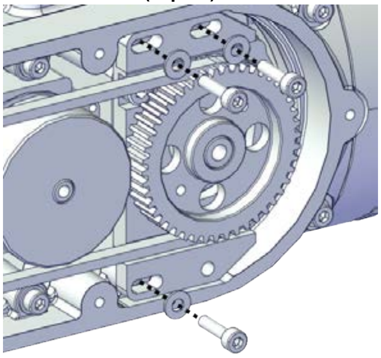
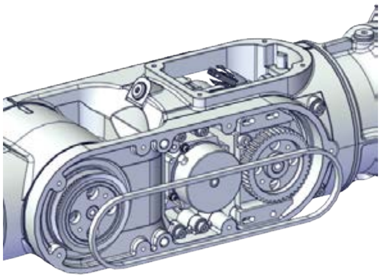
	Action	Note
2	Orient the motor correctly and fit it into the lower arm. **Tip** Leave the connectors FB5 and FB6 accessible from the process hub and the connectors MP5 and MP6 accessible from wrist side.	Motor orientation: orient the motor according to the figure below, in regard to the encircled motor connector.  xx1800003023
3	Refit the screws and washers. **Note** Do not tighten the screws yet.	Screw: M3x12 12.9 Lafre 2C2B/FC6.9 (3 pcs)  xx1800002996
4	Install the timing belt to the pulleys and verify that the belt runs correctly in the grooves of the pulleys.	 xx1800003024

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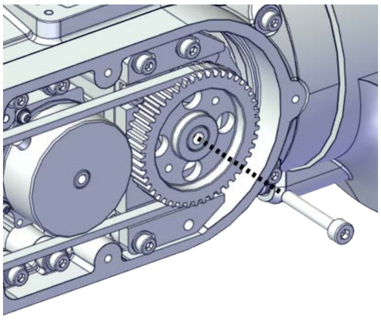
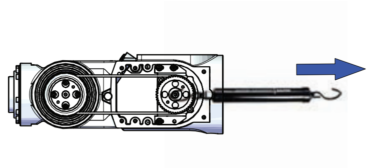
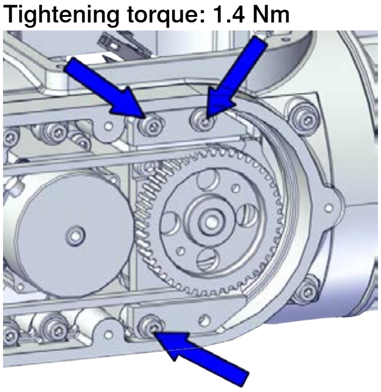
	Action	Note
5	Install an M4x25 or longer adjustment screw to the motor. **Note** Do not insert the entire screw to the hole.	 xx1900000007
6	Use a handheld dynamometer hooking to the screw and pull the dynamometer to reach the initial referenced force.	Initial referenced force for used belt: 8.96-9.8 N (for reference only) Initial referenced force for new belt: 12.8-14  xx1900000026
7	Secure the motor with the screws.	Tightening torque: 1.4 Nm  xx1800002995
8	Use a sonic tension meter to measure the timing belt tension.	Used belt: 81.3-86.9 Hz New belt:90-114 Hz (for reference only)
9	If the timing belt tension does not meet the requirement, loosen the motor screws and readjust.	

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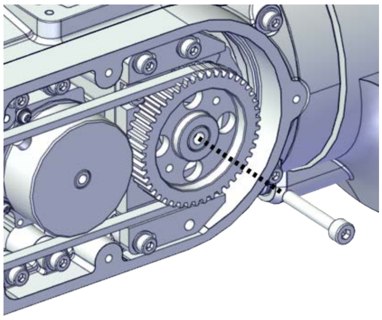
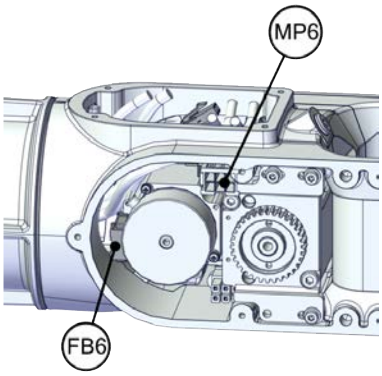
	Action	Note
10	Remove the adjustment screw from the motor.	 xx1900000007

Reconnecting the axis-6 motor connectors

	Action	Note
1	Reconnect the connectors. • FB6 • MP6  **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800002994
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Insert the cabling and connectors into the wrist.	

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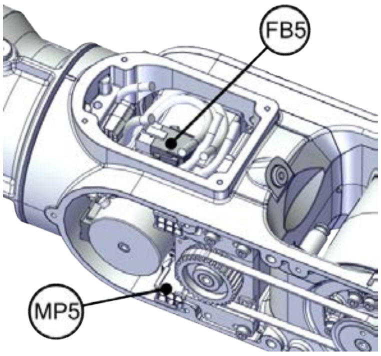
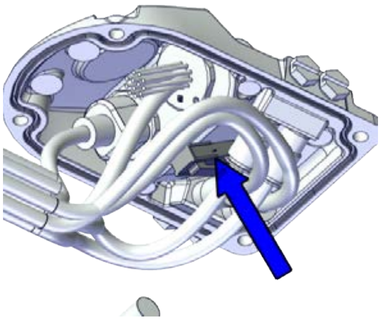
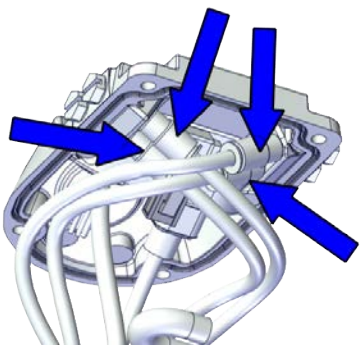
Reconnecting the axis-5 motor connectors

	Action	Note
1	Reconnect the connectors. • FB5 • MP5 **Tip** See the number markings on the connectors for help to find the corresponding connector.	 xx1800003025
2	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
3	Insert the cabling and connectors into the wrist.	

Refitting the process hub

	Action	Note
1	Reconnect the lamp unit connector J5.UL and place the connector behind the air hose connectors.	 xx1800002946
2	Reconnect the air hoses in a cross pattern. **Tip** See the number markings on the air hoses for help to find the corresponding air hoses. The air hoses with the same number connect to the same Y-shaped connector.	 xx1800002945

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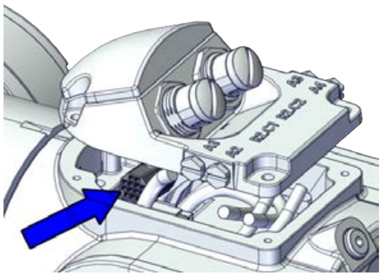
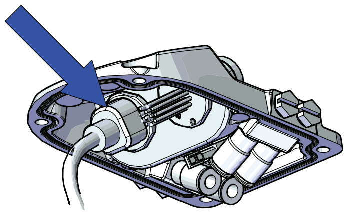
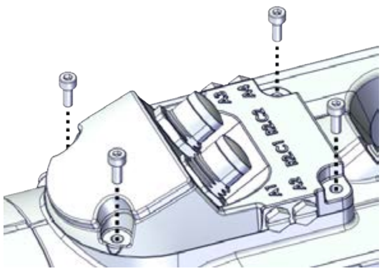
	Action	Note
3	**For robots with CP/CS cabling** Reconnect the connector. • J5.C1	 xx2100000293
4	**For robots with Ethernet cabling** Reconnect the connector J5.C2 using the tool.	J5.C2 connector assembly tool, included in the special toolkit 3HAC071022-001  xx1800002948
5	Route and secure the cabling with cable straps. **CAUTION** Correct cable routing is highly important. If the cables are routed and secured incorrectly the cables can be damaged.	
6	Refit the cover.	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.2 Nm  xx2000002219

Refitting the covers

	Action	Note
1	Apply grease to the cable package, cover all moving area of the package.	
2	Apply grease to the covers that have contacting area with the cable package.	

