ROBOTICS

Product manual

IRB 6790

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Product manual

IRB 6790 - 235/2.65
IRB 6790 - 205/2.80

IRC5, OmniCore

Document ID: 3HAC063331-001

Revision: N

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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 IRB 6790
- maintenance of the IRB 6790
- mechanical and electrical repair of the IRB 6790

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

- *Foundry Prime*

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

Product manual scope

The manual covers all variants and designs of the IRB 6790. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

Usage

This manual should be used during:

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

Note

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

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

Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

Prerequisites

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

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

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References

Documentation referred to in the manual, is listed below.

General

Document name	Document ID
Product manual, spare parts - IRB 6790	*3HAC064429-001*
Circuit diagram - IRB 6700 / IRB 6790	*3HAC043446-005*
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*
Directions for use - Fork lift accessory set 3HAC047054-001	*3HAC048484-002*
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*
Description and installation information - Manipulator harness - IRB 6790	*9AKK108470A2987-001*

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

For OmniCore robots

Document name	Document ID
Product specification - IRB 6790	*Document.ID-1*
Product manual - OmniCore V250XT Type B	*3HAC087112-001*
Product manual - OmniCore V400XT	*3HAC081697-001*
Operating manual - OmniCore	*3HAC065036-001*
Technical reference manual - System parameters	*3HAC065041-001*

For IRC5 robots

Document name	Document ID
Product specification - IRB 6790	*Document.ID-1*
Product manual - IRC5 For IRC5 robots, with main computer DSQC1000.	*3HAC047136-001*
Operating manual - IRC5 with FlexPendant	*3HAC050941-001*
Technical reference manual - System parameters	*3HAC050948-001*

Revisions

Revision	Description
A	First edition.

Continues on next page

Revision	Description
B	Published in release 20A. The following updates are made in this revision: • Corrected article number for guide pin M12x200 and removal tool M12. Deleted guide pin M12x250 from special tool list. • Self-threading screws removed from motor covers. • Removed incorrect information about upper arm connection plate. • Updated information about wrist cover gasket. • Added note to operating environment information regarding pH value in washing detergents. • Added images to section for transportation of a robot that has a tool mounted. • Added image of hole configuration of the base. • Added overpressure diagram to section *Installation requirements for Foundry Prime robots on page 68*. • Added information about action if the system alerts for too high leakage. • Added information about working range restrictions. • Updated information about cable clamp attachment inside the upper arm tube. • Updated information about requirement of the cable protection on axis 1. • Updated article numbers of motor cover o-rings and connection box o-rings. • Added information about screws at the balancing device front link ear shaft insert. • Replaced article number and name of grease, previously 3HAB3537-1. • Clarified and added information in mounting instructions for rotating sealings, see *Mounting instructions for sealings on page 187*. • Clarified text about position of robot and added table with dependencies between axes during Axis Calibration.
C	Published in release 21C The following updates are made in this revision: • Added information about Wrist Optimization in calibration chapter. • New press equipment for unloading balancing device introduced. New article number. User instructions for the equipment are enclosed with the tool. • New press equipment for replacing bearing on balancing device. User instructions for the equipment are enclosed with the tool. • Pallet removed from required tools tables. • Text regarding fastener quality is updated, see *Fastener quality on page 98*. • Press Tool Balance Device added to chapter 7.7 Special Tools.
D	Published in release 21D The following updates are made in this revision: • Hydraulic press tool number 3HAC020902-001, is replaced with 3HAC074411-001.
E	Published in release 22A. The following updates are done in this revision: • Updated information about Gleitmo treated screws, see *Screw joints on page 676*. • Removed information about inspecting fork lift accessories. Information is found in enclosed documentation for the fork lift accessories.
F	Published in release 22B. The following updates are done in this revision: • Added information about always replacing the o-rings on oil plugs with new o-rings when refitting the plugs. • Added a note about not running cabling submerged beneath detergent solution.

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Revision	Description
G	Published in release 22D. The following updates are done in this revision: • Changed tightening torque from 24 Nm to 10 Nm on stop screw, mechanical stop pin axis 1. • Added a step for overall inspection of cabling after cable harness has been replaced.
H	Published in release 23A. The following updates are done in this revision: • Corrected the overpressure diagram in section *Installation requirements for Foundry Prime robots on page 68*.
J	Published in release 23B. The following updates are done in this revision: • Corrections made based on feedback from University. • Added velcro strap to the maintenance schedule and added the article number of gasket for upper arm axis 3-4. • Added washers to the interface/harness cover.
K	Published in release 23C. The following updates are done in this revision: • Updated information regarding sealant when refitting the cable harness through the frame. • Updated the recommended placement of the silver label and clarified the terms silver label and calibration label. • Updated image of transportation position and added axis angles for the position. • Corrections made to the section *Fitting equipment to the robot*. • Updated the information about the overpressure unit, and how to find a leakage.
L	Published in release 23D. The following updates are done in this revision: • Updated the structure and information about the overpressure system.
M	Published in release 24B. The following updates are done in this revision: • Updated the illustration of drawing 1 and the table of fitting holes for extra equipment on axis 4. • Added information for the OmniCore robot controller. • Added the missing installation instruction *Extended working range, axis 1 (option) on page 99*. • Removed information about the base plate as this is not recommended for corrosive environments. • Added axis positions for most stable transport position and removed information about shipping position. • Added information about the new design of overpressure system.
N	Published in release 24D. The following updates are done in this revision: • Added information about new cable harness. • Changed date of implementation of new overpressure unit design. • Added action to check R1.MP connector adapter and replace if damaged. • Added signal cable adapter to the list of robot cables between the control cabinet and manipulator. Removed note about pressurized cable harness in same section. • Added length of cables between interface plate and manipulator base.

Product documentation

Categories for user documentation from ABB Robotics

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

Tip

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

Product manuals

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

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

Technical reference manuals

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

Application manuals

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

An application manual generally contains information about:

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

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- Examples of how to use the application.

Operating manuals

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

How to read the product manual

Reading the procedures

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

Safety information

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

Read more in the chapter *Safety on page 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.

Important information about robots with protection type Foundry Prime

Introduction

Foundry Prime robots are specially designed to work in harsh environments. Misuse of the robots or poor installation, cleaning, maintenance and repair can be harmful for the functioning of the robot.

Warranty claims

Warranty claims for defect products due to misuse or failure to fulfil operational and maintenance requirements will not be approved.

Pressurized components

Motors, balancing device and the serial measurement board cavity shall be pressurized on Foundry Prime robots during operation and shut down. The overpressure can be dropped when the temperature and humidity has reached the same level as the surrounding environment. The overpressure system that distributes and monitor the air flow consists of two parts, the overpressure unit and the flow sensor. For more information, see *Description of the overpressure system on page 71*.

Cleaning

Special procedures are needed when cleaning the Foundry Prime robot. See section *Cleaning the IRB 6790 on page 179*.

1 Safety

1.1 Safety information

1.1.1 Limitation of liability

Limitation of liability

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

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

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

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

Spare parts and equipment

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

1.1.2 Requirements on personnel

General

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

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

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

Personal protective equipment

Use personal protective equipment, as stated in the instructions.

1.2 Safety signals and symbols

1.2.1 Safety signals in the manual

Introduction to safety signals

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

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

Hazard levels

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

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

Continues on next page

1.2.1 Safety signals in the manual

Continued

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

1.2.2 Safety symbols on manipulator labels

Introduction to symbols

This section describes safety symbols etched as black and white directly on the manipulator. The safety symbols are also used on loose stickers delivered together with 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

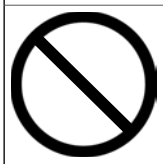
Both the manipulator and the controller are marked with symbols, containing important information about the product. This is important for all personnel handling the robot, for example during installation, service, or operation.

The safety labels are also delivered as loose stickers and should be fitted to an appropriate location outside the harsh environment in which the robot operates.

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.

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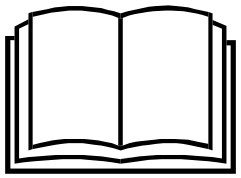
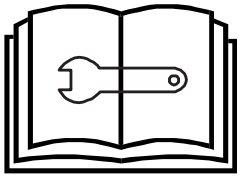
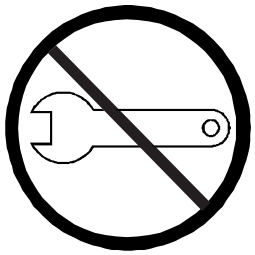
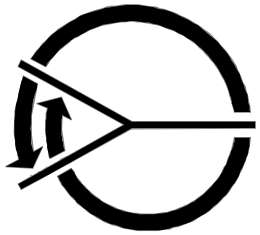
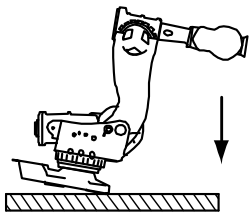
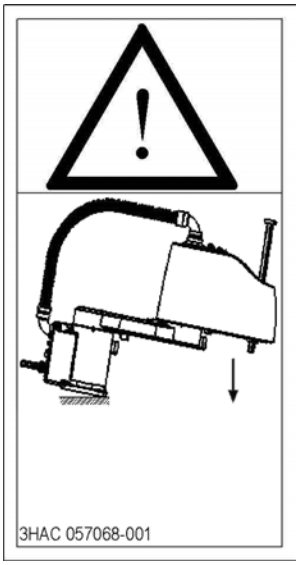
1.2.2 Safety symbols on manipulator labels
Continued

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

Continues on next page

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

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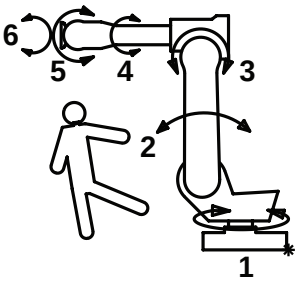
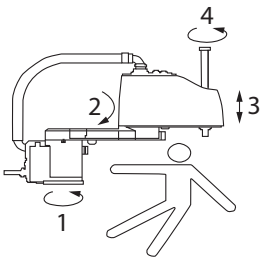
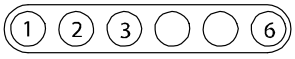
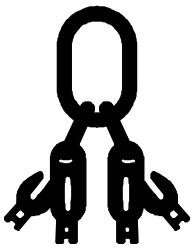
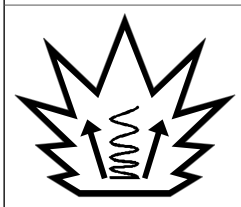
1.2.2 Safety symbols on manipulator labels
Continued

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

Continues on next page

Symbol	Description
 xx0900000821	**Lifting bolt**
 xx1000001242	**Adjustable chain sling with shortener**
 xx0900000822	**Lifting of robot**
 xx0900000823	**Oil** Can be used in combination with prohibition if oil is not allowed.
 xx0900000824	**Mechanical stop**
 xx1000001144	**No mechanical stop**
 xx0900000825	**Stored energy** Warns that this part contains stored energy. Used in combination with *Do not disassemble* symbol.

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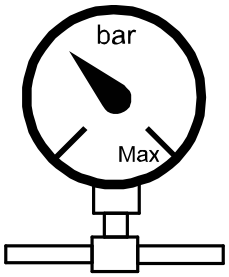
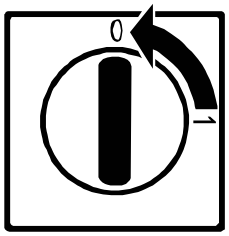
1.2.2 Safety symbols on manipulator labels

Continued

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

1.3 Robot stopping functions

Protective stop and emergency stop

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

For more information see:

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

1.4 Safety during installation and commissioning

National or regional regulations

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

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

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

Layout

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

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

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

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

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

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

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

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

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

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

Allergenic material

See *Environmental information on page 668* for specification of allergenic materials in the product, if any.

Securing the robot to the foundation

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

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

Continues on next page

Using lifting accessories and other external equipment

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

Electrical safety

Incoming mains must be installed to fulfill national regulations.

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

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

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

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

Note

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

Safety devices

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

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

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

Other hazards

A robot may perform unexpected limited movement.

WARNING

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

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

- Water
- Compressed air
- Hydraulics

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

Continues on next page

Pneumatic or hydraulic related hazards

Note

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

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

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

Dump valves should be used in case of emergency.

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

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

Verify the safety functions

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

1.5 Safety during operation

Automatic operation

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

Unexpected movement of robot arm

WARNING

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

A robot may perform unexpected limited movement.

WARNING

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

1.6 Safety during maintenance and repair

1.6.1 Safety during maintenance and repair

General

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

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

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

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

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

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

Hot surfaces

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

Allergic reaction

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

Gearbox lubricants (oil or grease)

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

 **Note**

Take special care when handling hot lubricants.

Warning	Description	Elimination/Action
 **Hot oil or grease**	Changing and draining gearbox oil or grease may require handling hot lubricant heated up to 90 °C.	Make sure that protective gear like goggles and gloves are always worn during this activity.

Continues on next page

Warning	Description	Elimination/Action
 **Allergic reaction**	When working with lubricants there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.
 **Possible pressure build-up in gearbox**	When opening the oil or grease plug, there may be pressure present in the gearbox, causing hot lubricant to spray from the opening.	Open the plug carefully and keep away from the opening. Do not overfill the gearbox when filling. Put oil absorbent cloth, bags or paper at appropriate locations to catch any oil residues. Use appropriate protective gear such as heat-resistant gloves, goggles/protective visor, or a body suit if necessary.
 **Do not overfill**	Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may: • damage seals and gaskets • completely press out seals and gaskets • prevent the robot from moving freely.	Make sure not to overfill the gearbox when filling it with oil or grease. After filling, verify that the level is correct.
 **Do not mix types of oil**	Mixing types of oil may cause severe damage to the gearbox.	When filling gearbox oil, do not mix different types of oil unless specified in the instructions. Always use the type of oil specified for the product.
 **Oil residues**	Oil residues might be present in a drained gearbox and spilled when separating a motor and gearbox during repair.	Make sure that protective gear like goggles/protective visor, gloves and arm protection are always worn during this activity. Put oil absorbent cloth, bags or paper at appropriate locations to catch any oil residues.
 **Heat up the oil**	Warm oil drains quicker than cold oil.	Run the robot before changing the gearbox oil, if possible.
 **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.

Continues on next page

1.6.1 Safety during maintenance and repair
Continued

Warning	Description	Elimination/Action
 **Contaminated oil in gearboxes**	For lifetime reasons always drain as much oil as possible from the gearbox. The magnetic oil plugs will gather residual metal chips.	

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 43*.

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

Unexpected movement of robot arm

WARNING

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

A robot may perform unexpected limited movement.

WARNING

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

Related information

See also the safety information related to installation and operation.

1.6.2 Emergency release of the robot axes

Description

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

How to release the brakes is described in the section:

- *Shut-down periods on page 89*.

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

Increased injury

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

DANGER

When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways.

Make sure no personnel is near or beneath the robot.

1.6.3 Brake testing

When to test

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

How to test

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

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

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

Note

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

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

1.7 Safety during troubleshooting

General

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

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

DANGER

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

CAUTION

Risk of hot surfaces that can cause burns.

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

WARNING

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

A robot may perform unexpected limited movement.

WARNING

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

Related information

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

1.8 Safety during decommissioning

General

See section *Decommissioning on page 667*.

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

Unexpected movement of robot arm

WARNING

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

A robot may perform unexpected limited movement.

WARNING

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

2 Installation and commissioning

2.1 Introduction to installation and commissioning

General

This chapter contains assembly instructions and information for installing the IRB 6790 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 41*.

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 IRB 6790 and the robot to protective earth and residual current device (RCD) before connecting to power and starting any installation work.

For more information see:

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

2.2 Unpacking

2.2.1 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 41*
6	If the robot is not installed directly, it must be stored as described in: *Storage conditions, robot on page 43*
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: *Operating conditions, robot on page 43*
8	Before taking the robot to its installation site, make sure that the site conforms to: • *Loads on foundation, robot on page 42* • *Protection classes, robot on page 44* • *Requirements, foundation on page 43*
9	Before moving the robot, please observe the stability of the robot: *Risk of tipping/stability on page 48*
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: *On-site installation on page 57*
11	Install required equipment, if any.

2.2.2 Technical data

Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 6790	1300 kg

Note

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

Mounting positions

The table shows valid mounting options for the manipulator.

Mounting option	Installation angle	Note
Floor mounted	0°	

Note

The actual mounting angle must always be configured in the system parameters, otherwise the performance and lifetime is affected.

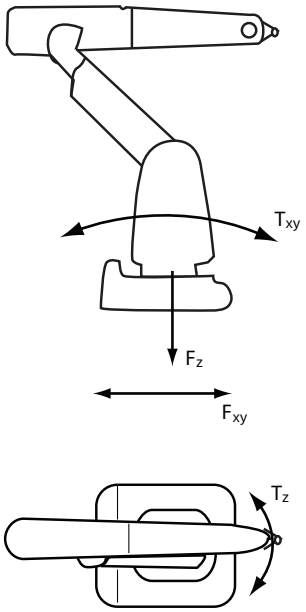
Continues on next page

2.2.2 Technical data
Continued

Loads on foundation, robot

The illustration shows the directions of the robots stress forces.