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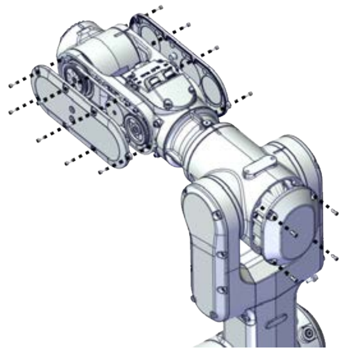
	Action	Note
3	Refit the covers. • Wrist covers • Housing cover	Screw: M3x8 12.9 Lafre 2C2B/FC6.9 Tightening torque: 1.2 Nm  xx2000002150

Concluding procedure

	Action	Note
1	Recalibrate the robot.	Calibration is detailed in section *Calibration on page 655*.
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 163*.	

6 Calibration

6.1 Introduction to calibration

6.1.1 Introduction and calibration terminology

Calibration information

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

Detailed instructions of how to perform Axis Calibration are given on the FlexPendant during the calibration procedure. To prepare calibration with Axis Calibration method, see *Calibrating with Axis Calibration method on page 665*.

Calibration terminology

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

6.1.2 Calibration methods

Overview

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

Types of calibration

Type of calibration	Description	Calibration method
Standard calibration	The calibrated robot is positioned at calibration position. Standard calibration data is found on the SMB (serial measurement board) or EIB in the robot.	Axis Calibration
Absolute accuracy calibration (optional)	Based on standard calibration, and besides positioning the robot at synchronization position, the Absolute accuracy calibration also compensates for: • Mechanical tolerances in the robot structure • Deflection due to load Absolute accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot. Absolute accuracy calibration data is found on the serial measurement board (SMB) or other robot memory. A robot calibrated with Absolute accuracy has the option information printed on its name plate (OmniCore). To regain 100% Absolute accuracy performance, the robot must be recalibrated for absolute accuracy after repair or maintenance that affects the mechanical structure.	CalibWare
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, 5 and 6.	Wrist Optimization

Brief description of calibration methods

Axis Calibration method

Axis Calibration is a standard calibration method for calibration of CRB 1100. It is the recommended method in order to achieve proper performance.

The following routines are available for the Axis Calibration method:

- Fine calibration
- Update revolution counters
- Reference calibration

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

An introduction to the calibration method is given in this manual, see *Calibrating with Axis Calibration method on page 665*.

Continues on next page

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.

Wrist Optimization method

Wrist Optimization is a method for improving reorientation accuracy for continuous processes like welding and gluing and is a complement to the standard calibration method.

The actual instructions of how to perform the wrist optimization procedure is given on the FlexPendant.

CalibWare - Absolute Accuracy calibration

The CalibWare tool guides through the calibration process and calculates new compensation parameters. This is further detailed in the *Application manual - CalibWare Field*.

If a service operation is done to a robot with the option Absolute Accuracy, a new absolute accuracy calibration is required in order to establish full performance. For most cases after replacements that do not include taking apart the robot structure, standard calibration is sufficient.

The Absolute Accuracy option varies according to the robot mounting position. This is printed on the robot name plate for each robot. The robot must be in the correct mounting position when it is recalibrated for absolute accuracy.

References

Article numbers for the calibration tools are listed in the section *Special tools on page 713*.

6.1.3 When to calibrate

When to calibrate

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

The resolver values are changed

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

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

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

The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See *Updating revolution counters on page 661*. This will occur when:

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

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

The robot is rebuilt

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

If the robot has *absolute accuracy* calibration, it needs to be calibrated for new absolute accuracy.

Robot is not floor mounted

The original calibration data delivered with the robot is generated when the robot is floor mounted. If the robot is not floor mounted, then the robot accuracy could be affected. The robot needs to be calibrated after it is mounted.

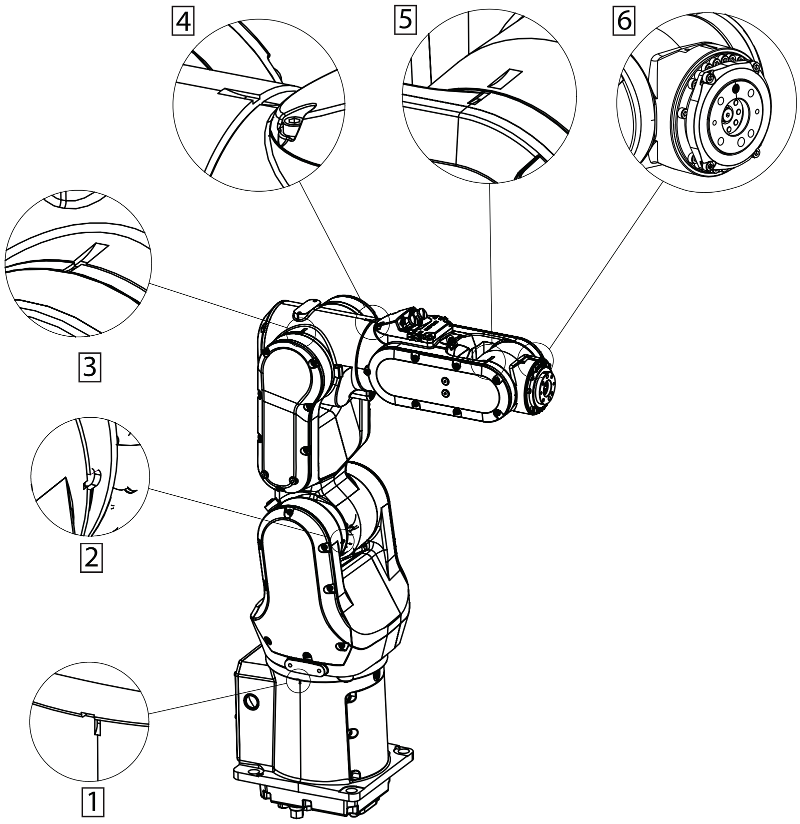
6.2 Synchronization marks and axis movement directions

6.2.1 Synchronization marks and synchronization position for axes

Introduction

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

Synchronization marks, CRB 1100



xx1800002455

CAUTION

To calibrate the axis 6, the notch on the wrist must be aligned with the marked pin hole on the tool flange. Before installing a tool on the tool flange, make sure a visible mark has been made to the tool at the corresponding position.

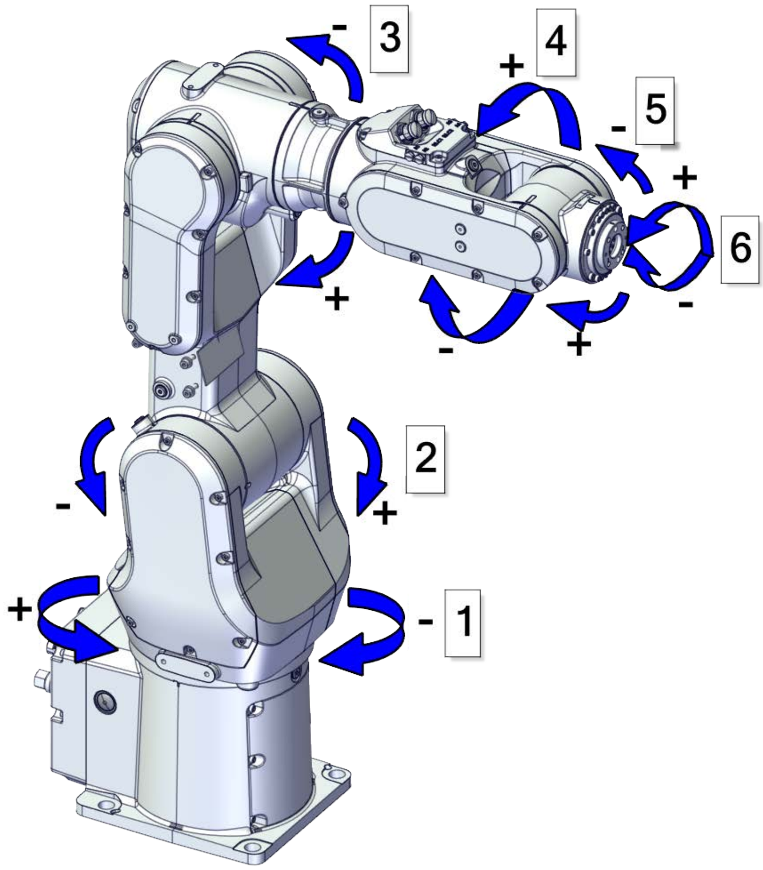
6.2.2 Calibration movement directions for all axes

Overview

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

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

Manual movement directions



xx1800002456

6.3 Updating revolution counters

6.3.1 Updating revolution counters on OmniCore robots

Introduction

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

Step 1 - Manually running the manipulator to the synchronization position

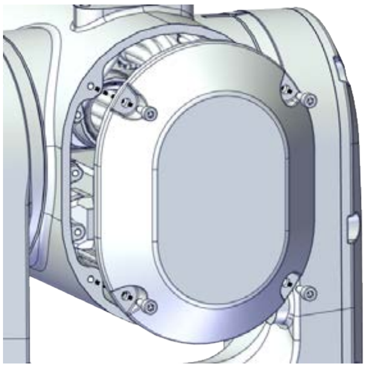
Use this procedure to manually run the manipulator to the synchronization position.

	Action	Note
1	Select axis-by-axis motion mode.	
2	Jog the manipulator to align the synchronization marks.	See *Synchronization marks and synchronization position for axes on page 659*.
3	When all axes are positioned, update the revolution counter.	*Step 2 - Updating the revolution counter with the FlexPendant on page 664*.

Correct calibration position of axis 4

When jogging the manipulator to synchronization position, it is extremely important to make sure that axis 4 is positioned correctly. Axis 4 can be calibrated at the wrong turn, resulting in an incorrect manipulator calibration.

Make sure axis 4 is positioned according to the cable harness status, not only according to the synchronization marks. Use the following procedure to check and correct the axis 4 position.

	Action	Note
1	Remove the housing cover.	 xx1800003011

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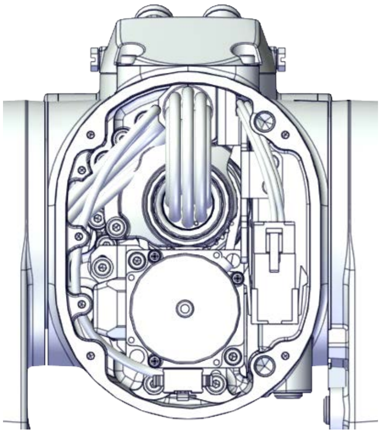
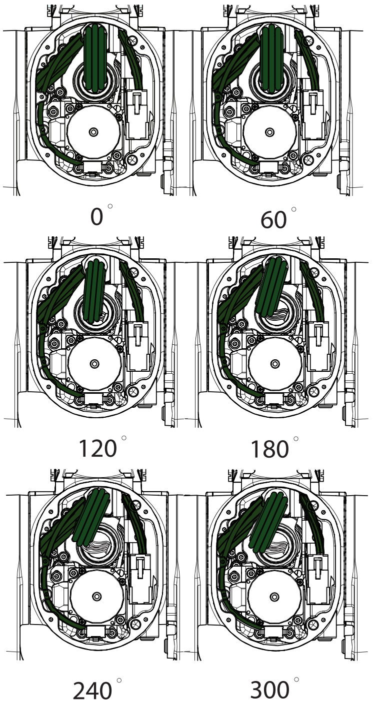
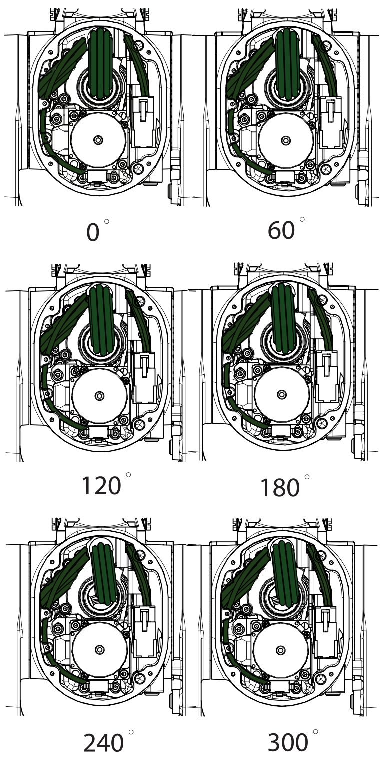
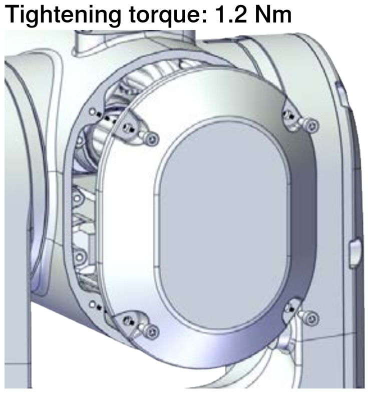
	Action	Note
2	Inspect the cable harness status. The cable harness must be in vertical state as shown in the figure. • If the cable harness twists towards left, proceed to step *3*. • If the cable harness twists towards right, proceed to step *4*.	 xx1800003317
3	**Cable harness twisting towards left** Jog the axis 4 anti-clockwise (with the operator facing the rear) until the cable harness is in vertical state.	 xx1800003318

Continues on next page

	Action	Note
4	**Cable harness twisting towards right** Jog the axis 4 clockwise (with the operator facing the rear) until the cable harness begins turning left. Then, jog the axis 4 back until the cable harness is in vertical state.	 xx1800003319
5	Refit the housing cover.	Screw: M3x8 (4 pcs) Tightening torque: 1.2 Nm  xx1800003011

If the axis is rotated one or more turns from its calibration position before updating the revolution counter, the correct calibration position will be lost due to non-integer gear ratio.

At delivery the manipulator is in the correct position. Do NOT rotate axis 4 at power up before the revolution counters are updated.

Continues on next page

Step 2 - Updating the revolution counter with the FlexPendant

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

	Action
1	On the start screen, tap **Calibrate**. The calibration summary page for the mechanical unit is displayed.
2	In the **Calibration Methods** menu, select **Revolution Counters**.
3	In the **Selection** column select the axes for which revolution counters need to be updated. **Note** A warning is displayed prompting you to check the cable harness status before proceeding with the revolution counter update for axis 4. See *Correct calibration position of axis 4 on page 661*.
4	Tap **Update**. A dialog box is displayed warning that the updating operation cannot be undone.
5	Tap **OK** to update the revolution counter.
6	**CAUTION** If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury! Check the synchronization position very carefully after each update. See *Checking the synchronization position on page 684*.

6.4 Calibrating with Axis Calibration method

6.4.1 Description of Axis Calibration

Instructions for Axis Calibration procedure given on the FlexPendant

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

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

Overview of the Axis Calibration procedure

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

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

For axis 6 calibration there is one bushing on the wrist and one mounting hole on the tool flange.

The Axis Calibration procedure described roughly:

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

   WARNING

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

   WARNING

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

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

   WARNING

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

Continues on next page

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

Routines in the calibration procedure

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

Fine calibration routine

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

Reference calibration routine

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

Also choose this routine if the robot is wall mounted or suspended.

Note

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

Note

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

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

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

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

Update revolution counters

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

Validation

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

Continues on next page

Position of robot axes

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

It is possible to position some of the other axes in positions different from 0 degrees. Information about which axes are allowed to be jogged is given on the FlexPendant. These axes are marked with **Unrestricted** in the FlexPendant window. Also the following table shows the dependencies between the axes.

Requirements for axis positioning during calibration

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

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

System containing SafeMove

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

How to calibrate a suspended or wall mounted robot

The CRB 1100 is fine calibrated floor standing in factory, prior to shipping.

To calibrate a suspended or wall mounted robot, reference calibration could be used. Reference values for a suspended or a wall mounted robot must be created with the robot mounted at its working position, not standing on a floor.

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

6.4.2 Calibration tools for Axis Calibration

Calibration tool set

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

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

WARNING

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

Equipment, etc.	Article number	Note
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.