The directions are valid for all floor mounted, suspended and inverted 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)	Max. load (emergency stop)
Force xy	±7.4 kN	±19.8 kN
Force z	14.6 ±4.5 kN	14.6 ±15.7 kN
Torque xy	±21.0 kNm	±37.1 kNm
Torque z	±5.0 kNm	±11.4 kNm

Continues on next page

Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.3 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. 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 application manual of the controller software, section *Motion Process Mode*.

[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	100% 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	+50°C (122°F)

Continues on next page

2.2.2 Technical data
Continued

Parameter	Value
Maximum ambient humidity	100% at constant temperature (gaseous only).

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.

Operating environment, robot

The robot may be exposed to washing detergents with pH 7-10.

For shorter periods, the robot may be exposed to washing detergent between pH 6 to 7, if all parts of the robot are rinsed with tap water afterwards. Organic acids, e.g. acetic acid, are not allowed to be used.

Note

Washing and cleaning detergents with corrosion inhibitor is recommended. Corrosive environment are also depending on tap water quality. To avoid risk with tap water quality, deionized water is recommended together with detergent.

Note

If the pH value or the detergent concentration is varying from its original specification, it can become very corrosive.

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 Foundry Prime	IP69[ii]

i According to IEC 60529.
ii Includes all manipulator electrical compartments, excludes the Harting connector on the connection panel which is IP67.

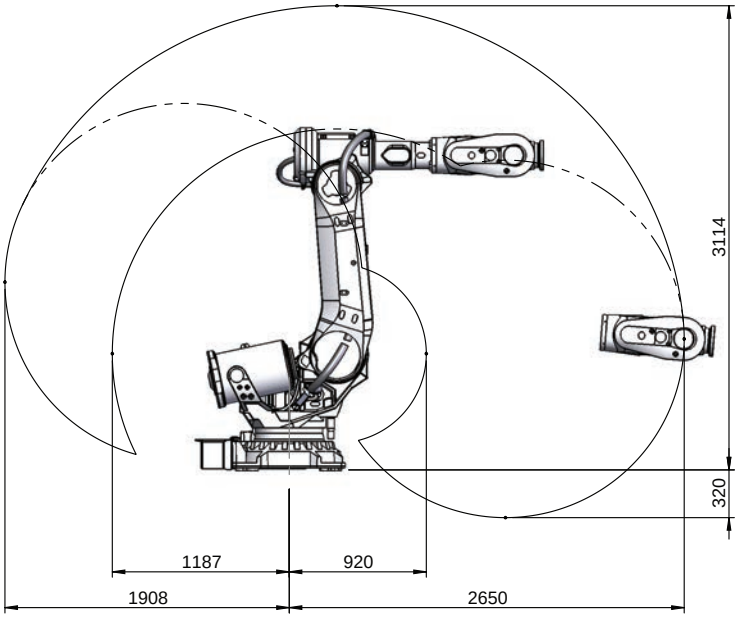
2.2.3 Working range

Working range

Axis	Type of motion	Working range	Note
Axis 1	Rotation motion	±170° or ±220° (option)	
Axis 2	Arm motion	-65°/+85°	
Axis 3	Arm motion	-180°/+70°	
Axis 4	Wrist motion	±300°	Default value.
Axis 5	Bend motion	±130°	
Axis 6	Turn motion	±360°	Default value.
		±93.7 revolutions	Maximum value. The default working range for axis 6 can be extended by changing parameter values in the software.

Illustration, working range IRB 6790 - 235/2.65

This illustration shows the unrestricted working range of the robot.



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Robot type	Handling capacity	Reach
IRB 6790	235 kg	2.65 m

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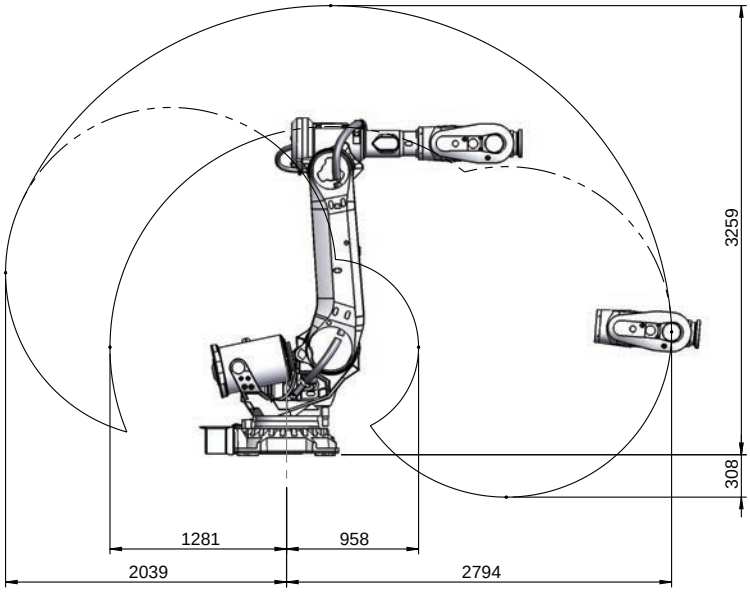
2.2.3 Working range
Continued

Illustration, working range IRB 6790 - 205/2.80

This illustration shows the unrestricted working range of the robot.



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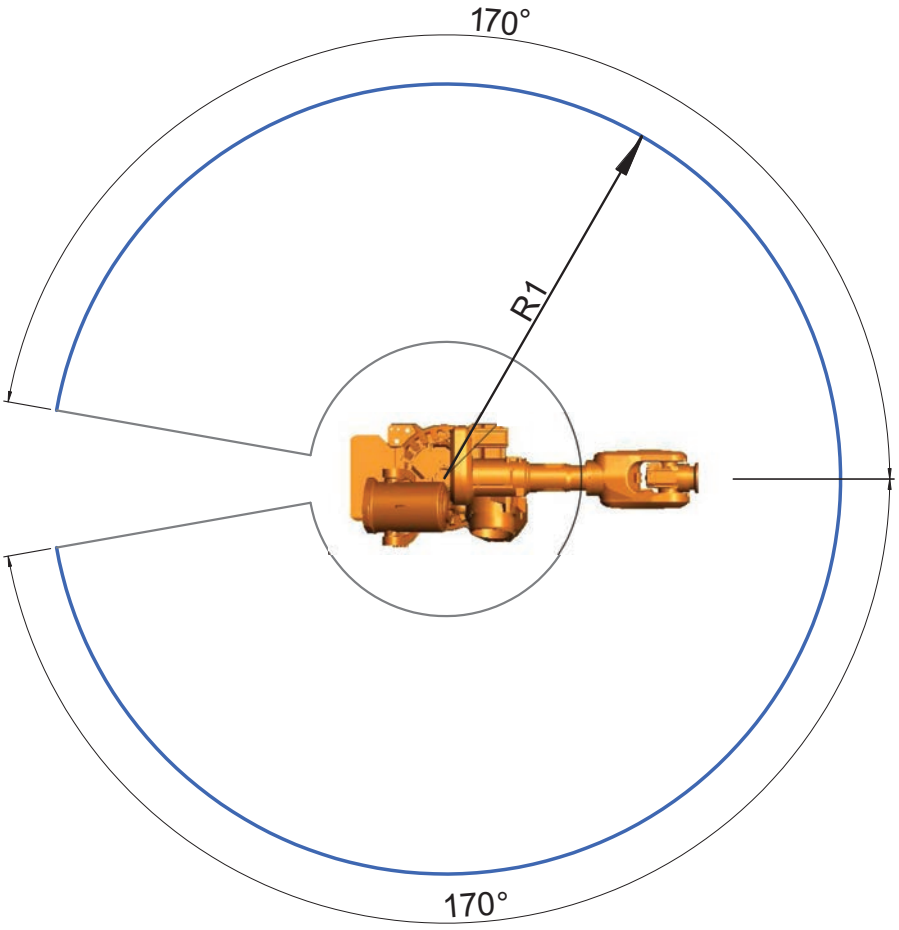
Robot type	Handling capacity	Reach
IRB 6790	205 kg	2.80 m

Continues on next page

Turning radius axis 1



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Robot variant	R1 (mm)
IRB 6790 - 235/2.65	2650
IRB 6790 - 205/2.80	2794

2.2.4 Risk of tipping/stability

Risk of tipping

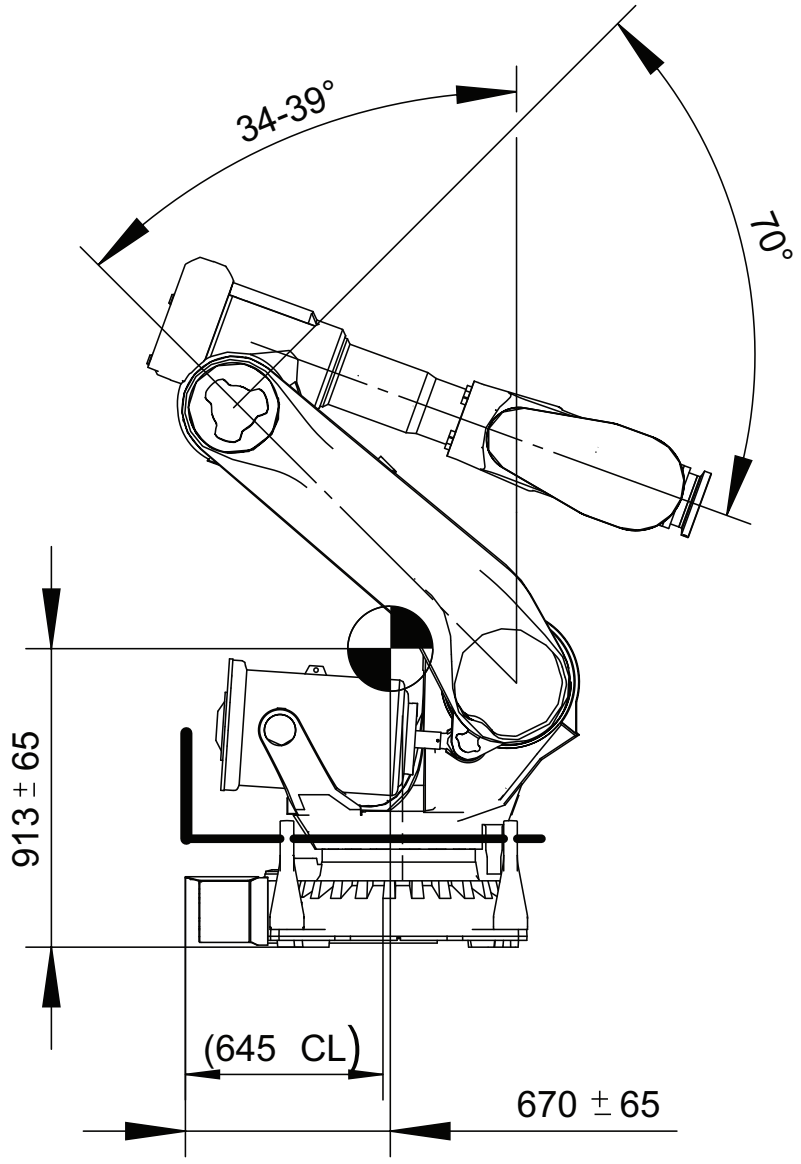
If the robot is not fastened to the foundation while moving the arm, the robot is not stable in the whole working area. Moving the arm will displace the center of gravity, which may cause the robot to tip over.

The transportation position is the most stable position.

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

Transportation position

This figure shows the robot in its transportation position.



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Axis number	Angle of axis
Axis 1	0°

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Axis number	Angle of axis
Axis 2	-34 to -39°
Axis 3	+70°
Axis 4	0°
Axis 5	0°
Axis 6	0°

Note

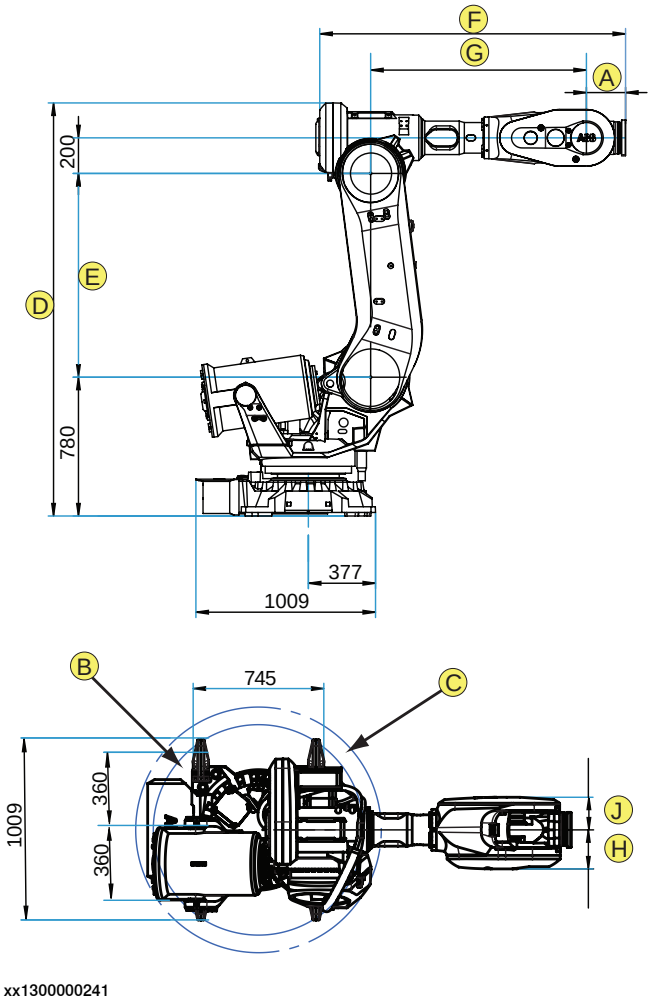
The robot might be positioned in a different position at delivery, due to actual configurations and options (for example DressPack).

WARNING

The robot will be mechanically unstable if not properly secured to the foundation.

2.2.5 Main dimensions

Illustration



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Dimensions for different robot variants

Pos	Description
B	Radius ax1, front = 532 mm
C	Radius ax1, back = 633 mm

Robot variant	A	D	E	F	G	H	J
IRB 6790 - 235/2.65	200	2300	1135	1670	1,182.5	209	186
IRB 6790 - 205/2.80	200	2445	1280	1670	1,182.5	186	209

2.2.6 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.

2.3 On-site transportation

2.3.1 Robot transportation precautions

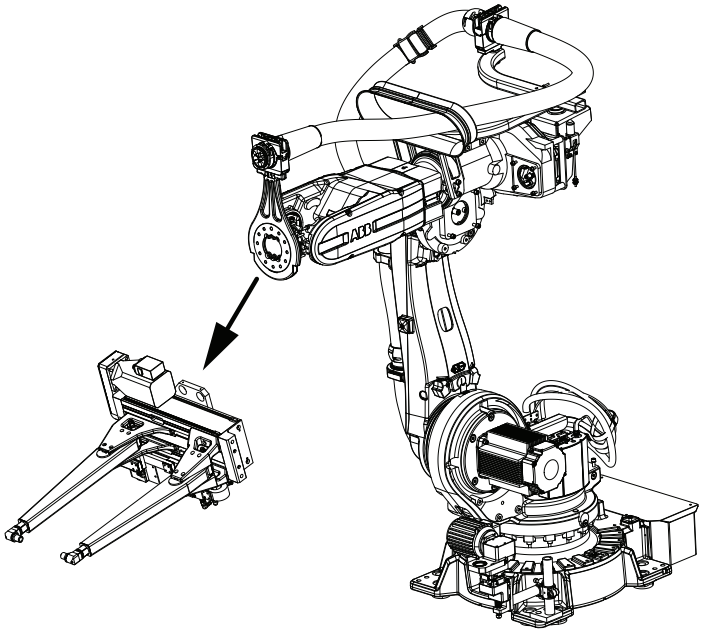
General

This section describes ABB approved transportation precautions for ABB robots.

> **CAUTION**
>
> **All transportation in or outside the plant, must be carried out according to the method described in this section.**
>
> **Transportation in any other way can seriously damage the robot. If the robot is incorrectly transported and the instructions are not followed, the robot is not covered by the warranty and ABB will not accept any compensation claim.**

Method 1 - recommended method

Transportation according to method 1 is strongly recommended by ABB.