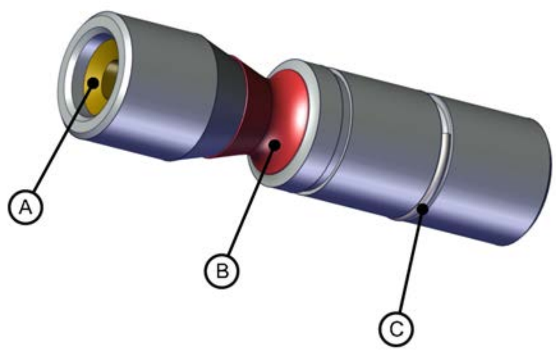
Examining the calibration tool

Check prior to usage

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

WARNING

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



xx1500001914

A	Tube insert
B	Plastic protection
C	Steel spring ring

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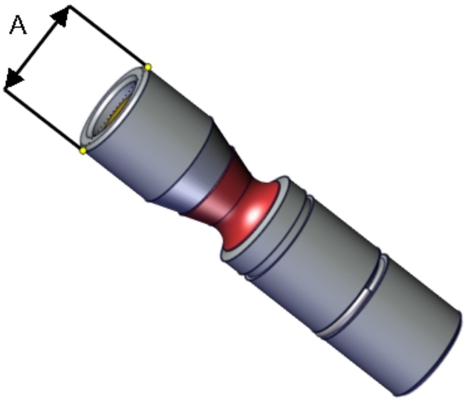
Periodic check of the calibration tool

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

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



xx1500000951

A	Outer diameter

Periodic check of the calibration tool for the tool flange (3HAC058238-001)

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

- Outer diameter within Ø5g5 mm.
- Straightness within 0.005 mm.

.

xx1600001142

A	Outer diameter

6.4.3 Installation locations for the calibration tools

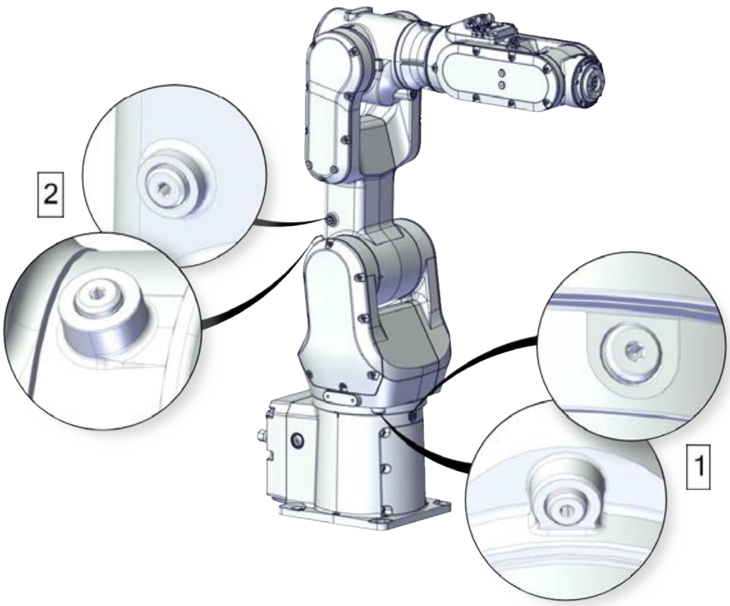
Location of fixed calibration items

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

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

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

For axis 6 there is only one bushing, the second calibration tool is installed at the mounting flange of the turning disk.



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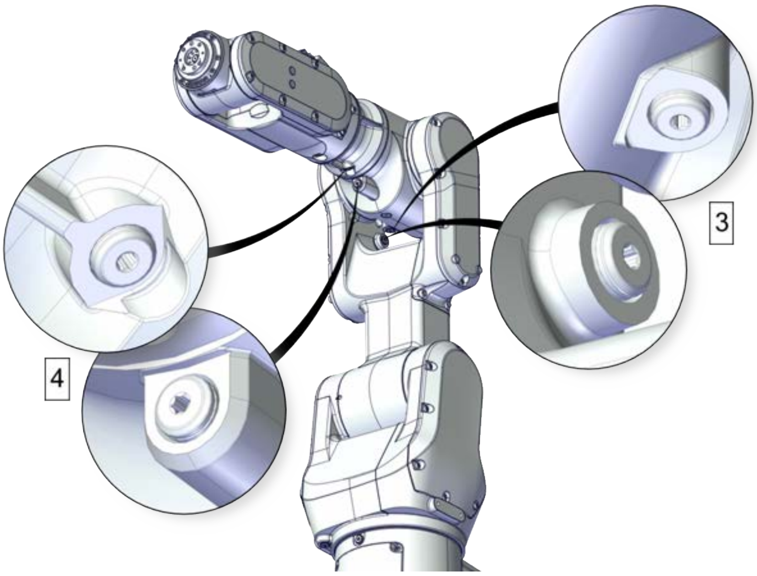
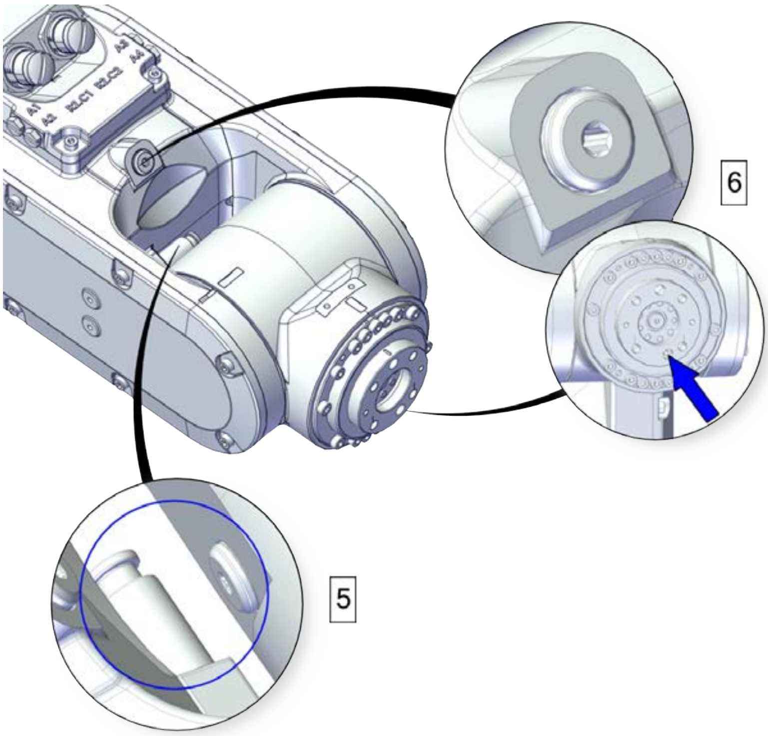


xx1800003514



xx1800003515

Spare parts

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

Spare part	Article number	Note
Protective plug for bushing	3HAC059556-001	Replace if damaged or missing.

Continues on next page

Spare part	Article number	Note
Protective plug for bushing, Clean Room	3HAC059557-001	Used with protection type Clean Room. Replace if damaged or missing.
Calibration pin cover, 6 mm	3HAC061926-001	Replace if damaged or missing.

6.4.4 Axis Calibration - Running the calibration procedure

Required tools

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

WARNING

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

Equipment, etc.	Article number	Note
Calibration tool box, Axis Calibration	3HAC074119-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.

Required consumables

Consumable	Article number	Note
Clean cloth	-	

Spare parts

Spare part	Article number	Note
Protective plug for bushing	3HAC059556-001	Replace if damaged or missing.
Protective plug for bushing, Clean Room	3HAC059557-001	Used with protection type Clean Room. Replace if damaged or missing.
Calibration pin cover, 6 mm	3HAC061926-001	Replace if damaged or missing.

Overview of the calibration procedure on the FlexPendant

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

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

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

1. Choose calibration routine. The routines are described in *Routines in the calibration procedure on page 666*.
2. Choose which axis/axes to calibrate.
3. The robot moves to synchronization position.
4. Validate the synchronization marks.

Continues on next page

5. The robot moves to preparation position.
6. Remove the protective cover from the fixed pin and the protection plug from the bushing, if any, and install the calibration tool.

   When calibrating axis 5, remove the protective cover from the fixed pin using a tweezer, and install the calibration tool.
7. The robot performs a measurement sequence by rotating the axis back and forth.
8. Remove the calibration tool and reinstall the protective cover on the fixed pin and the protection plug in the bushing, if any.

   After the calibration of axis 5, refit the protective cover on the fixed pin for axis 5 using a tweezer.
9. The robot moves to verify that the calibration tool is removed.
10. Choose whether to save the calibration data or not.

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

Preparation prior to calibration

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

	Action	Note
1	**DANGER** While conducting the calibration, the robot needs to be connected to power. Make sure that the robot's working area is empty, as the robot can make unpredictable movements.	
2	Wipe the calibration tool clean. **Note** The calibration method is exact. Dust, dirt or color flakes will affect the calibration value.	Use a clean cloth.
3	Check if the standard calibration data for axes 4, 5 or 6 are updated with wrist optimization. This is shown in the calibration overview/summary window on the FlexPendant.	If the data is optimized, the calibration routine **Wrist Optimization** must be re-run after standard calibration. See *Calibrating with Wrist Optimization method on page 681*.

Starting the calibration procedure

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

	Action	Note
1	Tap the calibration icon and enter the calibration main page.	

Continues on next page

	Action	Note
2	All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question. **Note** For RobotWare 7, the mechanical unit page is displayed only if there is more than one mechanical unit available.	
3	The calibration method used at ABB factory for each axis is shown, as well as calibration method used for the robot during last field calibration.	The FlexPendant will give all information needed to proceed with Axis Calibration.
4	**Valid for RobotWare 7** Tap **Calibration Methods** on the right pane and then tap **Calibration**. The software will automatically call for the procedure for the valid calibration method.	
5	Follow the instructions given on the FlexPendant.	A brief overview of the sequence that will be run on the FlexPendant is given in *Overview of the calibration procedure on the FlexPendant on page 673*.

Fitting of calibration tools

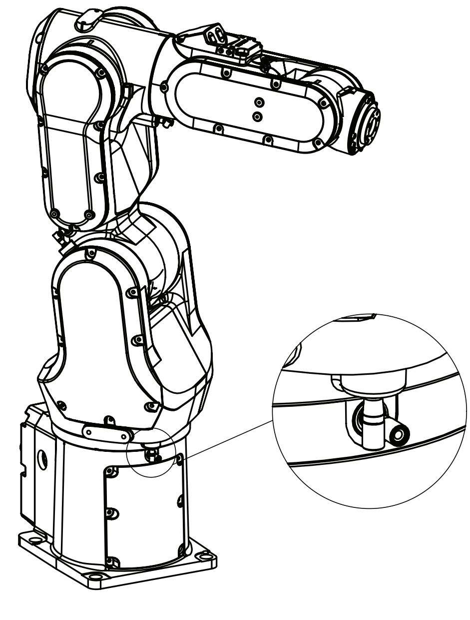
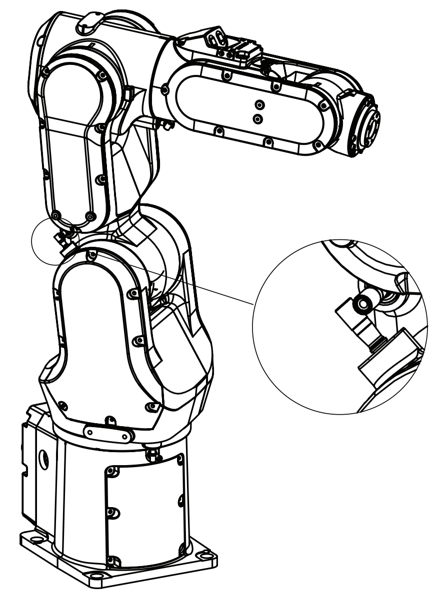
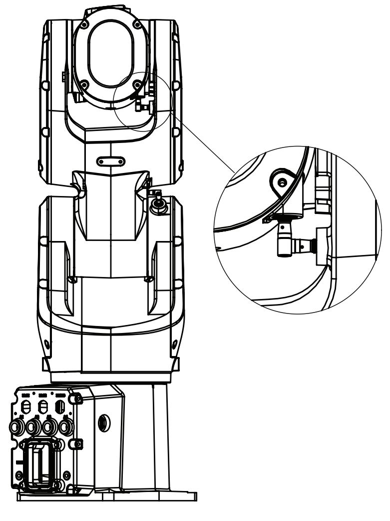
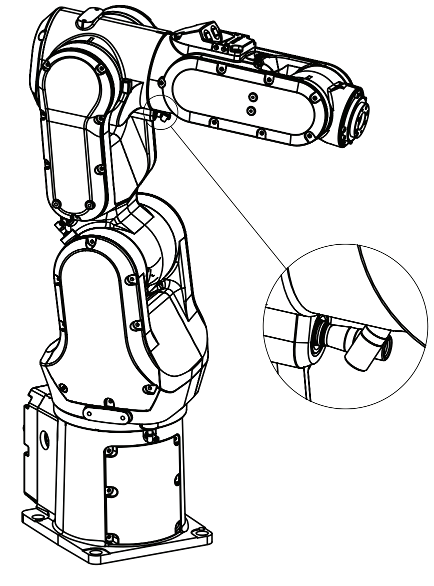
The figures show the calibration tool in contact with the fixed pin on each axis.

The position of the complete robot shown for each axis is only an example.

In order for the axis to be able to be moved to calibration position, or in order for getting proper access to the calibration bushing, other axes might need to be jogged to positions different from 0 degrees. Information about which axes are

Continues on next page

allowed to be jogged will be given on the FlexPendant. These axes are marked with **Unrestricted** in the FlexPendant window.

Calibration tools in contact	
Axis 1  xx1900000113	Axis 2  xx1900000114
Axis 3  xx1900000115	Axis 4  xx1900000116

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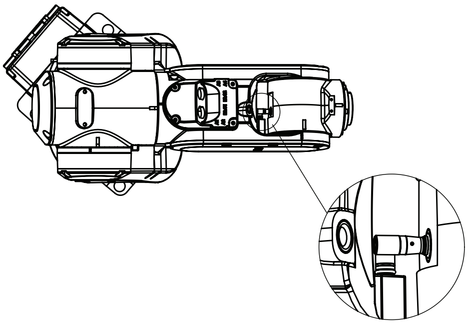
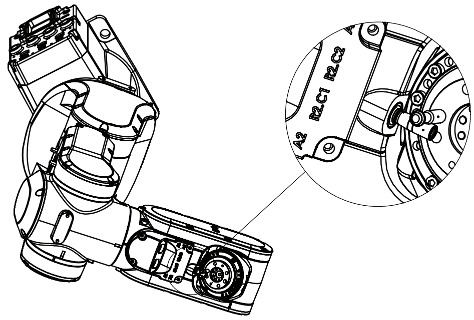
Calibration tools in contact	
Axis 5  xx1900000117	Axis 6 Make sure to orient the tool flange calibration tool correctly.  xx1900000118

Restarting an interrupted calibration procedure

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

Situation	Action
The three-position enabling device on the FlexPendant has been released during robot movement.	Press and hold the three-position enabling device and press **Play**.
The RobotWare program is terminated with **PP to Main**.	Remove the calibration tool, if it is installed, and restart the calibration procedure from the beginning. See *Starting the calibration procedure*. If the calibration tool is in contact the robot axis needs to be jogged in order to release the calibration tool. Jogging the axis in wrong direction will cause the calibration tool to break. Directions of axis movement is shown in *Calibration movement directions for all axes on page 660*

Axis Calibration with SafeMove option

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

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

CAUTION

SafeMove must be synchronized after the calibration is completed.