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Always follow these instructions when transporting an ABB robot according to method 1:

- Always remove the tool before transportation of the robot.
- Always place the robot in the ABB recommended transport position, described in section *Risk of tipping/stability on page 48*.
- Always read and follow the instructions in section *Pre-installation procedure on page 40*

Continues on next page

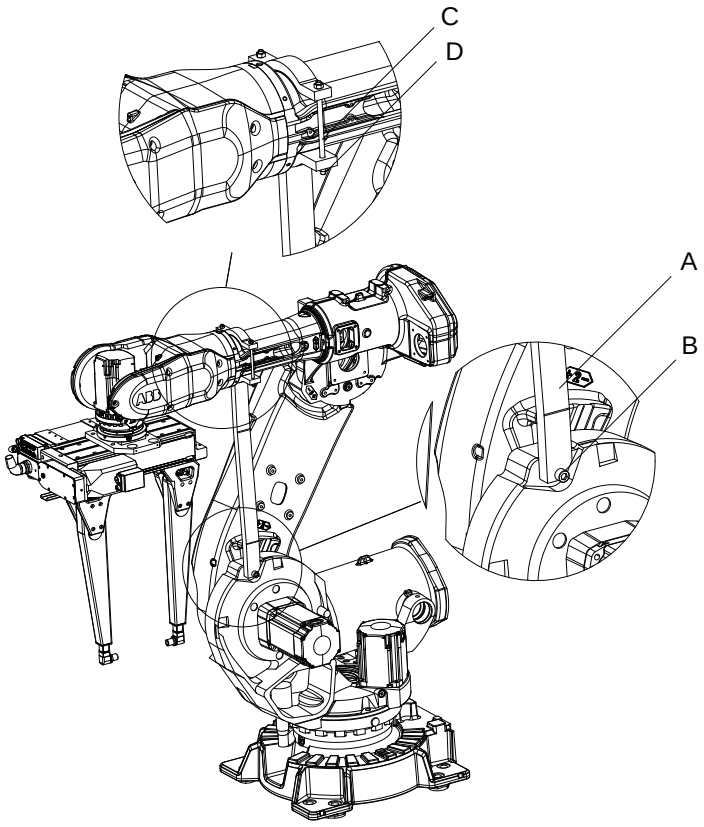
Method 2 - transportation with a tool mounted to the robot

Transportation according to method 2 is approved by ABB, only if use of method 1 is not possible.

Always follow these instructions when transporting an ABB robot according to method 2:

- Always read and follow the instructions in section *Securing the robot with a transport support on page 56*
- Always place the robot in the ABB recommended transport position for robot with tool, described in sub section *Transport position with a transport support on page 54*.
- Always use the recommended transport support described in sub section *Recommended transport support on page 55*.

IRB 6790



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A	Transport Support
B	Hexagon socket head cap screw M16x140
C	Threaded bar M10x200
D	Nut M10

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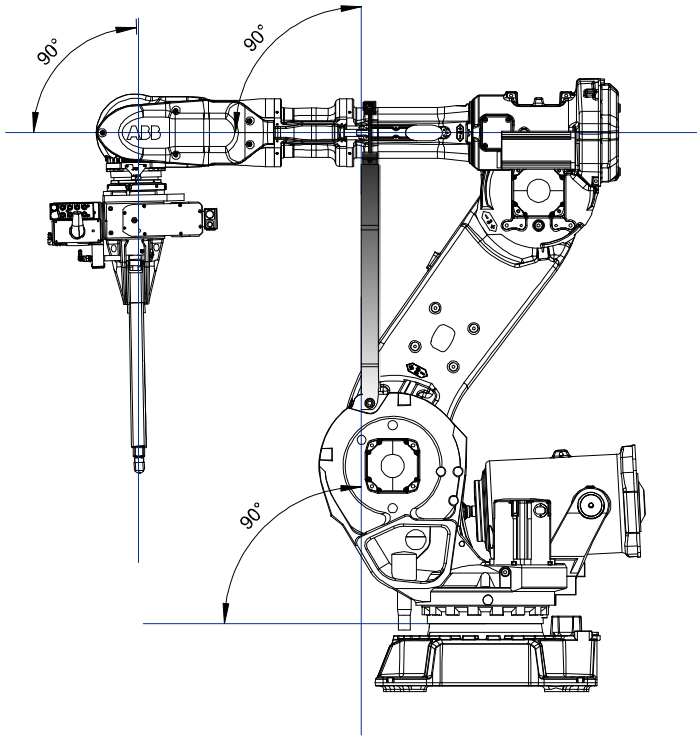
2.3.1 Robot transportation precautions
Continued

Transport position with a transport support

All transportation of the robot with tool must follow these instructions.

IRB 6790



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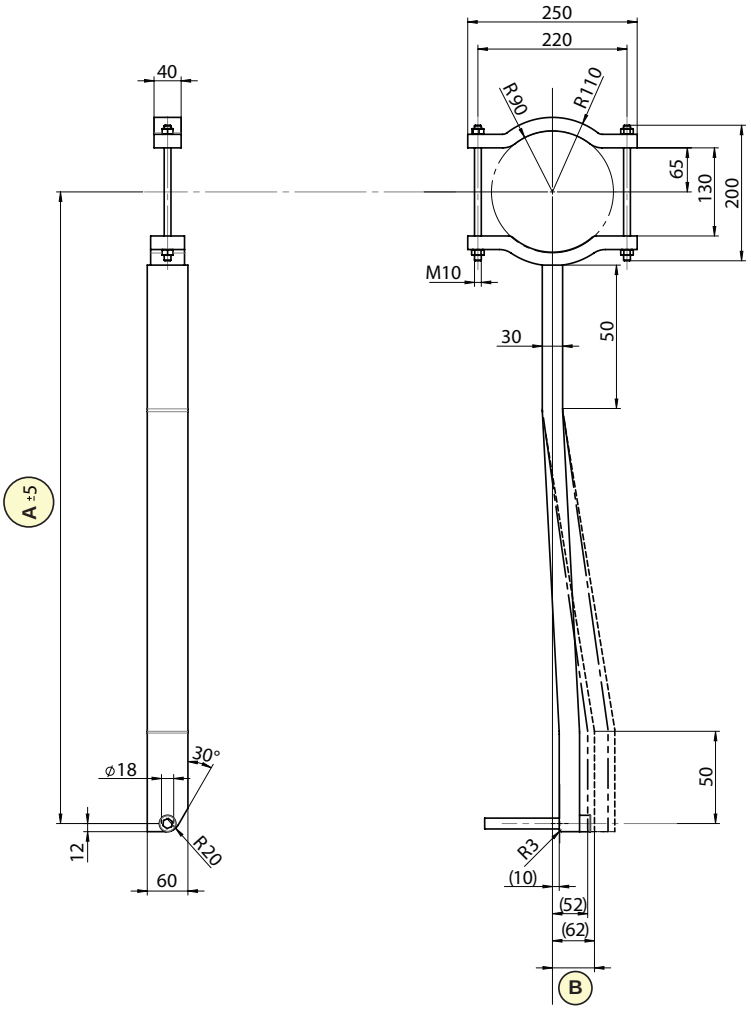
Recommended transport support

Always use the recommended transport support when transporting a robot with tool.

IRB 6790



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Variant	IRB 6790 - 235/2.65	IRB 6790 - 205/2.80
Lower arm L	1135	1280
A	1000	1160
B	21	21

2.3.2 Securing the robot with a transport support

General

This section describes how to fit the transport support to the robot in order to secure the robot for transportation. The transport support is required if the robot must be transported with mounted tools.

DANGER

Releasing the brakes is a hazardous action that may cause injury and damage property. It must be done with great care and only when absolutely necessary.

Fitting the transport support

Fitting the transport support

	Action	Note
1	Fit the transport support's lower end to the robot using the recommended screw joint, (A) in figure.	Do not tighten the screw. See attachment point for the specific robot in the section *Transport position with a transport support on page 54*.
2	Jog the robot into a position as near above as possible to the recommended transport position for the specific robot, as specified in section *Transport position with a transport support on page 54*.	**CAUTION** Do not try to jog the robot to the exact position (max distance 1mm).
3	Use the brake release for axis 3 to reach the final resting position on the transport support, see the section *Shut-down periods on page 89*.	See attachment point for the specific robot in the section *Transport position with a transport support on page 54*
4	Tighten all the attachment screws, (A) and (B), in the figure with the brake release for axis 3 still activated starting with the lower attachment screw.	**CAUTION** Do not attempt to tighten any attachment screws without first releasing the brakes. This can seriously damage the robot.
5	Use the brake release for axis 5 and 6 to reach the final resting position for the tool, see the section *Shut-down periods on page 89*	

2.4 On-site installation

2.4.1 Brief installation procedure

Introduction

This procedure is a brief guide when installing the robot for the first time. Also see *Pre-installation procedure on page 40*.

First installation

Use these procedures to install the IRB 6790.

	Action	Note
1	Transport the manipulator to its intended location.	
2	Install the valid platform or prepare the foundation for the manipulator.	
3	Lift and secure the manipulator to the platform/foundation.	See *Lifting the robot on page 58*. See *Orienting and securing the robot on page 65*.
4	Connect the manipulator to the controller.	See • *Product manual - IRC5* • *Product manual - OmniCore V250XT Type B* • *Product manual - OmniCore V400XT*
5	Configure the safety settings.	See • *Product manual - IRC5* • *Product manual - OmniCore V250XT Type B* • *Product manual - OmniCore V400XT*
6	How to start and run the robot is described in the product manual for the controller.	See • *Product manual - IRC5* • *Product manual - OmniCore V250XT Type B* • *Product manual - OmniCore V400XT*
7	Install required equipment, if any.	
8	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

2.4.2 Lifting the robot

2.4.2.1 Lifting the robot with fork lift

Lifting methods

The robot may be lifted and transported using a fork lift, provided that available special aids are used.

This section specifies available special aids and references to valid user documentation for the lifting accessories.

Required tools and equipment

Equipment	Article number	Note
Fork lift accessory set	3HAC047054-003	Contains fork lift pockets and all required hardware for installation. User instructions are enclosed with the tool, see Directions for use - Fork lift accessory for IRB 6700.

Required documents

Document	Document number
Directions for use - Fork lift accessory for IRB 6700	3HAC048484-002

Lifting the robot

	Action	Note
1	Lift the robot with a fork lift according to the user instructions enclosed with the fork lift accessory.	

2.4.2.2 Lifting robot with lifting accessory (recommended lifting method)

General

This section contains a general overview of how to lift the complete robot using special lifting accessory.

Illustration, lifting accessory

The following figure shows the principle for how to use and lift the entire robot with lifting accessory. For a more detailed instruction, see the user instructions enclosed with the accessory.

Note

The user manual may be out of date. The latest revision is available for download via myABB Business Portal, *www.abb.com/myABB*.

Required equipment

Equipment	Article number	Note
Lifting accessory, robot	3HAC15607-1	Includes user instructions 3HAC15971-2

Slings attached directly onto robot

This section details how to lift and move the robot using lifting slings when these are attached directly onto the robot.

Note

Please refer to the enclosed user instruction for instruction how to place the manipulator in an correct position. Attempting to lift a manipulator in any other position may result in the robot tipping over, causing severe damage or injury!

	Action	Note
1	Run the overhead crane to a position above the robot.	
2	Position the robot as detailed in enclosed instruction!	Article number is specified in *Required equipment on page 59*. Release the brakes, if required, as detailed in section *Shut-down periods on page 89*.
3	Fit the *lifting accessory* to the robot as described in the enclosed instruction! Go to the user instructions enclosed with the lifting accessory. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Article number is specified in *Required equipment on page 59*.

Continues on next page

2.4.2.2 Lifting robot with lifting accessory (recommended lifting method)
Continued

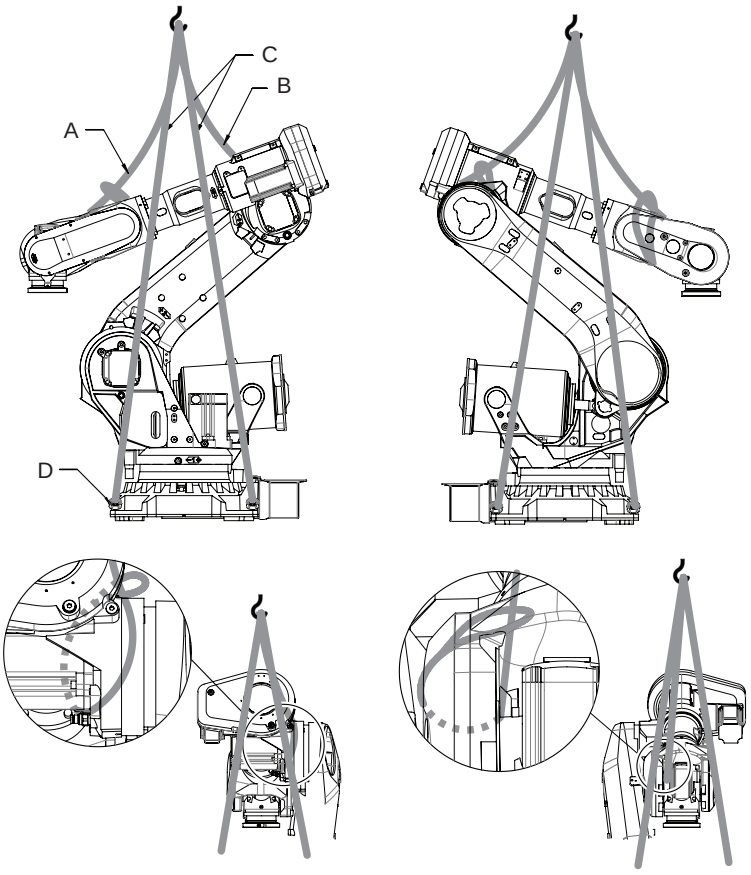
	Action	Note
4	**CAUTION** The IRB 6790 robot weighs 1300 kg. All lifting accessories used must be sized accordingly!	
5	**WARNING** Personnel must not, under any circumstances, be present under the suspended load!	
6	Raise overhead crane to lift the robot.	Make sure all hooks and attachments maintain their correct positions while lifting the robot! Always move the robot at very low speeds, making sure it does not tip.

2.4.2.3 Lifting the robot with roundslings

Roundslings used for lifting and transporting

The robot can be lifted and transported using roundslings according to this section.

Attaching the roundslings



Variant	Length A (1 pc) Do not strain!	Length B (1 pc) Do not strain!
IRB 6790 - 235/2.65	Roundsling, 2 m	Roundsling, 2 m
IRB 6790 - 205/2.80	Roundsling, 2 m	Roundsling, 2 m

C	Roundsling, 2.5 m (4 pcs)
D	Lifting eye, M20 (4 pcs)

Required equipment

See quantity of roundslings in figure *Attaching the roundslings on page 61*.

Equipment, etc.	Article number	Note
Overhead crane	-	
Lifting eye, M20	-	Working load limit: 2,000 kg.
Roundsling, 2 m	-	Length: 2 m. Lifting capacity: 2,000 kg.
Roundsling, 2.5 m	-	Length: 2.5 m. Lifting capacity: 2,000 kg.

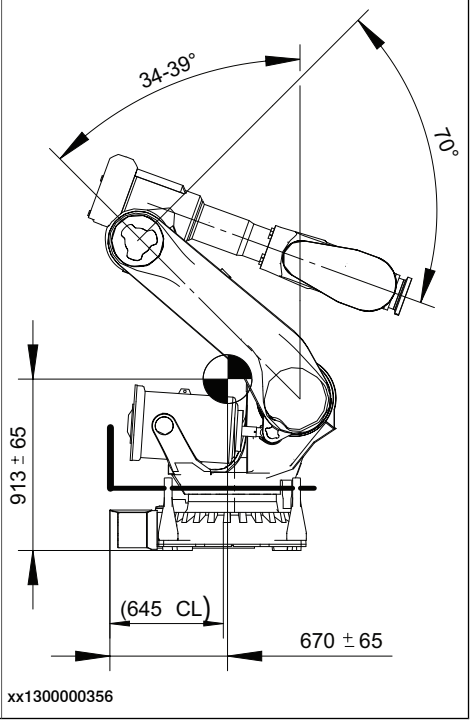
Continues on next page

2.4.2.3 Lifting the robot with roundslings
Continued

Lifting the robot with roundslings

Use this procedure to lift the robot with roundslings.

Jogging the robot to lifting position

	Action	Note
1	Jog the robot into position: • Axis 1: calibration position (0°) • Axis 2: -45° • Axis 3: +65° • Axis 4: no significance • Axis 5: +70° • Axis 6: no significance **WARNING** The robot is likely to be mechanically unstable if not secured to the foundation.	