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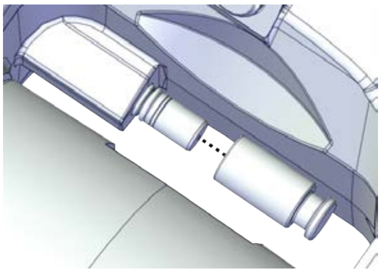
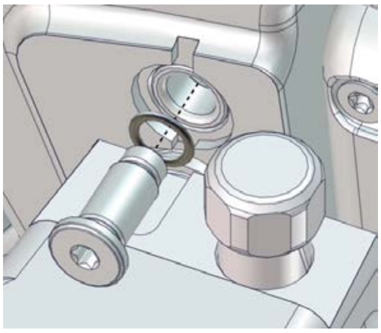
After calibration

	Action	Note
1	Reinstall the protective cover on the fixed calibration pin on each axis, directly after the axis has been calibrated. Replace the cover with new spare part, if missing or damaged.	 xx1900001421 Calibration pin cover, 6 mm: 3HAC061926-001
2	Reinstall the protective plug and sealing in the bushing on each axis, directly after the axis has been calibrated. Ensure that the sealing is not damaged. Replace the plug and the sealing with new spare part, if missing or damaged.	 xx1500000952 Protective plug for bushing: 3HAC059556-001.
3	If the standard calibration data for axes 4, 5 or 6 should be updated with wrist optimization, run the calibration routine **Wrist Optimization**.	See *Calibrating with Wrist Optimization method on page 681*.

6.4.5 Reference calibration

Brief introduction to Reference Calibration

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

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

Manual tuning of calibration offset

Manual tuning of calibration offset is normally not needed, but can be useful in some situations. The requirement to do manual tuning is that there is a known accurate position, that worked accurately before the repair (step 5, see *Brief introduction to Reference Calibration on page 679*).

Example "Adjust axis 4":

1. Create a backup.

Continues on next page

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

6.5 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, 6. Re-run the **Wrist Optimization** routine after standard calibration to re-achieve the optimized positions of the wrist axes.

Overview of the calibration procedure on the FlexPendant

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

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

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

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

   Tip

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

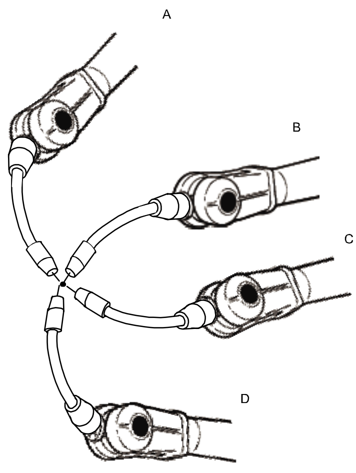
   a. Jog the robot to an appropriate position, A, for the first approach point.

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

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

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

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



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

Continues on next page

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

   WARNING

   Robot moves automatically when pressing **Calibrate**.

6. Wrist optimization is finished.
7. Redefine / verify TCP for all tools.

6.6 Verifying the calibration

Introduction

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

Verifying the calibration

Use this procedure to verify the calibration result.

	Action	Note
1	Run the calibration home position program twice. Do not change the position of the robot axes after running the program!	See *Checking the synchronization position on page 684*.
2	Adjust the *synchronization marks* when the calibration is done, if necessary.	This is detailed in section *Synchronization marks and synchronization position for axes on page 659*.
3	Write down the values on a new label and stick it on top of the calibration label. The label is located on one side of the base.	

6.7 Checking the synchronization position

Introduction

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

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

Using a `MoveAbsJ` instruction

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

	Action	Note
1	Tap **Code**.	
2	Create a new program.	
3	Use **MoveAbsJ** in the **Add Instruction** menu.	

4	Create the following program:
	`MoveAbsJ [[0,0,0,0,0,0],`
	`[9E9,9E9,9E9,9E9,9E9,9E9]]`
	`\NoEOffs, v1000, fine, tool0`	

5	Run the program in manual mode.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See *Synchronization marks and synchronization position for axes on page 659* and *Updating revolution counters on page 661*.

Using the jogging window

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

	Action	Note
1	Tap **Jog**.	
2	From the **Mechanical unit** list select a mechanical unit.	
3	From the **Motion mode** section, select an axis-set that need to be jogged. For example, to jog axis 2, select the axis set **Axis 1-3**.	
4	Follow the screen instruction on joystick movements to understand the direction of the axis that you want to move and move the joystick.	
5	Manually run the robots axes to a position where the axis position value read on the FlexPendant, is equal to zero.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See *Synchronization marks and synchronization position for axes on page 659* and *Updating revolution counters on page 661*.

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.

Continues on next page

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

7.2 Oil and grease stains on motors and gearboxes

Description

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

Consequences

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

Possible causes

The symptom can be caused by:

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

Recommended actions

The following actions are recommended:

	Action	Information
1	**CAUTION** Allow hot parts to cool down.	
2	Wipe off the oil or grease, see *Cleaning the CRB 1100 on page 170*. Monitor the robot over time to see if new oil or grease occurs.	If the oil spill is small, this step is sufficient.
3	Check the gearbox oil level.	
4	Too hot gearbox oil may be caused by: • Incorrect oil quality or level. • The robot work cycle runs a specific axis too hard. Investigate whether it is possible to program small "cooling periods" into the application. • Overpressure created inside gearbox.	Robots performing certain, extremely heavy duty work cycles may be fitted with vented oil plugs. These are not fitted to normal duty robots, but can be purchased from your local ABB representative.
5	Inspect all sealings and gaskets between motor and gearbox. Replace broken parts.	

7.3 Mechanical noise or dissonance

Description

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

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

A humming resonance sound can occur without being an error. Mechanical resonance sound is a physical phenomenon in mechanical structures. It has no impact on product performance or lifetime. Adjusting the robot movement speed out of the range that causes the resonance will eliminate the sound.

Consequences

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

Possible causes

The symptom can be caused by:

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

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

- Overheating.

Recommended actions

The following actions are recommended:

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

7.4 Manipulator collapses on power down

Description

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

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

Consequences

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

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

Possible causes

The symptom can be caused by:

- Faulty brake.
- Faulty power supply to the brake.

Recommended actions

The following actions are recommended:

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

7.5 Motor temperature too high

Description

The robot stops and the motor temperature for joint arg is too high.

Consequences

It is not possible to continue until the motor has cooled down. The system goes to Motors Off.

Possible causes

The symptom can be caused by:

- The values for payload and arm load are not consistent with the actual ones.
- The value for ambient temperature setting in the controller is not consistent with the actual operating temperature environment.
- The user program may contain too much high acceleration and deceleration of the joint.
- Gravity torque or external forces for the joint can also be too high.

Recommended actions

The following actions are recommended:

	Action	Information
1	**CAUTION** Allow hot parts to cool down.	
2	Verify that the values for payload and arm load are set correctly.	
3	Verify that the value for ambient temperature setting in the controller is consistent with the actual operating temperature environment.	
4	Rewrite the user program to reduce the motor utilization.	The ways could be but not limited to optimizing robot movement cycle, adjusting acc, dec as well as external force, adding wait time, and introducing alternative path/RAPID, etc.

7.6 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**.

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.

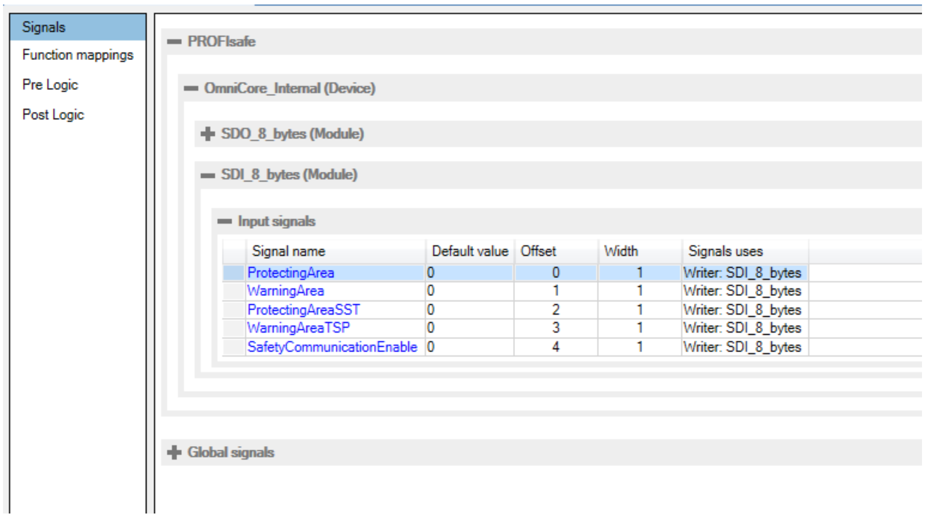
Possible causes

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.



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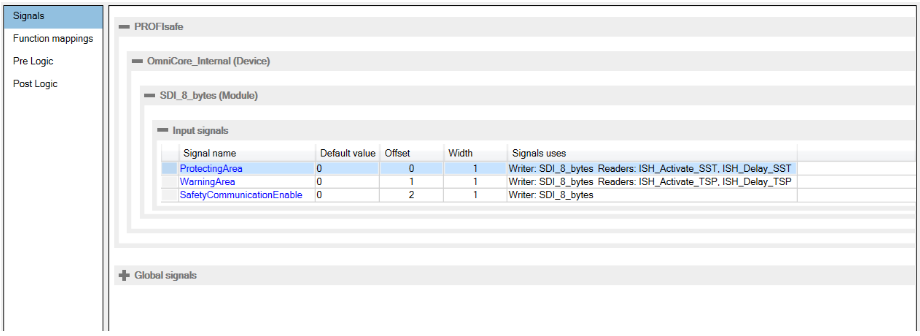
For robots running RobotWare 7.6 or later, the following signals can be observed.



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4 If the signals cannot be observed, choose **I/O Engineering Tool** from **Configuration** in the **Configuration** group.

5 Go back to the **Visual SafeMove** window and write the SafeMove configurations to the controller again.

You will observe the signals and the communication is correctly set up.

7.8 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.

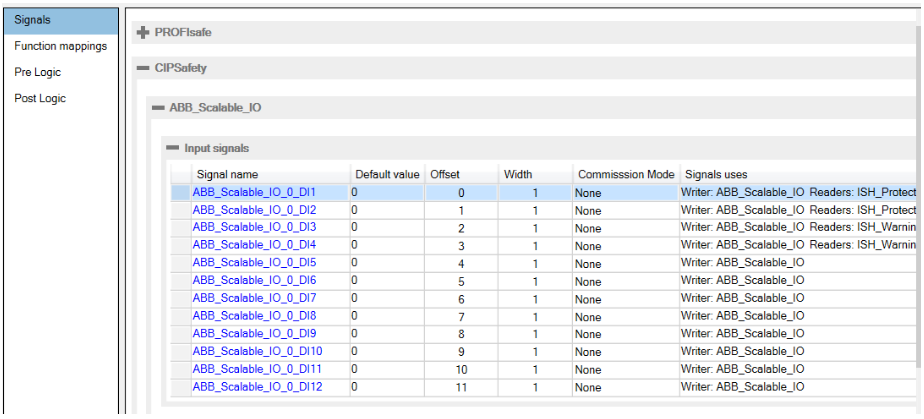
Possible causes

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.



Signal name	Default value	Offset	Width	Commisssion Mode	Signals uses
ABB_Scalable_IO_0_DI1	0	0	1	None	Writer: ABB_Scalable_IO Readers: ISH_Protect
ABB_Scalable_IO_0_DI2	0	1	1	None	Writer: ABB_Scalable_IO Readers: ISH_Protect
ABB_Scalable_IO_0_DI3	0	2	1	None	Writer: ABB_Scalable_IO Readers: ISH_Warnin
ABB_Scalable_IO_0_DI4	0	3	1	None	Writer: ABB_Scalable_IO Readers: ISH_Warnin
ABB_Scalable_IO_0_DI5	0	4	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_DI6	0	5	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_DI7	0	6	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_DI8	0	7	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_DI9	0	8	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_DI10	0	9	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_DI11	0	10	1	None	Writer: ABB_Scalable_IO
ABB_Scalable_IO_0_DI12	0	11	1	None	Writer: ABB_Scalable_IO

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4. If the signals cannot be observed, choose **I/O Engineering Tool** from **Configuration** in the **Configuration** group.
5. Go back to the **Visual SafeMove** window and write the SafeMove configurations to the controller again.

   You will observe the signals and the communication is correctly set up.

7.9 Errors related to stopped background task T_SWIFTI_LED

Description

Execution errors are reported because the background task T_SWIFTI_LED is stopped.

Consequences

Program execution is halted.

Possible causes

The I/O module is changed or reset.

Recommended actions

1. Tap **I/O** in the main page of the FlexPendant.
2. Check the device status, whether the **CabinetIO** device with address **192.168.125.100** is in **Not connected** state, and there is another device in **Unknown** state.
3. If in previous situation, tap the menu button after the unknown device and tap **Identify** in the list.

   Verify whether the unknown device is the I/O module installed on the controller. If yes, the LED blinks on the I/O module.
4. Tap **Configure** in the list for the unknown device.
5. In the displayed **I/O Modernization** window, choose **Update device** in the **Configuration** area and select **CabinetIO** from the drop-down list.

   This will update the unknown device to CabinetIO.
6. Tap **Apply**.
7. Restart the controller.

   The system works normally.

7.10 Unable to change speed value in FlexPendant

Description

In manual mode, the **Speed** scrollbar in the FlexPendant cannot be dragged to edit the speed.

This issue may occur when robot is running in RobotWare 7.5 or an earlier version.

Consequences

Robot movement speed cannot be edited in manual mode in FlexPendant.

Possible causes

The speed control module uses the value of the system input whose **Action** is **Set speed** to control the actual movement speed. If the communication between the OmniCore controller and laser scanner fails, the controller considers this situation as that the protecting area is triggered, and the speed will be limited to 0%. If the communication failure remains when the operating mode is changed to Manual, the **Set speed** value is still valid.

Recommended actions

1. In the FlexPendant, tap **I/O** in the main page.
2. Reset the StartInProtecting DO.

   The speed limitation will be released.

7.11 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.

For more details, see *Strategies (RobotWare 7.5) on page 153*.

Recommended actions

Users could perform either of the following solutions:

- Reset the program pointer and start the program in the Safe area again.
- Enter the Warning area but not trigger the TSP supervision violation and then back to the Safe area again.

7.12 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

- Lamp indicator does not light up after the installed options are reselected.
- 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.

7.13 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. See detailed procedures in *The SafeMove configurator app on FlexPendant on page 105*.

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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 702*.

Transportation

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

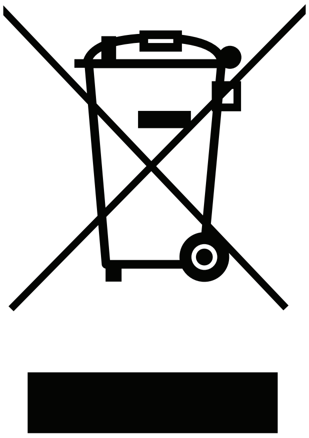
8.2 Environmental information

Introduction

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

Symbol

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



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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, base adapter, swing, swing support, lower arm, lower arm support, swing, covers, motors, gearboxes, SMB unit, etc
Batteries, Lithium	Serial measurement board
Copper	Cables, motors
Lead	Serial measurement board
Neodymium	Motors
Oil, grease	Gearboxes, process hub, etc
Plastic/rubber	Cables, SMB unit, gearboxes, timing belt, cooling pads, connector kits, etc
Steel	Base, swing, lower arm, extender unit, wrist, motors, gearboxes, SMB unit, etc

Continues on next page

China RoHS symbol

The following symbol shows the information to hazardous substances and the environmental protection use period of CRB 1100 according to "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products (SJ/T 11364-2014) ".

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Green symbol with "e" in it: The product does not contain any hazardous substances exceeding concentration limits and is a green environmentally friendly product which can be recycled.