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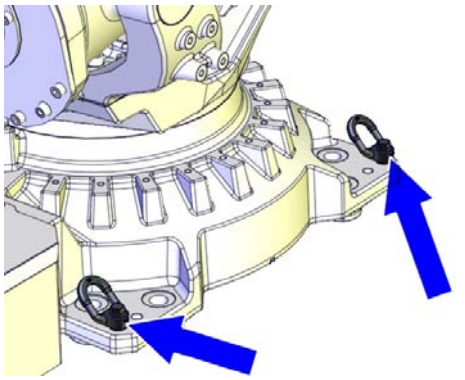
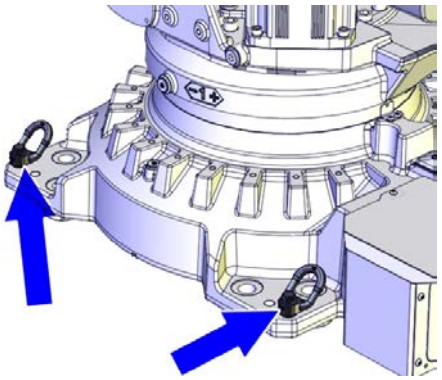
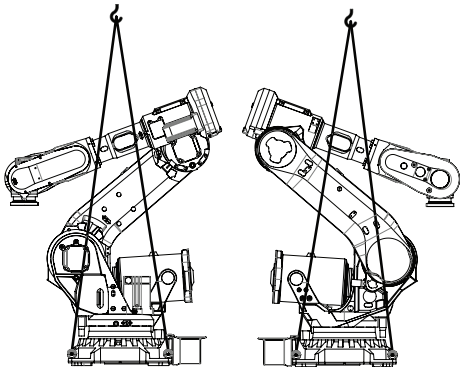
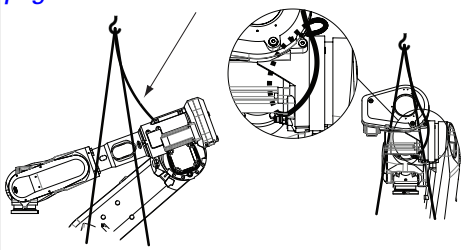
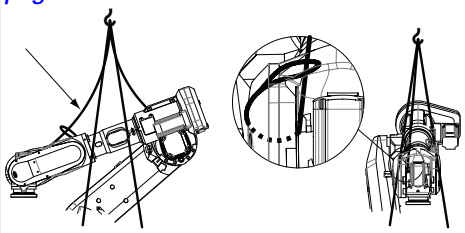
Lifting the robot with roundslings

	Action	Note
1	Fit lifting eyes to the outer holes on each corner of the base.	 xx1200001301  xx1200001302
2	Run roundslings through the lifting eyes and fasten them in an overhead crane. **CAUTION** If the lifting eyes have sharp edges that might damage the roundslings, lifting shackles must be used to attach the roundslings to the lifting eyes.	Make sure the roundslings do not rub against any sharp edges. Roundsling, 2.5 m (4 pcs)  xx1300001572

Continues on next page

2.4.2.3 Lifting the robot with roundslings
Continued

	Action	Note
3	Attach a securing roundsling at the rear according to figure. **Note** The securing sling must not be strained at lifting. It only secures for tipping.	Length for the roundsling is given in the table *Attaching the roundslings on page 61*.  xx1300001573
4	Attach a securing roundsling at the front according to figure. **Note** The securing sling must not be strained at lifting. It only secures for tipping.	Length for the roundsling is given in the table *Attaching the roundslings on page 61*.  xx1300001574
5	**CAUTION** The IRB 6790 robot weighs 1300 kg. All lifting accessories used must be sized accordingly!	
6	**WARNING** Personnel must not, under any circumstances, be present under the suspended load!	
7	Raise the overhead crane to lift the robot. **CAUTION** Make sure that the roundsling running from the front, left corner is positioned on the correct side of the brake release unit plate when stretching the roundslings with the crane.	

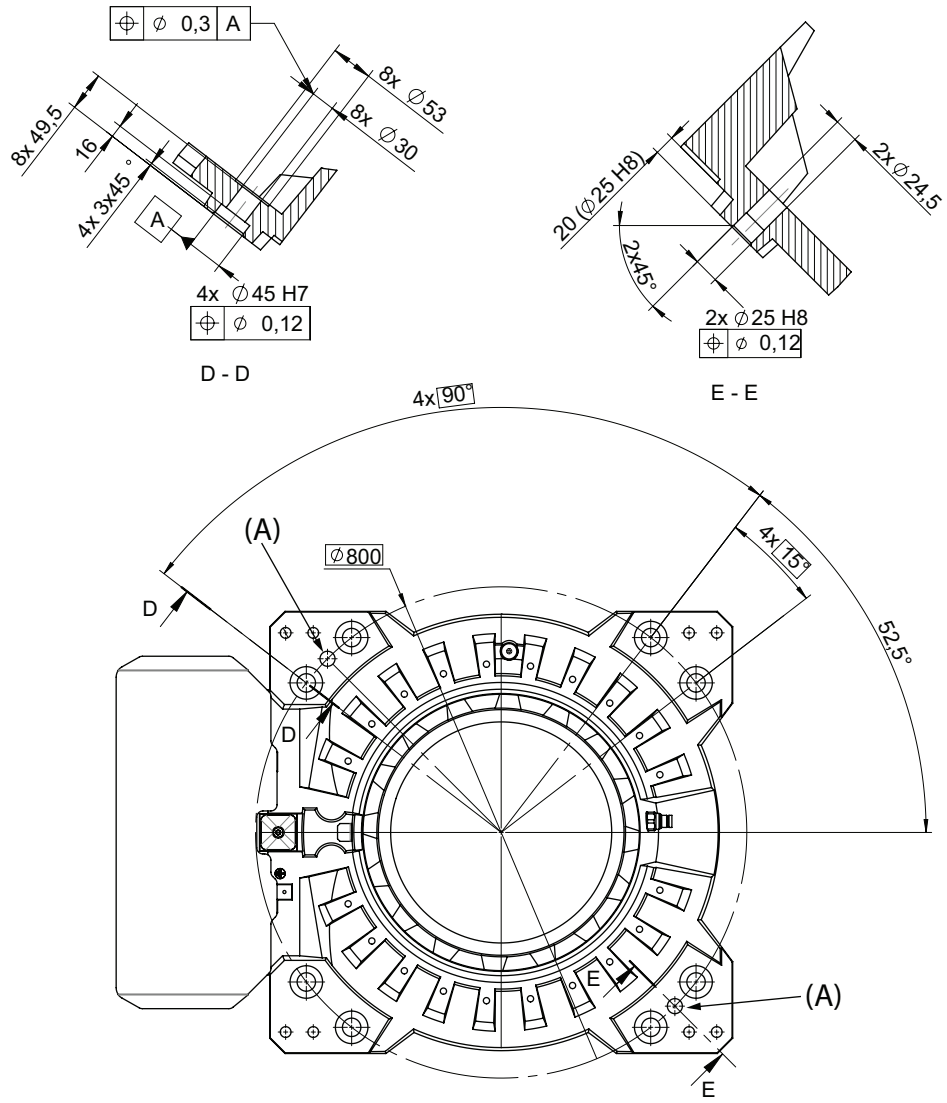
2.4.3 Orienting and securing the robot

General

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

Hole configuration, base

The figure shows the hole configuration used when positioning and securing the robot.



xx1300000243

Pos	Description
A	Holes for guide pins (x2)

3

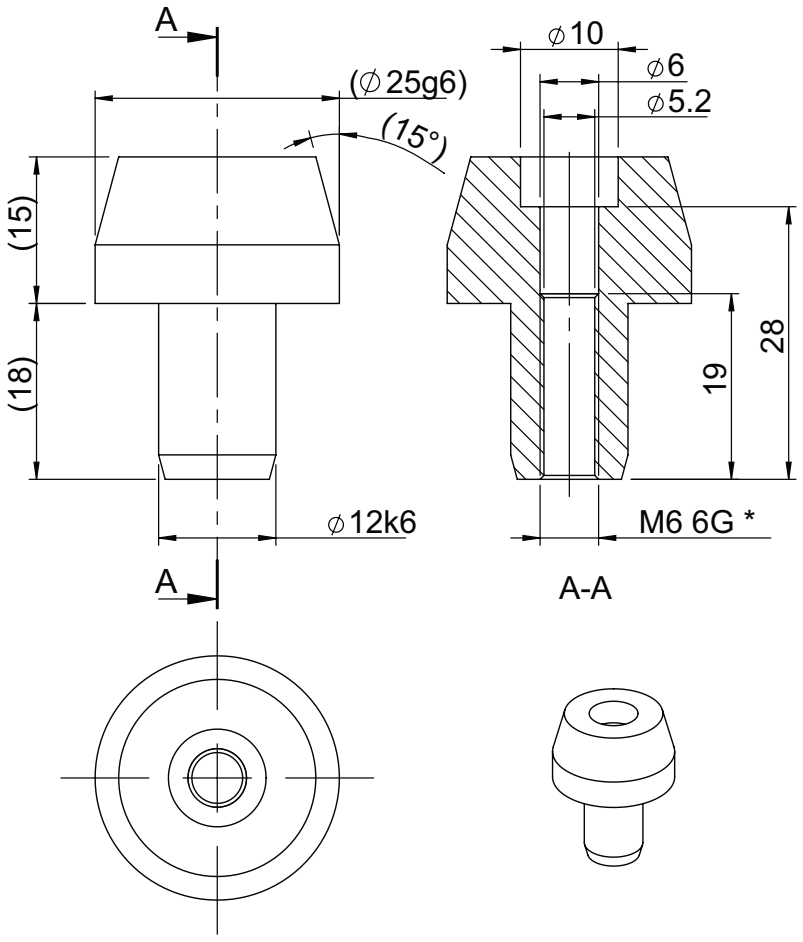
Continues on next page

2.4.3 Orienting and securing the robot
Continued

Required equipment

Guide pins

It is necessary to use guide pins when securing the robot to a base plate or a track motion.



XX1500000248

A	Cylindrical guide pin

Touch up kit for rust prevention

Equipment	Article number	Note
Touch up kit for rust prevention	3HAC088576-001	

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 or to a track motion.

When the robot is used in a corrosive environment, the securing screws and washers must be of stainless steel.

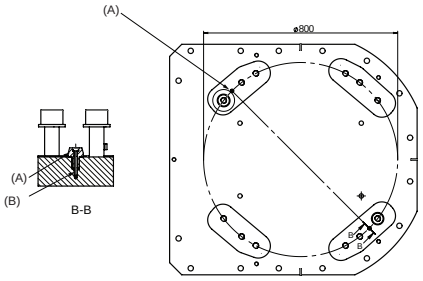
Suitable screws, lightly lubricated:	M24 x 100
Quantity:	8 pcs
Quality:	8.8

Continues on next page

Screw tightening yield point utilization factor (v) (according to VDI2230):	90% (v=0.9)
Suitable washer:	4 mm flat washer
Tightening torque:	550 Nm (screws lubricated with Molykote 1000) 600-725 Nm, typical 650 Nm (screws none or lightly lubricated)

Securing the robot to the foundation

Use this procedure to secure the robot to the foundation.

	Action	Note
1	Fit two guide pins to the guide pin holes in the base plate. **Note** All screws and pins are delivered in a plastic bag together with the base plate.	 xx1500000250 A Cylindrical guide pin (2 pcs) B M5 x 40. Tightening torque 6 Nm. (x2)
2	Lift the robot.	See *Lifting the robot with roundslings on page 61*.
3	Move robot close to its installation location.	
4	Guide the robot gently using two M24 screws while lowering it into its mounting position.	Make sure the robot base is correctly fitted onto the guide sleeves!
5	Lubricate the holes for the screws in the robot foot according to the information included in the touch up kit for rust prevention.	
6	Fit the bolts and washers in the base attachment holes.	Specified in *Attachment screws on page 66*. **Note** Lightly lubricate screws before assembly.
7	Tighten bolts in a crosswise pattern to ensure that the base is not distorted.	

2.4.4 Installation requirements for Foundry Prime robots

Introduction

Robots with protection type Foundry Prime are specially designed to work in harsh environments. To ensure that the protection offers the best reliability, special measures are required during installation and operation. It is required that the environmental and application conditions are fulfilled and that the special maintenance activities and intervals for the Foundry Prime protected robot are followed.

The motors, the balancing device, and the serial measurement board cavity must be pressurized on Foundry Prime robots during operation and shut down. The overpressure can be dropped when the temperature and humidity has reached the same level as the surrounding environment. The overpressure system, designed to detect leakage, consists of an overpressure unit and a flow sensor.

If the used detergent is assumed to damage the robot, contact ABB Support service.

Precautionary measures

Make sure that the Foundry Prime coating of the robot is not broken during testing, installation, or repair work. Use the touch up paint kit available for Foundry Prime 3 (article number 3HAC035355-001) to repair any damages in the coating.

Lubricate the cavities and gears of gearboxes

Run each axis on high speed at least once per hour. This activity will lubricate the gearbox cavities and gears, which reduces the risk for corrosion due to condensation in the gearboxes.

Information labels

No adhesive labels are placed on the robot at delivery. ABB recommends that labels are placed outside the robot cell, for example on the robot controller cabinet. If labels are required inside the robot cell, then the inside of the SMB box is also possible.

All warning labels are etched into the robot stainless steel plates.

Continues on next page

2.4.4.1 Description of the manipulator cable harness 3HAC090903-001

Note

This section describes the manipulator cable harness 3HAC090903-001, introduced in 2025. It replaces the previous cable harness, 3HAC061214-001, both as installed on new deliveries of IRB 6790 and as spare part for existing IRB 6790.

Main features and functionality

The cable harness 3HAC090903-001 differs from the previous cable harness, mainly by the following features:

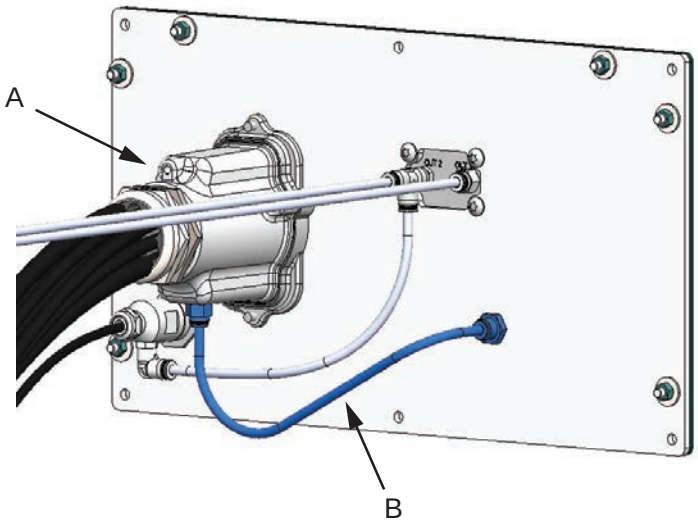
- The power cables are no longer pressurized, but instead sealed in the cable ends in the manipulator (motors, SMB cavity and wrist unit).
- Combined with changed routing of air hoses, any air that might enter the power cables is exhausted at the R1.MP connector. This minimizes harmful strain in the cable jackets.

Note

Air exhaust is only approved when cable harness 3HAC090903-001 is installed.

Illustration of air exhaust at R1.MP

The air exhaust is located at the R1.MP connector on the interface plate as shown in the figure.



xx2400001848

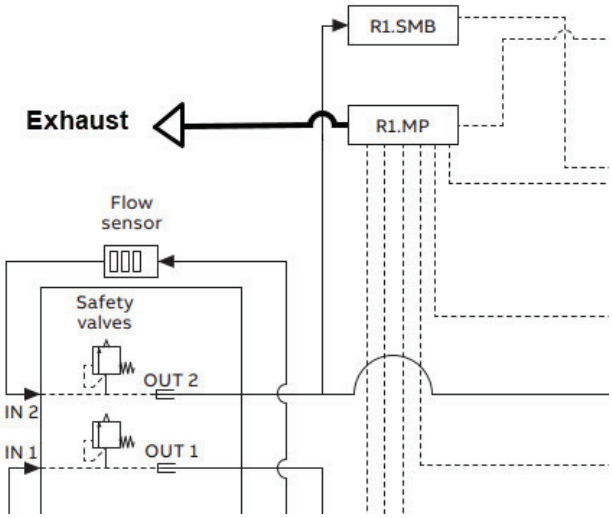
A	Power connector R1.MP
B	Air exhaust

Continues on next page

2.4.4.1 Description of the manipulator cable harness 3HAC090903-001
Continued

Flow diagram

Air exhaust function is added to the pneumatic diagram according to the figure.



xx2400001849

Spare part compatibility

The cable harness 3HAC090903-001 is the recommended spare part and is compatible with the previous harness, with some minor adaptions that are required at exchange. See document *Description and installation information - Manipulator harness - IRB 6790* in ABB Library for more information about how to exchange the cable harness. See *References on page 10* for document number.

Identification

Identify which cable harness is installed, by the article number. The number is found either at the connector R1.MP on the cable harness or in WebConfig.