Oil and grease

Where possible, arrange for oil and grease to be recycled. Dispose of via an authorized person/contractor in accordance with local regulations. Do not dispose of oil and grease near lakes, ponds, ditches, down drains, or onto soil. Incineration must be carried out under controlled conditions in accordance with local regulations.

Also note that:

- Spills can form a film on water surfaces causing damage to organisms. Oxygen transfer could also be impaired.
- Spillage can penetrate the soil causing ground water contamination.

8.3 Scrapping of robot

Note

The decommissioning process shall be preceded by a risk assessment.

Important when scrapping the robot

DANGER

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

- Always remove all batteries. If a battery is exposed to heat, for example from a blow torch, it will explode.
- Always remove all oil/grease in gearboxes. If exposed to heat, for example from a blow torch, the oil/grease will catch fire.
- When motors are removed from the robot, the robot will collapse if it is not properly supported before the motor is removed.
- A used robot does not have the same performance as on delivery. Springs, brakes, bearings, and other parts might be worn or broken.

9 Reference information

9.1 Introduction

General

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

9.2 Applicable standards

General

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

Robot standards

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

Other standards used in design

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

Region specific standards and regulations

Standard	Description
ANSI/RIA R15.06	Safety requirements for industrial robots and robot systems
ANSI/UL 1740	Safety standard for robots and robotic equipment
CAN/CSA Z 434-03	Industrial robots and robot Systems - General safety requirements
EN ISO 10218-1	Robots and robotic devices — Safety requirements for industrial robots — Part 1: Robots

9.3 Unit conversion

Converter table

Use the following table to convert units used in this manual.

Quantity	Units		
Length	1 m	3.28 ft.	39.37 in
Weight	1 kg	2.21 lb.	
Weight	1 g	0.035 ounces	
Pressure	1 bar	100 kPa	14.5 psi
Force	1 N	0.225 lbf	
Moment	1 Nm	0.738 lbf-ft	
Volume	1 L	0.264 US gal	

9.4 Screw joints

General

This section describes how to tighten the various types of screw joints on ABB robots.

The instructions and torque values are valid for screw joints comprised of metallic materials and do *not* apply to soft or brittle materials.

UNBRAKO screws

UNBRAKO is a special type of screw recommended by ABB for certain screw joints. It features special surface treatment (Gleitmo as described below) and is extremely resistant to fatigue.

Whenever used, this is specified in the instructions, and in such cases, *no other type of replacement screw* is allowed. Using other types of screws will void any warranty and may potentially cause serious damage or injury.

Gleitmo treated screws

Gleitmo is a special surface treatment to reduce the friction when tightening the screw joint. It is recommended by ABB for M6-M20 screw joints. Screws treated with Gleitmo may be reused 3-4 times before the coating disappears. After this the screw must be discarded and replaced with a new one.

When handling screws treated with Gleitmo, protective gloves of **nitrile rubber** type should be used.

Generally, screws are lubricated with *Gleitmo 603* mixed with *Geomet 500* or *Geomet 702* in proportion 1:3. *Geomet* thickness varies according to screw dimensions, refer to the following.

Dimension	Lubricant	Geomet thickness
M6-M20 (any length except M20x60)	*Gleitmo 603* + *Geomet 500*	3-5 µm
M6-M20 (any length except M20x60)	*Gleitmo 603* + *Geomet 720*	3-5 µm
M20x60	*Gleitmo 603* + *Geomet 500*	8-12 µm
M20x60	*Gleitmo 603* + *Geomet 720*	6-10 µm

Screws lubricated in other ways

Screws lubricated with Molykote 1000 or Molykote P1900 should *only* be used when specified in the repair, maintenance or installation procedure descriptions.

In such cases, proceed as follows:

1. Apply lubricant to the screw thread.
2. Apply lubricant between the plain washer and screw head.
3. Screw dimensions of M8 or larger must be tightened with a torque wrench. Screw dimensions of M6 or smaller may be tightened without a torque wrench *if* this is done by trained and qualified personnel.

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Lubricant	Article number
Molykote 1000 (molybdenum disulphide grease)	3HAC042472-001
Molykote P1900 (molybdenum disulphide grease)	3HAC070875-001

Tightening torque

Before tightening any screw, note the following:

- Determine whether a **standard** tightening torque or **special** torque is to be applied. The **standard torques** are specified in the following tables. Any **special torques** are specified in the repair, maintenance or installation procedure descriptions. **Any special torque specified overrides the standard torque!**
- Use the *correct tightening torque* for each type of screw joint.
- Only use *correctly calibrated* torque keys.
- Always *tighten the joint by hand,* and never use pneumatic tools.
- Use the *correct tightening technique*, that is *do not* jerk. Tighten the screw in a slow, flowing motion.
- Maximum allowed total deviation from the specified value is **10%**!

Tightening torque for oil-lubricated screws with slotted or cross-recess head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws* with *slotted or cross-recess head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Tightening torque for oil-lubricated screws with allen head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws* with *allen head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Dimension	Tightening torque (Nm) Class 8.8, oil-lubricated	Tightening torque (Nm) Class 10.9, oil-lubricated	Tightening torque (Nm) Class 12.9, oil-lubricated
M5	6	-	-
M6	10	-	-
M8	24	34	40
M10	47	67	80
M12	82	115	140
M16	200	290	340
M20	400	560	670

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Dimension	Tightening torque (Nm) Class 8.8, oil-lubricated	Tightening torque (Nm) Class 10.9, oil-lubricated	Tightening torque (Nm) Class 12.9, oil-lubricated
M24	680	960	1150

Tightening torque for lubricated screws (Molykote, Gleitmo or equivalent) with allen head screws

The following table specifies the recommended standard tightening torque for *screws lubricated with Molycote 1000, Gleitmo 603 or equivalent* with *allen head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Dimension	Tightening torque (Nm) Class 10.9, lubricated [i]	Tightening torque (Nm) Class 12.9, lubricated [i]
M5		8
M6		14
M8	28	35
M10	55	70
M12	96	120
M16	235	300
M20	460	550
M24	790	950

[i] Lubricated with Molycote 1000, Gleitmo 603 or equivalent

9.5 Weight specifications

Definition

In installation, repair, and maintenance procedures, weights of the components handled are sometimes specified. All components exceeding 22 kg (50 lbs) are highlighted in this way.

To avoid injury, ABB recommends the use of a lifting accessory when handling components with a weight exceeding 22 kg. A wide range of lifting accessories and devices are available for each manipulator model.

Example

Following is an example of a weight specification in a procedure:

	Action	Note
	CAUTION The arm weighs 25 kg. All lifting accessories used must be sized accordingly.	

9.6 Standard toolkit

General

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

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

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

Contents, standard toolkit

Qty	Tool	Rem.
1	Socket head cap 2-17 mm	
1	Torque wrench 0.3-45 Nm	
1	Torque wrench 50 Nm±5 Nm	For securing robot to foundation.
1	Ratchet head for torque wrench 1/2	
1	Hex socket head cap no. 2.5 socket 1/2" bit L=110 mm	
1	Small screwdriver	
1	T-handle with ball head	
1	Small cutting plier	
1	Plastic mallet	
1	Needle-nose plier	

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 712*, and of special tools, listed directly in the instructions and also gathered in this section.

Special tools

Note

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

Tools and equipment with spare part number: **(These tools can be ordered from ABB)**	
-	24 VDC power supply
3HAC074119-001	Calibration tool box, Axis Calibration Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. The tool box also includes a unique calibration pin for CRB 1100 to be fitted to the tool flange during calibration of axis 6.
-	Sonic tension meter Used for measuring the timing belt tension.
-	Dynamometer Used for measuring the timing belt tension.
3HAC071022-001	Special toolkit Includes J5.C2 connector assembly tool, brake release button assembly tool, axis-4 motor fitting tool and M3x25 eye bolt.

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10 Spare parts

10.1 Spare part lists and illustrations

Location

Spare parts and exploded views are not included in the manual but delivered as a separate document for registered users on myABB Business Portal, *www.abb.com/myABB*.

Tip

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

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