New cable harness (introduced in 2025): 3HAC090903-001

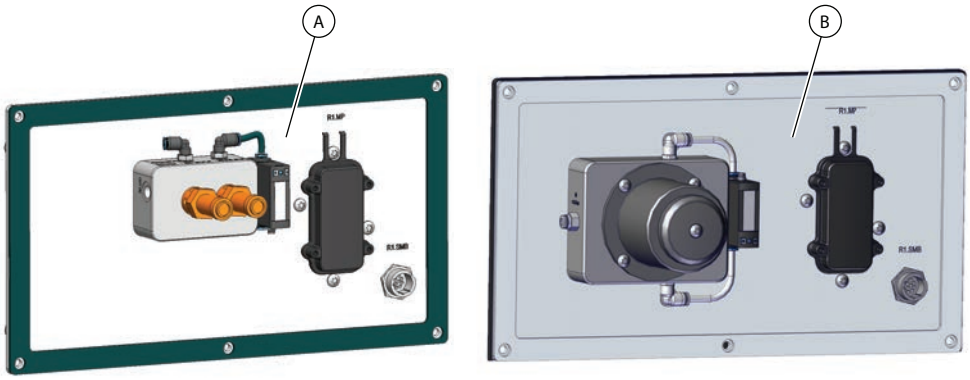
Replaced cable harness: 3HAC061214-001

2.4.4.2 Description of the overpressure system

Redesign of the overpressure system

Note

The overpressure system was redesigned as of November, 2024. Choose the correct section, depending on the design.



xx2400000735

A	The design is described in this section.
B	The design is described in section *Description of the overpressure system before November 2024 on page 78*

Continues on next page

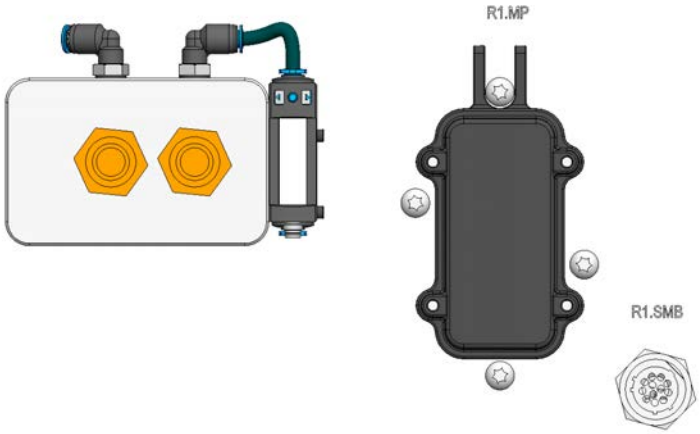
2.4.4.2 Description of the overpressure system
Continued

Overpressure unit

The overpressure unit supplies stream of air to the robot system and the balancing device. The supplied air from the regulator should be set at 0.3 bar and the internal pressure relief valve is preset to 0.4 bar. Depending on how the regulators are installed, integrated or detached, the air stream is then distributed differently. The two pressure regulators must be supplied by the customer.

Overpressure unit with detached pressure regulators

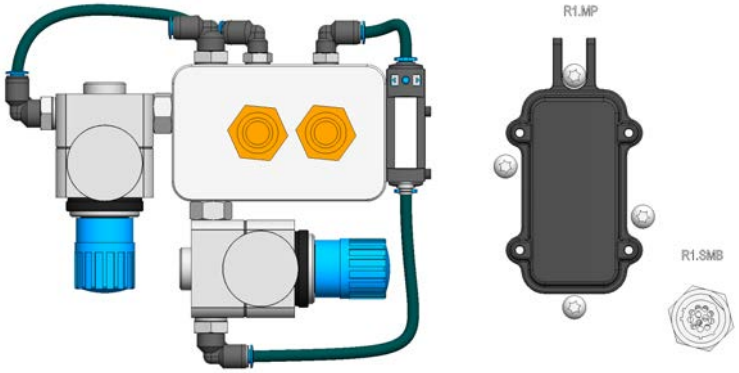
With detached regulators, the air is supplied to the robot system and the balancing device through two channels, IN (1) and IN (2). The pressurized air that is supplied to IN (2) via the flow sensor is routed to the robot system through OUT 2 and monitored by the controller. See figure and the *Overpressure diagram - with detached pressure regulators on page 76*.



xx2400000642

Overpressure unit with integrated regulators

With integrated regulators, the air is supplied to channel IN (A) and internally routed to the regulators OUT (A) and OUT (B) with a maximum of 12 bar. It is recommended to use a suitable connector to IN (A) and use double nipples to connect the pressure regulators at OUT (A) and OUT (B). The outlet from the pressure regulator at OUT (A) is to be connected to IN (1). The outlet from the pressure regulator at OUT (B) is to be connected to the inlet of the flow sensor. See figure and *Overpressure diagram - with integrated pressure regulators on page 77*.



xx2400000643

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These components are recommended when using integrated regulators:

- 2x Festo double nipples ESK 1/4-1/4
- 2x Festo precision pressure regulator LRP-1/4-0.7 with pressure gauge MAP-40 1-1/8-EN
- 3x Festo Push-in L fitting QSL-G1/4-6 Festo tube

Air leakage

There is a constant, normal, leakage in the system. The leakage value is individual for each system and is a predefined value set by ABB.

If the leakage exceeds the predefined value, the system alerts with a signal to the I/O system. If the system alerts, investigate the leakage and seal it, see *Inspecting the overpressure system on page 141* and *Repairing the overpressure leakage on page 205*.

Air pressure in the harness

Leakages or damage on the harness is monitored by the flow sensor. The air flow from the overpressure unit to the robot is terminated at R1.MP connector and at the sealed SMB cable attached to the interface plate.

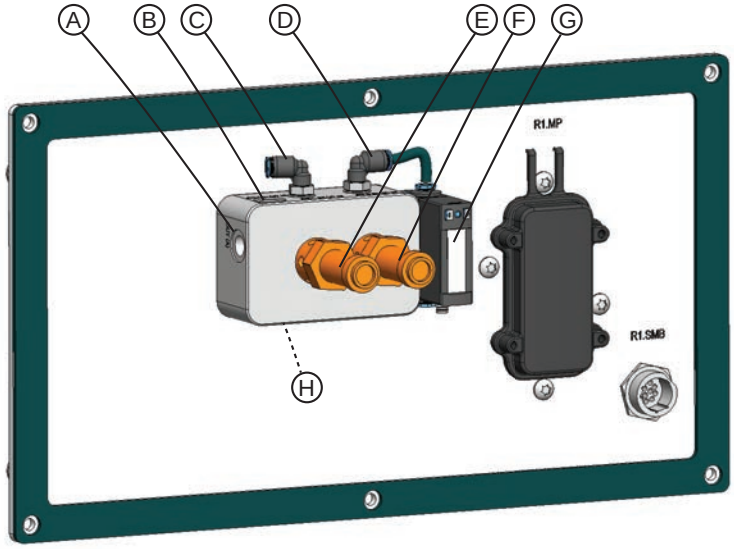
Note

The manipulator harness 3HAC090903-001 is pneumatically connected in a different way (air exhaust at R1.MP). This will exclude the power cables to influence the flow data (leakage), as they are not pressurized.

Continues on next page

2.4.4.2 Description of the overpressure system
Continued

Interface plate connection front and back



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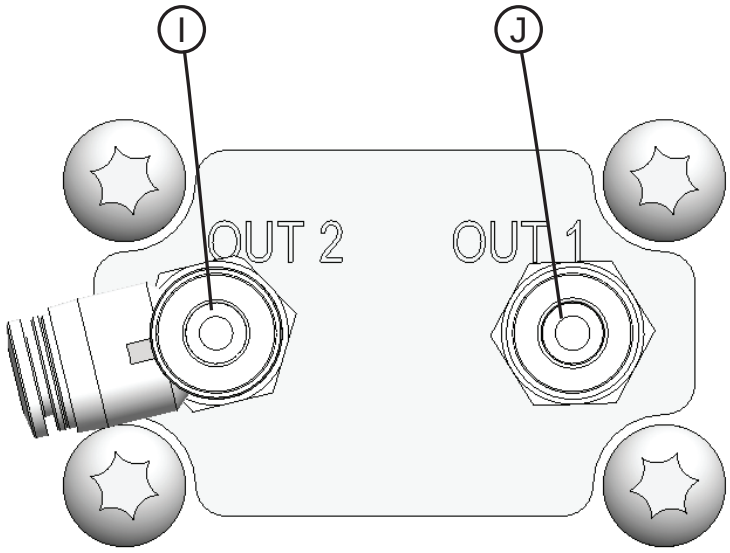

xx2400000645

A	OUT (A)
B	IN A
C	Air inlet (IN 1)
D	Air inlet (IN 2)
E	Pressure relief valve (OUT 1)
F	Pressure relief valve (OUT 2)
G	Flow sensor display
H	OUT (B) - Not visible in illustration
I	OUT 2 connection
J	OUT 1 connection

Continues on next page

Flow sensor

The flow sensor monitors the leakage and is active when the system is set to Motors On and Auto. The value of the air flow is shown on a small display. If the air flow exceeds a preset value, the flow sensor sends a switch signal to the controller. The flow sensor value is configured during installation/production using the procedure described in section *Set the flow sensor on page 86*.

Air supply requirements

The air supplied at Air Inlet of Overpressure Unit must meet the requirements stated in the table below.

Note

The two precision pressure regulators must be supplied by the customer.

WARNING

If the pressurized air contains oil, it could result in a brake failure in the motors and cause the robot arms to fall down, leading to personal injury or physical damage.

Parameter	Value
Dew point	<+2 °C at 6 bar
Solid particle size	<5 microns
Oil content	<1 ppm (1 mg/m^3)
Air flow	>100 L/min
Air pressure (into pressure regulators)	According to the pressure regulator requirements
Air pressure (after pressure regulators)	0.2-0.3 bar

Air preparation unit components

Components such as oil absorber, air dryer and pressure regulator are not included in the delivery of the overpressure system.

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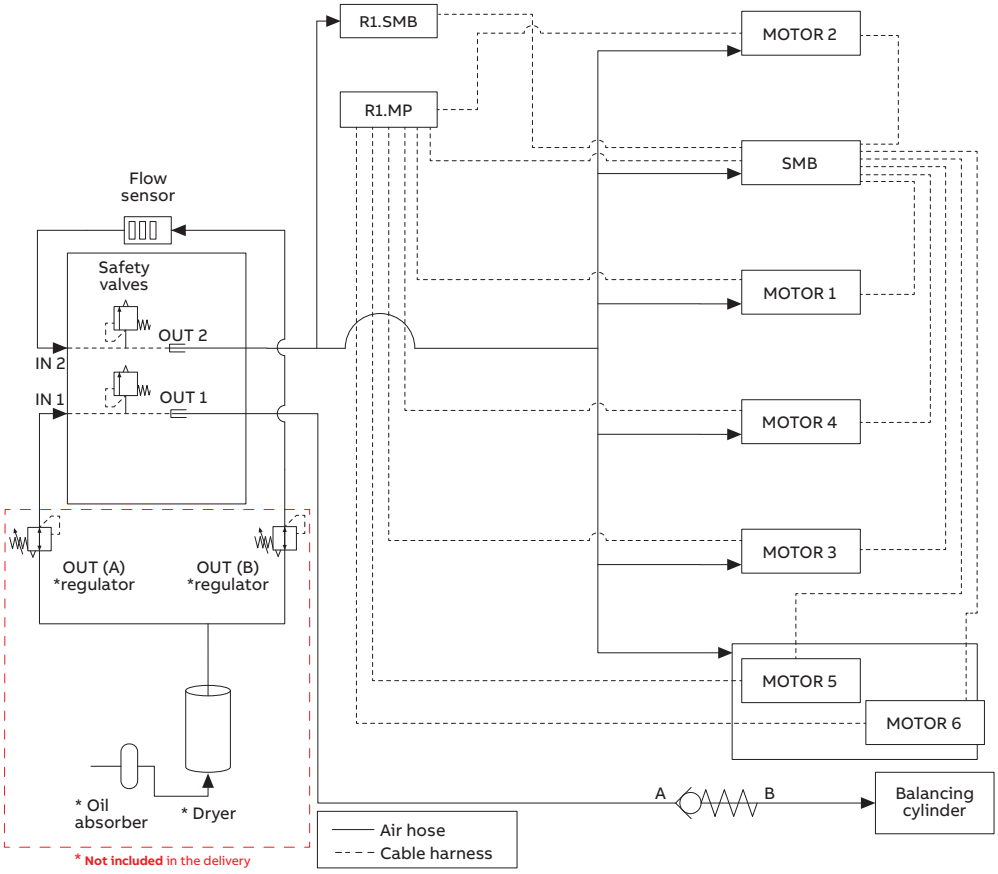
2.4.4.2 Description of the overpressure system

Continued

Overpressure diagram - with detached pressure regulators



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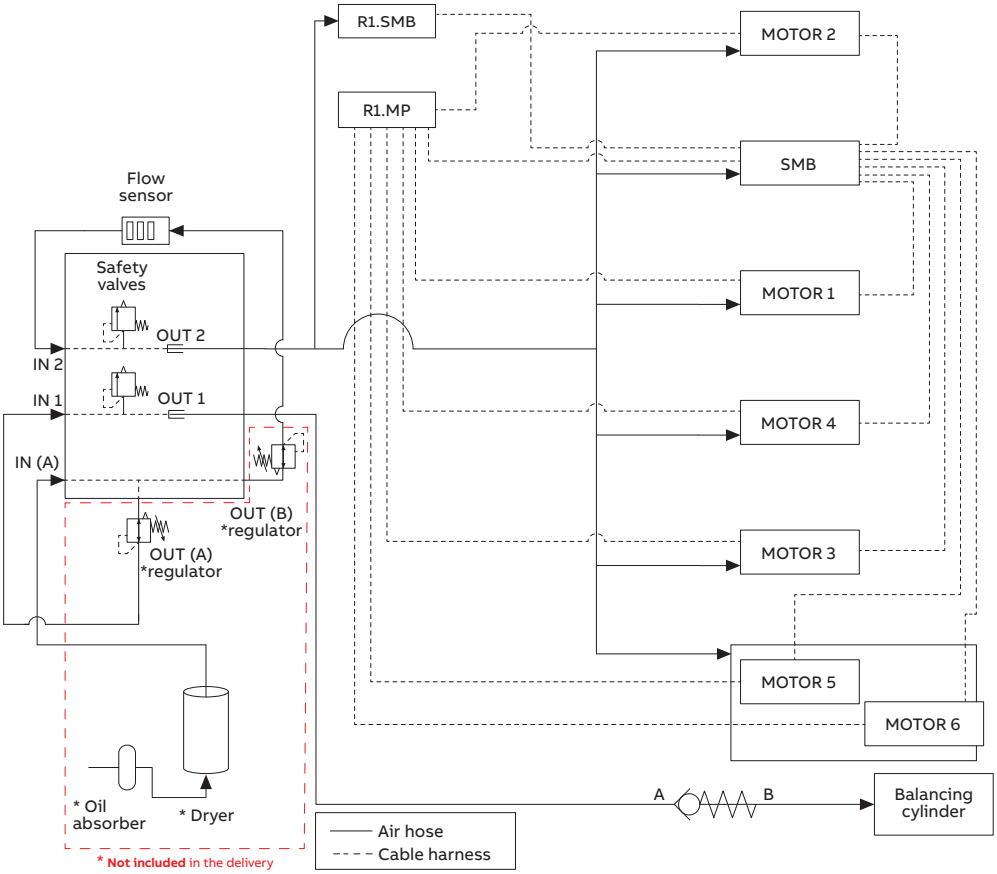
Overpressure diagram - with integrated pressure regulators



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2.4.4.2.1 Description of the overpressure system before November 2024

Note

The overpressure system was redesigned as of November, 2024. The design after the month of November 2024 is described in a separate chapter, see *Description of the overpressure system on page 71*.

Overpressure unit before November 2024

The overpressure unit supplies a stream of air at 0.3 bar gauge pressure (1.3 bar on absolute scale) which passes through a flow sensor that sends a switch signal to the controller, if the air flow exceeds a predetermined value. The flow sensor value is configured during production using the procedure described in section *Set the flow sensor on page 86*.

The overpressure unit distributes the pressurized air into two different air outlets (OUT 1 and OUT 2). One air channel (OUT 1) pressurizes the balancing unit, and the other air channel (OUT 2) pressurizes the robot system, including the harness. The flow sensor is only measuring and monitoring the flow rate related to air channel OUT 2. The pressure relief valves are set to release the air if the air exceeds 0.4 bar. See the pneumatic diagram, *Overpressure diagram on page 81*.

Air leakage

There is a constant, normal, leakage in the system. The leakage value is individual for each system and is a predefined value set by ABB.

If the leakage exceeds the predefined value, the system alerts with a signal to the I/O system. If the system alerts, investigate the leakage and seal it, see *Inspecting the overpressure system on page 141* and *Repairing the overpressure leakage on page 205*.

Air pressure in the harness

Leakages or damage on the harness is monitored by the flow sensor. The air flow from the overpressure unit to the robot and the harness is terminated at R1.MP connector and at the sealed SMB cable attached to the interface plate.

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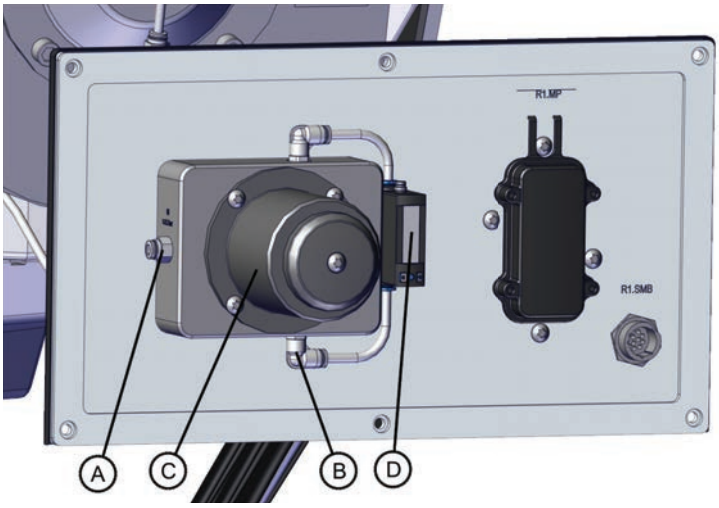
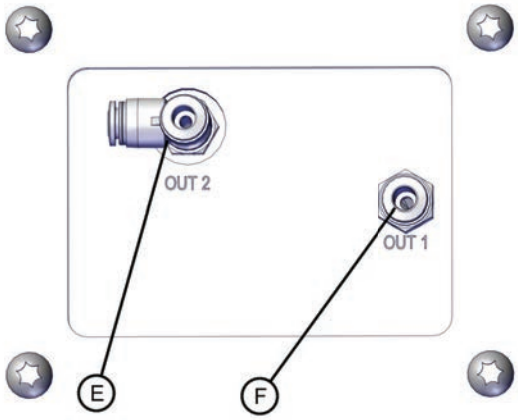
Interface plate connection front and back



xx2300001821



xx2300001822

A	Air inlet
B	Outlet air to flow sensor
C	Pressure relief valve
D	Display
E	OUT 2 connection
F	OUT 1 connection

Continues on next page

2.4.4.2.1 Description of the overpressure system before November 2024
Continued

Flow sensor

The flow sensor monitors the leakage and is active when the system is set to Motors On and Auto. The value of the air flow is shown on a small display. If the air flow exceeds a preset value, the flow sensor sends a switch signal to the controller. The flow sensor value is configured during installation/production using the procedure described in section *Set the flow sensor on page 86*.

Air supply requirements

The air supplied at Air Inlet of Overpressure Unit must meet the requirements stated in the table below. An example of pressure regulator suited for this is Festo LRP 1/4-0.7.

WARNING

If the pressurized air contains oil, it could result in a brake failure in the motors and cause the robot arms to fall down, leading to personal injury or physical damage.

Parameter	Value
Dew point	<+2 °C at 6 bar
Solid particle size	<5 microns
Oil content	<1 ppm (1 mg/m^3)
Air flow	>100 L/min

Air preparation unit components

Components such as oil absorber, air dryer and pressure regulator are not included in the delivery of the overpressure system.

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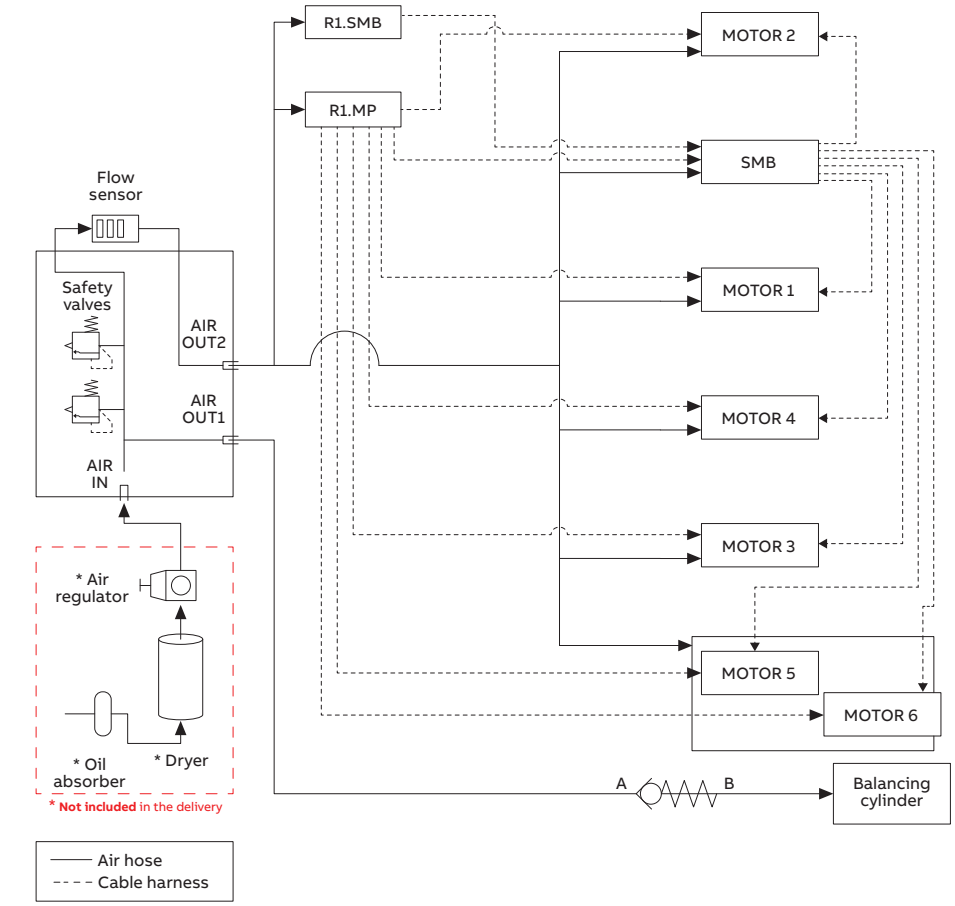
Overpressure diagram



xx1900002084

2.4.4.3 Installation requirements, procedure and guidelines

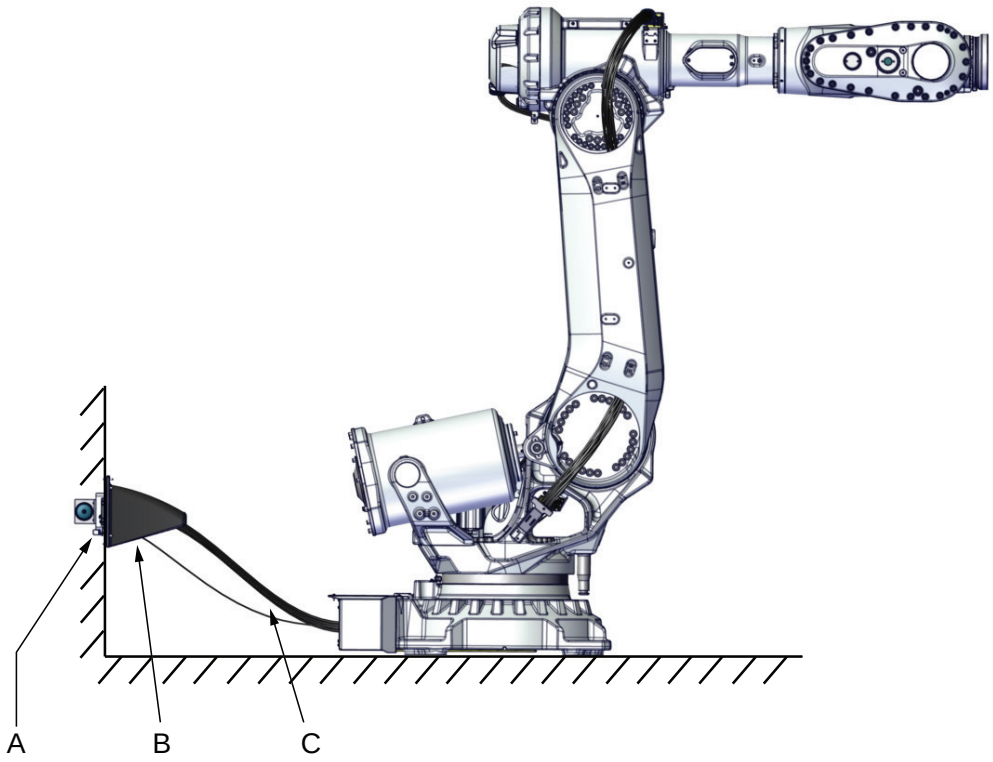
Note

This section contains information that is relevant for all different designs of the overpressure system.

Installation on a coherent and conductive structure

The manipulator must be installed on a coherent and conductive metallic structure which reaches the connector point on the wall (unbroken, to be able to connect to ground). The connector point is installed on the outside (dry) wall to protect the connectors from detergents. The flow sensor at the connection point does not withstand fluids.

Protect the interface plate from direct or indirect spray with the harness/interface cover. Put the interface plate where it is not subject to direct or indirect spray.



xx1700001180

A	Connector point / interface plate
B	Harness/interface cover
C	Cables between interface plate and manipulator base (5 m)

Continues on next page

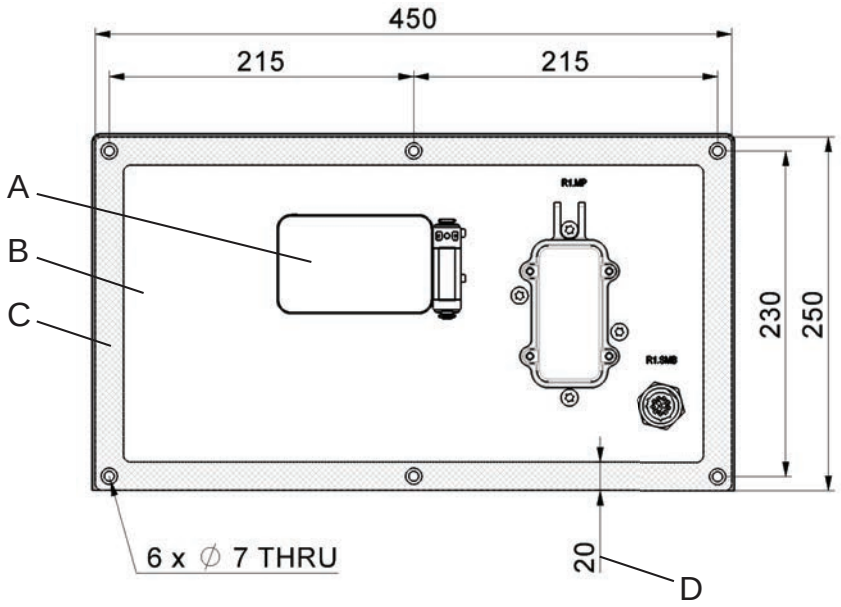
Correct placement of cables

Note

Do not run the cables connected between the interface plate and the manipulator base submerged beneath detergent solution, since that kind of extensive exposure to fluids shortens the expected life of the cables significantly.

Gasket required on the interface plate

A gasket is included in the delivery and required on the interface plate according to the figure. The proposed dimensions of the required cut in the wall is 410x210 mm.



xx2400000746

A	Overpressure unit
B	Interface plate, stainless steel
C	Gasket (attached with M6, 6 pcs)
D	Gasket width dimension

Connect the cables

Tip

For more information about the connections in the controller, see the product manual for the robot controller, listed in *References on page 10*.

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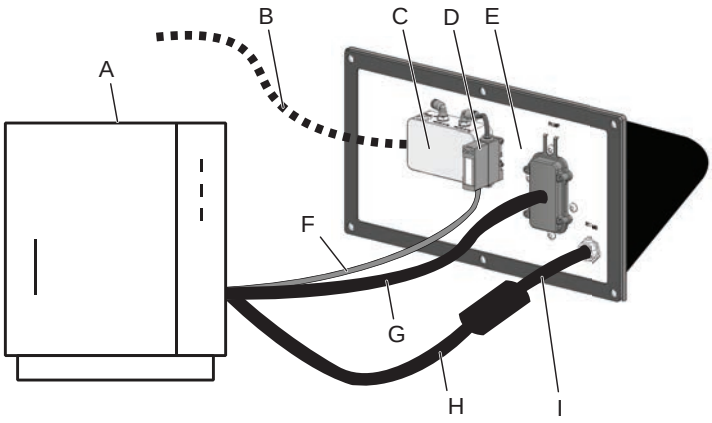
2.4.4.3 Installation requirements, procedure and guidelines
Continued



xx2400000744

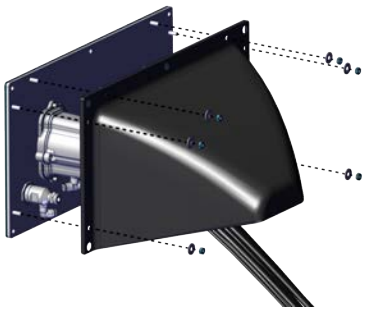
A	Robot controller
B	Air inlet (not visible in picture)
C	Overpressure unit
D	Flow sensor
E	Interface plate
F	Flow sensor cable
G	Robot cable, power
H	Control cable signal
I	Sealed signal cable, sealed (L=0.3 m)

	Action	Note
1	Connect the robot cable, power, from the cabinet to the interface plate (R1.MP).	See *Robot cables on page 105* for article numbers.
2	Connect the sealed signal cable (F) to the interface plate (R1.SMB).	
3	Connect the control cable signal (G) from the cabinet to the sealed signal cable (F).	See the product manual for the robot controller for details.
4	Connect the flow sensor cable from the cabinet (X63) to the interface plate (flow sensor).	
5	Connect the air supply according to the overpressure diagram: • For an overpressure system designed before November 2024, see *Overpressure diagram on page 81* • For an overpressure system designed after November 2024 with detached pressure regulators, see *Overpressure diagram - with detached pressure regulators on page 76* • For an overpressure system designed after November 2024 with integrated pressure regulators, see *Overpressure diagram - with integrated pressure regulators on page 77*.	

Continues on next page

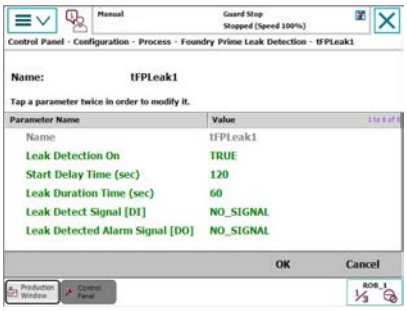
Installation of the harness/interface cover

The harness/interface cover is delivered separately with the robot. It must be installed before the robot is taken into use. It protects the connectors against direct water or chemicals.

	Action	Note
1	Remove the nuts from the studs on the interface plate.	
2	Pull the harness through the cover and fasten the cover with the nuts and the washers.	 xx1800000685

2.4.4.4 Leakage supervision system

Setup the flow supervision system in robot controller

	Action	Note
1	Configure the signal at setup via the I/O system. Set Leak Detection On to TRUE.  xx1700001401	Event log 37110 appears in cases where the signal is not set.
2	If required, setup an output signal (warning lamp etc.)	

Set the flow sensor

The procedure is needed after replacement of, for example, cable harness. All values are set in factory at delivery.

xx1900000621

A	Display
B	Navigation buttons, increase or decrease values
C	Edit button, set values and exit system menu

	Action	Note
1	Measure the initial leakage with all covers closed.	The robot has to be pressurized for 5 minutes for initial leakage to be stable.
2	If leakage is higher than 1.5 l/min, see *Repairing the overpressure leakage*.	
3	If leakage is below 1.5 l/min, note the actual leakage (actual leakage= X).	
4	Make sure that the sensor is ready for operation (RUN mode).	Screen is ON and indicates leakage values.
5	Tap Edit. **Edit** appears. **OutA** flashes.	Tap A or B for adjustments of value.

Continues on next page

	Action	Note
6	Tap Edit again. **Fctn** flashes.	Ready to choose switch function.
7	Tap **A** or **B** to select switching function.  xx1800001182	The function decides the signal switch and resets the signal.
8	Tap Edit. The value is saved.	
9	L Min/SP is shown. Set parameter with **A** or **B**, X+1.0 L.Min	Adjust set point of the signal.
10	Tap Edit. The value is saved.	Confirms value.
11	Set the hysteresis parameter with **A** or **B**, 0.5 L.min	Adjust reset point.
12	Tap Edit three (3) times. The device shows the flow display.	The screen shows the set values and exits the system.
13	Output A is set to 1 at X+1.0 l/min and set to 0 at X+0.5 l/min.	
14	Test alarm function together with controller before use.	

Handling of alarm in the overpressure system

Prerequisites: the system is set according to *Set the flow sensor on page 86*.

To get an alarm it is required that Motors On have been active for at least 120 seconds, and after that, the signal from the flow sensor has been activated (set to 1) during 60 seconds.

As soon as the Motor On disappear or the signal from flow sensor is reset to 0, the time counting start from 0 again.

Example:

Default leakage = 0.7 l/min

The alarm is set to '1' if the leakage has been minimum 1.7 l/min during 60 seconds.

The alarm is set to '0' at 1.2 l/min.

Note

The alarm is only shown in the event log by default. If other alarm handling is desired it has to be programmed.

Continues on next page

2.4.4.4 Leakage supervision system
Continued

For more information on how to detect and repair a leakage in the overpressure system, see section *Inspecting the overpressure system on page 141* and *Repairing the overpressure leakage on page 205*.

2.4.4.5 Shut-down periods

Shut-down periods

During shut-down periods the cleaning cell must be ventilated out (aired out). This reduces the risk that moister is sucked into gearboxes during cooling down. It gives the robot the possibility to dry as the rust inhibition effect normally gets reduced after some time.

Ventilate and air out the cell during and after shut-downs:

- The cell must be ventilated during shut-down until the atmospheric humidity in the cell has reached the same level as the surrounding environment.
- Will avoid that humid air is trapped into gearboxes or other cavities due to raised vacuum when cooling down.
- Will give the robot a chance to dry as most rust preventive components in washing detergents have a decaying effect, i.e. the rust preventive effect is reduced after a time. Please refer to the Product Specification of the washing detergent in question for decaying effect. Washing detergent or water without rust inhibitor can give an accelerated corrosion on some robot components.
- **The overpressure must be kept at 0.2 - 0.3 bar during 24 hours independent of Motors On/Off mode, start-up and shut-down periods**.

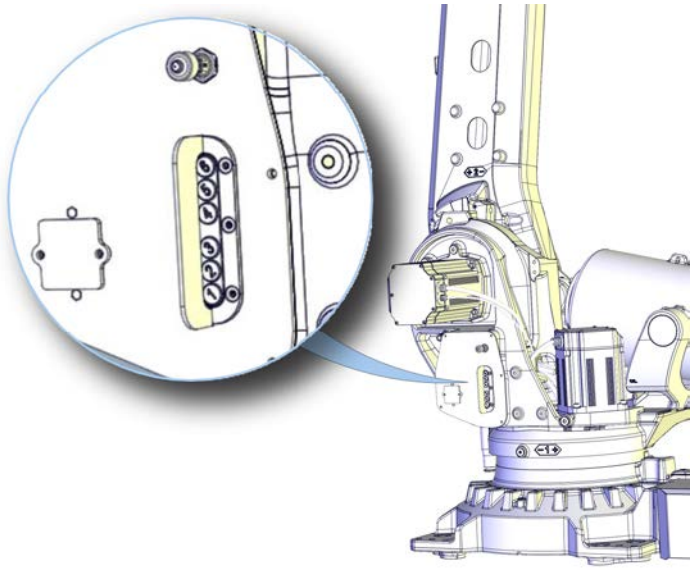
2.4.5 Manually releasing the brakes

Introduction to manually releasing the brakes

This section describes how to release the holding brakes for the motors of each axis.

Location of brake release unit

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



xx1200000964

Releasing the brakes

This procedure details how to release the holding brakes when the robot is equipped with an internal brake release unit.

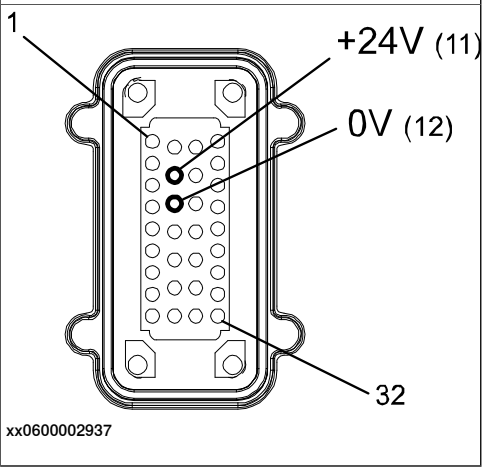
	Action	Note
1	The internal brake release unit is equipped with buttons for controlling the axes brakes. The buttons are numbered according to the numbers of the axes. If the robot is not connected to the controller, power must be supplied to the connector R1.MP according to the section *Supplying power to connector R1.MP on page 91*.	Buttons are shown in figure *Location of brake release unit on page 90*.
2	**DANGER** When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways. Make sure no personnel is near or beneath the robot.	

Continues on next page

	Action	Note
3	Release the holding brake on a particular robot axis by pressing the corresponding button on the internal brake release unit. The brake will function again as soon as the button is released.	

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!	
2	Supply 0V on pin 12 and 24V on pin 11.	 xx0600002937

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

General

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.

References

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

- *Operating manual - IRC5 with FlexPendant*
- *Operating manual - OmniCore*

Stopping time and braking distances

The performance of the motor brake depends on if there are any loads attached to the robot. For more information, see product specification listed in *References on page 10*.

2.4.7 Fitting equipment to the robot

General

Extra loads can be fitted on the upper arm housing, the lower arm, and on the frame. Definitions of distances and masses are shown in the following figures. The robot is supplied with holes for fitting extra equipment (see figure in *Holes for fitting extra equipment on page 96*). Maximum allowed arm load depends on center of gravity of arm load and robot payload.

Note

All equipment and cables used on the robot, must be designed and fitted not to damage the robot and/or its parts.

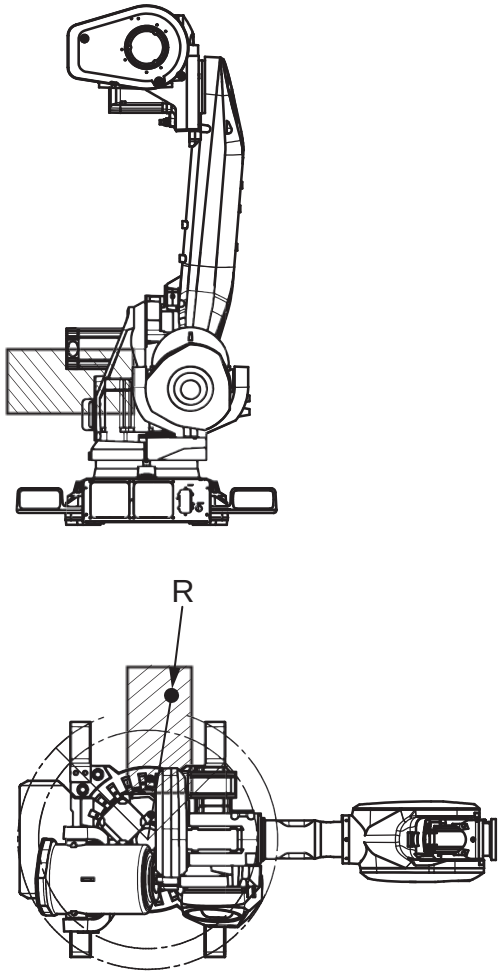
Frame (hip load)

Extra load can be fitted on the frame.

	Description
Permitted extra load on frame	$J_H = 100\ kgm^2$
Recommended position (see the following figure)	$J_H = J_{H0} + M4 \times R^2$ where: • J_{H0} is the moment of inertia of the equipment • R is the radius (m) from the center of axis 1 • M4 is the total mass (kg) of the equipment including bracket and harness (≤ 250 kg)

Continues on next page

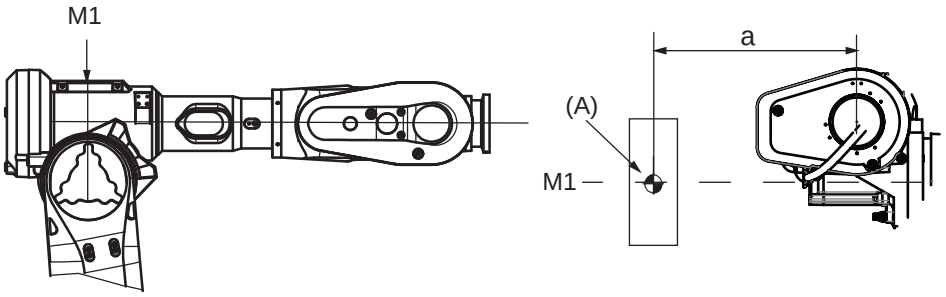
2.4.7 Fitting equipment to the robot
Continued



xx1300000262

Upper arm

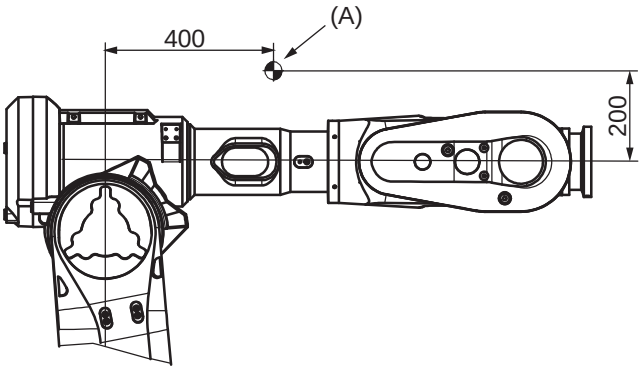
Allowed extra load on the upper arm housing, in addition to the maximum handling weight, is M1 ≤ 50 kg with a distance (a) ≤ 500 mm from the center of gravity in the axis-3 extension.



xx1400002019

A	Mass center

Continues on next page



xx1300000866

A	Center of gravity 50 kg

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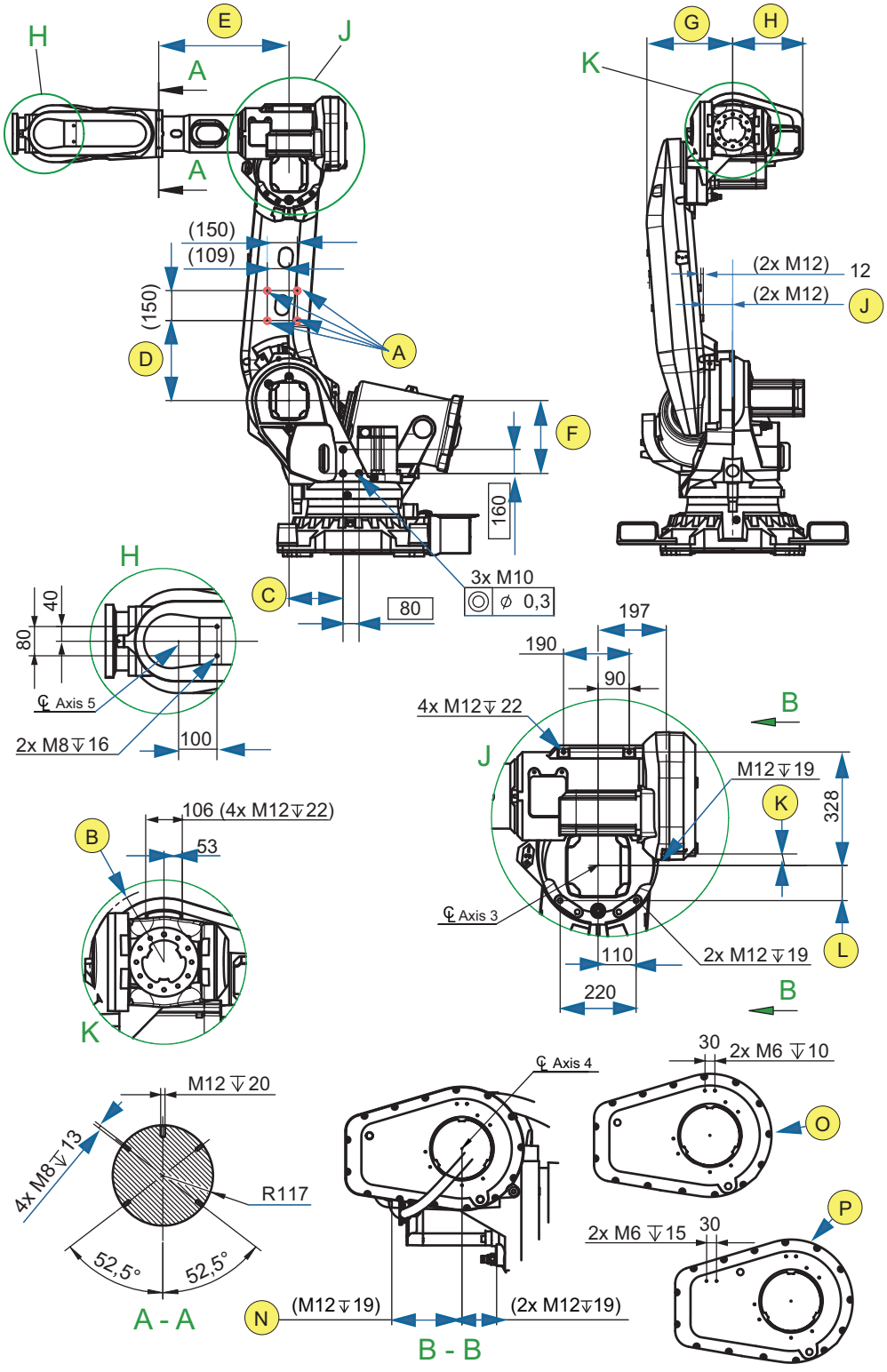
2.4.7 Fitting equipment to the robot
Continued

Holes for fitting extra equipment

Position of attachment holes - drawing 1



xx1300000263

A	Allowed position for attachment holes, M12 through. Be careful not to touch the cables when drilling.

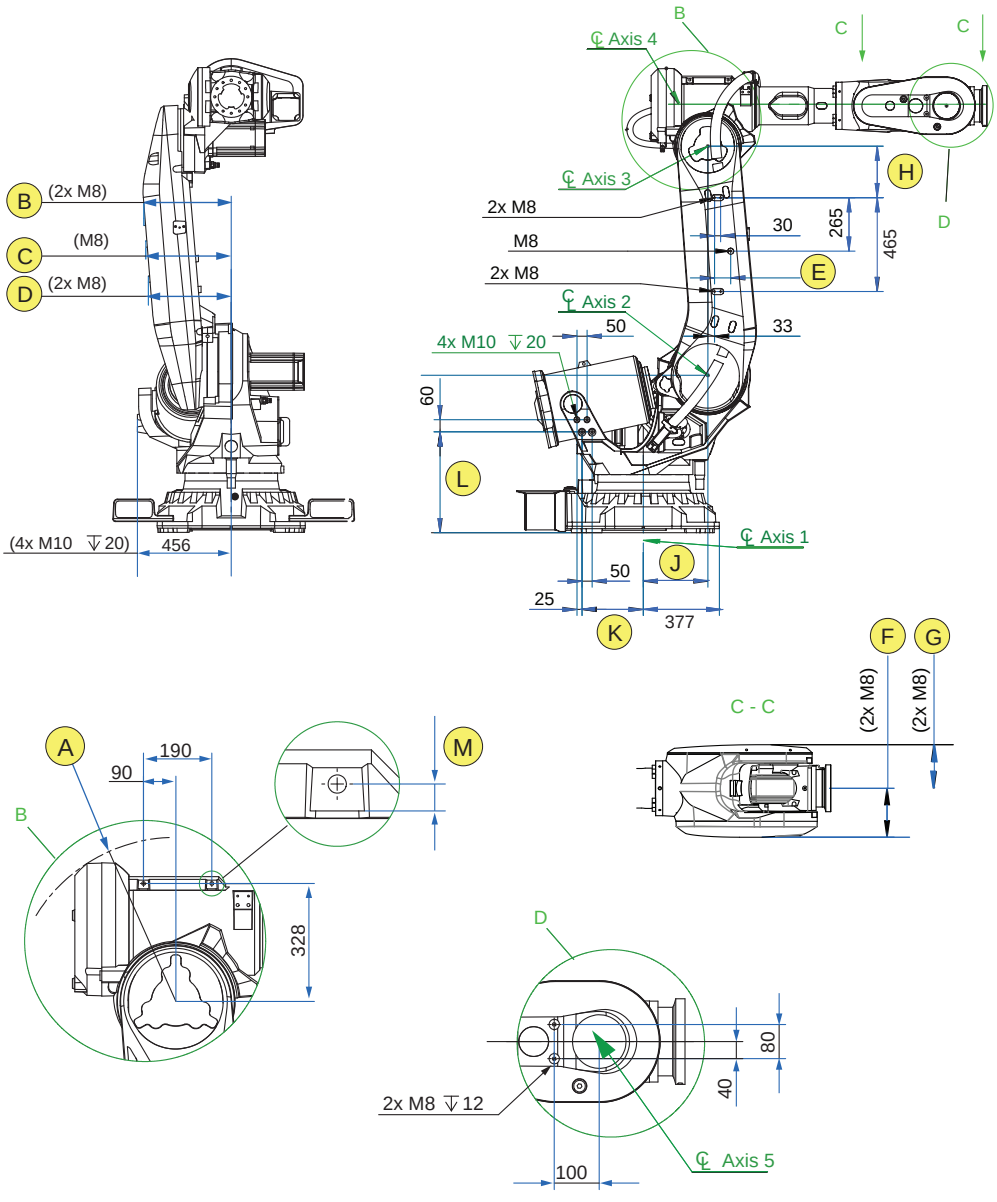
Continues on next page

O	Attachment holes on arm house cover for extra equipment IRB 6790 - 235/2.65, IRB 6790 - 205/2.80
P	Attachment holes on arm house cover for extra equipment Not valid for IRB 6790

Variant	B[i]	C	D	E	F	G	H	J	K	L	M	N
IRB 6790 - 235/2.65	R=216	270	400	652.5	365	437	349	147	33	102	104	210
IRB 6790 - 205/2.80	R=216	270	500	652.5	365	437	349	147	33	102	104	210

i Smallest circumscribed radius axis-4.

Position of attachment holes - drawing 2



xx1300000264

Variant	A[i]	B	C	D	E	F	G	H	J	K	L	M
IRB 6790 - 235/2.65	R=456	433	418	403	80	208.5	186	255	320	303.5	500	13.8

Continues on next page

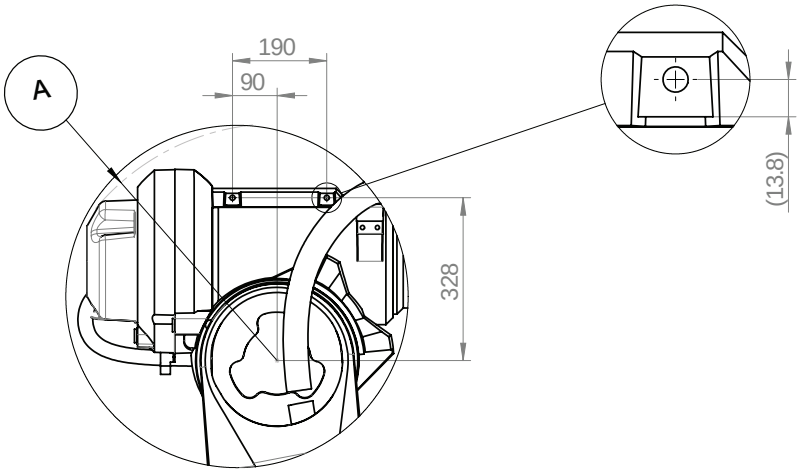
2.4.7 Fitting equipment to the robot
Continued

Variant	A[i]	B	C	D	E	F	G	H	J	K	L	M
IRB 6790 - 205/2.80	R=456	438	423	408	80	208.5	186	255	320	303.5	500	13.8

i Smallest circumscribed radius axis-3.

Extra cover

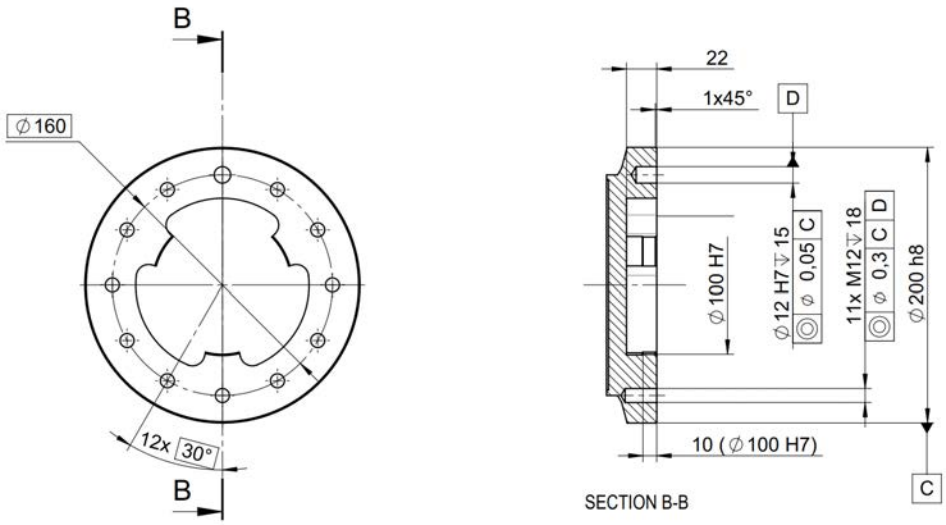
There is an extra upper arm cover for LID (LeanID) variants, which causes the value A to be different for the LID variants.



xx2100002054

Tool flange, standard

Below is the standard tool flange. The guide pin hole is, in calibration position, pointing upwards in Z-direction.



xx1700001590

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.

2.4.8 Extended working range, axis 1 (option)

Overview

The working range of axis 1 can be extended on a floor-mounted robot, from the default range limited by mechanical stops. The working range can be extended to ±220°.

CAUTION

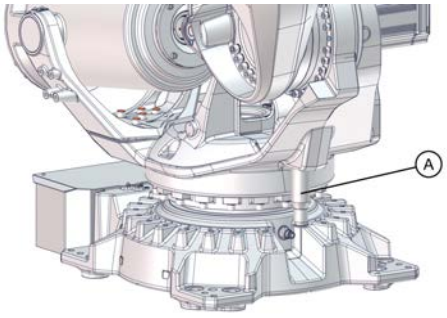
The option *Extended work range* enables an extension of the working range for axis 1, through a software configuration. With this option installed, the working range can exceed the range limited by the mechanical stop on axis 1. The working range shall be limited through the option SafeMove.

A risk analysis must be done to ensure that no risks remain when using option *Extended work range*, to limit the working range, and before removing the mechanical stops.

For information about the option SafeMove, see *Application manual - Functional safety and SafeMove2* (IRC5) or *Application manual - Functional safety and SafeMove* (OmniCore).

If the mechanical stop is removed, then the manipulator should have a marking for this, for example, a label. If the robot is delivered with the option *Extended work range*, then such a label is included on delivery.

Extending the working range

	Action	Note/Illustration
1	Configure the safety setup and verify it by test.	
2	Hold the mechanical stop pin in a firm grip, and remove it by unscrewing the attachment screw.	 xx2100001705 A Mechanical stop pin
3	In RobotWare, redefine the working range limitations in the system parameters, topic *Motion*. The *Arm* parameters *Upper Joint Bound* and *Lower Joint Bound* can be changed to the values corresponding to the actual installation.	With the option *Extended working range*, the maximum value for the system parameters *Upper Joint Bound* and *Lower Joint Bound* is 3.84 respectively -3.84. The values are in radians, that is 3.84 radians = 220 degrees.

Continues on next page

2.4.8 Extended working range, axis 1 (option)
Continued

Related information

The system parameters are described in detail in the reference manual, see *References on page 10*.

For more information about SafeMove, see *Application manual - Functional safety and SafeMove2* (IRC5) or *Application manual - Functional safety and SafeMove* (OmniCore).

2.5 On-site storage

2.5.1 Increase the lifetime of the robot

During storage

There are ways to increase the lifetime of the robot during storage after test installation (for example Factory acceptance test) and normal storage.

- Neutralize all detergents after tests or production. Lower the concentration of detergents as much as possible to reduce wear of, for example, the seals.
- Use the air purge during storage. This will keep the over-pressure in the system and reduce risks of detergents coming into motors and gears.
- The cell must be ventilated during shut-down until the atmospheric humidity in the cell has reached the same level as the surrounding environment.

2.6 Restricting the working range

2.6.1 Axes with restricted working range

General

When installing the robot, make sure that it can move freely within its entire working space. If there is a risk that it may collide with other objects, its working space should be limited.

The working range of the following axes may be restricted:

- Axis 1, hardware (mechanical stop) and software.
- Axis 2, software.
- Axis 3, software.

This section describes how to install hardware that restricts the working range.

Note

Adjustments must also be made in the robot configuration software (system parameters). References to relevant manuals are included in the installation procedures.

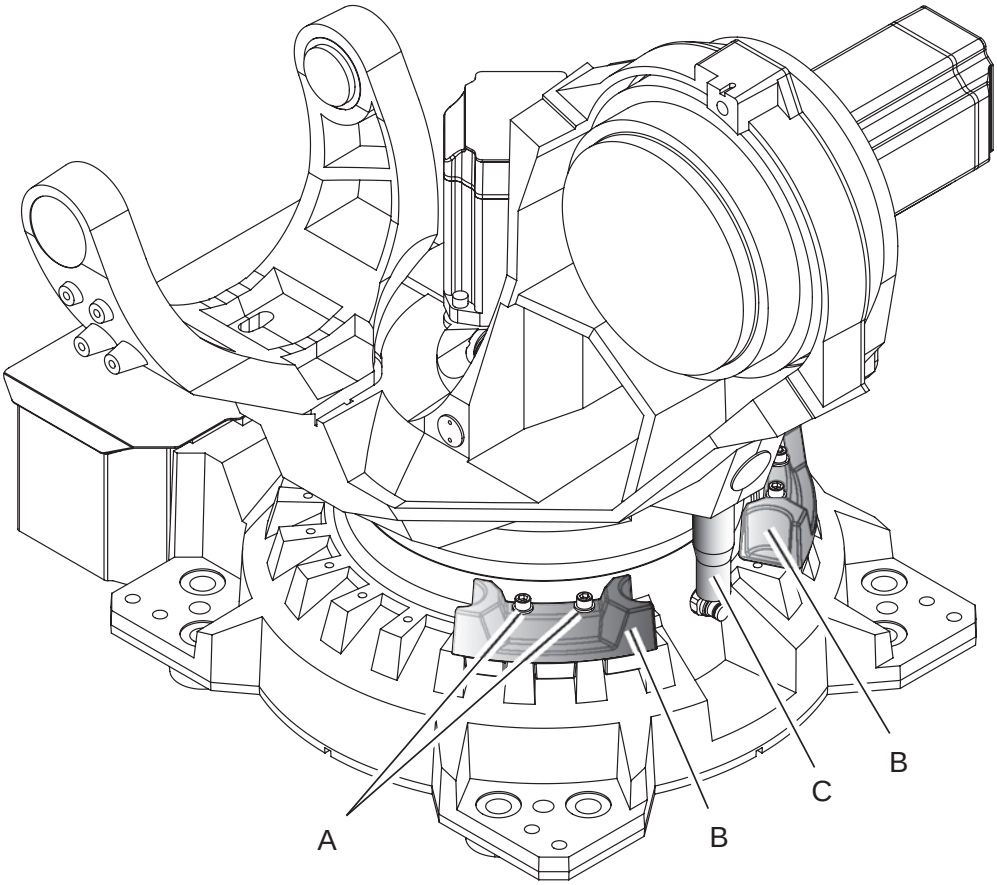
2.6.2 Mechanically restricting the working range of axis 1

General

The working range of axis 1 is limited by fixed mechanical stops and adjustment of the system parameter configuration. The working range can be reduced by adding additional mechanical stops giving 7.5 or 15 graduation, between 22.5° and 135° in both directions.

Mechanical stops, axis 1

The illustration shows the mounting position of the stop pin and one of the additional mechanical stops available for axis 1.



xx1300001971

A	Attachment screws M12x70 quality 12.9 Gleitmo 603 (2 pcs per additional mechanical stop) When the robot is used in a corrosive environment, the securing screws and washers must be of stainless steel.
B	Movable mechanical stop
C	Mechanical stop pin axis-1

Continues on next page

2.6.2 Mechanically restricting the working range of axis 1
Continued

Required equipment

Equipment, etc.	Article number	Note
Movable mechanical stop set, axis 1 (15°).	3HAC055744-001	Includes attachment screws and an assembly drawing.
Standard toolkit	-	
Technical reference manual - System parameters	-	Article number is specified in section *References on page 10*.

Installation, mechanical stops axis 1

Use this procedure to fit the additional mechanical stops to axis 1 of the robot. An assembly drawing is also enclosed with the product.

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot Before entering the robot working area.	
2	Fit the additional mechanical stop to the frame according to the figure *Mechanical stops, axis 1 on page 103*.	Tightening torque: 60 Nm.
3	Adjust the software working range limitations (system parameter configuration) to correspond to the mechanical limitations.	The system parameters that must be changed (*Upper joint bound* and *Lower joint bound*) are described in *Technical reference manual - System parameters*.
4	**WARNING** If the mechanical stop pin is deformed after a hard collision, it must be replaced! Deformed *movable stops* and/or *additional stops* as well as deformed *attachment screws* must also be replaced after a hard collision.	

2.7 Electrical connections

2.7.1 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

All cables between the robot and controller are divided into the following categories:

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

Robot cables

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

Cable sub-category	Description	Connection point, cabinet	Connection point, robot
Robot cable, power	Transfers drive power from the drive units in the controller to the robot motors.	XS1	R1.MP
Robot cable, signals	Transfers resolver data from and power supply to the serial measurement board.	XS2	R1.SMB

Robot cable, power

Power cable length	Article number
7 m	3HAC063487-001
15 m	3HAC063488-001
22 m	3HAC063489-001

Continues on next page

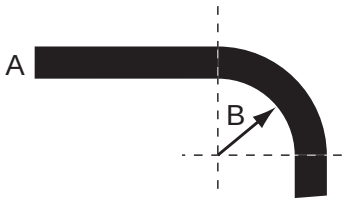
2.7.1 Robot cabling and connection points
Continued

Robot cable, signals

Signal cable length	Article number
7 m	3HAC2493-1
15 m	3HAC2530-1
22 m	3HAC2540-1
Adapter cable, signal Used between the interface plate and the robot signal cable (to the controller). Sealed signal cable, sealed (L=0.3 m)	3HAC066535-001

Bending radius for static floor cables

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



xx1600002016

A	Diameter
B	Diameter x10

Grounding point on wall

The grounding point is placed at the connector on the wall of the installation site. The grounding/bonding point is used for potential equalizing between control cabinet, manipulator and any peripheral devices.

Flow sensor cable

Connect the flow sensor cable to the controller and the flow sensor.

See *Connect the cables on page 83*.

2.8 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.

2.9 Test run after installation, maintenance, or repair

Safe handling

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

DANGER

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

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

Collision risks

CAUTION

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

3 Maintenance

3.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 6790.

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

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

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

Safety information

Observe all safety information before conducting any maintenance work.

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

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

Note

If the IRB 6790 is connected to power, always make sure that the IRB 6790 is connected to protective earth and a residual current device (RCD) before starting any maintenance work.

For more information see:

- *Product manual - OmniCore V250XT Type B*
- *Product manual - OmniCore V400XT*
- *Product manual - IRC5*
- *Robot cabling and connection points on page 105*.

3.2 Maintenance schedule and expected component life

3.2.1 Specification of maintenance intervals

Introduction

The intervals are specified in different ways depending on the type of maintenance activity to be carried out and the working conditions of the IRB 6790:

- Calendar time: specified in months regardless of whether the system is running or not.
- Operating time: specified in operating hours. More frequent running means more frequent maintenance activities.

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

3.2.2 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 113*

Activities and intervals, standard equipment

The table below specifies the required maintenance activities and intervals:

Maintenance activities	Regularly	Every 6 months	Every 12 months	Every 18 months	Every 24 months	Every 36 months	Every 12,000 hours [i]	Every 20,000 hours [i]	Every 40,000 hours [i]	Reference
Cleaning activities										
Cleaning the robot	x									*Cleaning the IRB 6790 on page 179*
Inspection activities										
Inspecting the oil level in gearboxes		x								*Inspection activities on page 114*.
Inspecting the balancing device			x							*Inspecting the balancing device on page 128*
Inspecting the robot harness			x [ii]							*Inspecting the cable harness on page 132*
Inspecting the velcro straps	x									*Inspecting the cable harness on page 132*
Inspecting the dampers			x							*Inspecting the dampers on page 139*
Inspecting the mechanical stop			x							*Inspecting the axis-1 mechanical stop pin on page 135*
Inspecting the surface treatment			x							If damaged surface is found, use touch up paint. *Painting damaged nickel coated surfaces with touch up paint on page 191*
Inspecting the overpressure system (unit)			x							

Continues on next page

3.2.2 Maintenance schedule
Continued

Maintenance activities	Regularly	Every 6 months	Every 12 months	Every 18 months	Every 24 months	Every 36 months	Every 12,000 hours [i]	Every 20,000 hours [i]	Every 40,000 hours [i]	Reference
Replacement/changing activities										
Changing the oil in axis-1 gearbox				x [iii]				x [iv]		*Changing oil, axis-1 gearbox on page 145*
Changing the oil in axis-2 gearbox				x *[iii]*				x *[iv]*		*Changing oil, axis-2 gearbox on page 150*
Changing the oil in axis-3 gearbox				x *[iii]*				x *[iv]*		*Changing oil, axis-3 gearbox on page 155*
Changing the oil in axis-4 gearbox				x						*Changing oil, axis-4 gearbox on page 160*
Changing the oil in axis-5 gearbox				x						*Changing oil, axis-5 gearbox on page 164*
Changing the oil in axis-6 gearbox				x *[iii]*				x *[iv]*		*Changing oil, axis-6 gearbox on page 168*
Replacing the SMB battery pack						x [v]				*Replacing the SMB battery on page 172*
Replacing the desiccant bag					x					*Replacing the desiccant bag on page 175*
Analyzing activities										
Analyzing the water content in gearbox oil, axes 1, 2, 3 and 6			x							NOTE: Analyze the water content when changing oil. *Analyzing the water content in gearbox oil on page 143*
Overhaul										
Overhaul of complete robot									x	

i Operating hours counted by the DTC = Duty time counter.
ii Replace when damage or cracks is detected or life limit is approaching that specified in section *Expected component life on page 113*.
iii Interval for oil change if water content in oil is not possible to measure.
iv Interval for oil change if water content in oil is possible to measure.
v The battery is to be replaced at given maintenance interval or at battery low alert.

3.2.3 Expected component life

General

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

> **Note**
>
> For expected component life of Foundry Prime robots see *Expected component life - protection type Foundry Prime on page 113*.

Expected component life - protection type Standard

Component	Expected life	Note
Cable harness Normal usage [i]	40,000 hours [ii]	Not including: • Possible SpotPack harnesses • Optional upper arm harnesses
Cable harness Extreme usage [iii]	20,000 hours [ii]	Not including: • Possible SpotPack harnesses • Optional upper arm harnesses
Balancing device	40,000 hours [iv]	
Gearboxes [v]	40,000 hours	

i Examples of "normal usage" in regard to movement: most material handling applications.
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.
iv The given life for the balancing device is based on a test cycle of 4,000,000 cycles that starts from the initial position and goes to maximum extension, and back. Deviations from this cycle will result in differences in expected life!
v The SIS for an IRC5 system is described in the *Operating manual - Service Information System*.

Expected component life - protection type Foundry Prime

The demanding nature of using Foundry Prime robots in a washing application, can shorten the life of the robot's components compared to that of standard robots in a typical robotic application. See *Expected component life - protection type Standard on page 113*for standard robots. Depending on the actual washing application, the life of an individual robot can vary or being reduced.

The life of Foundry Prime robots in washing applications will depend on a number of factors. The most important factors are:

- the washing detergent used
- the ambient environment
- installation, maintenance, and repair procedures
- the operation cycle of the robot.

3.3 Inspection activities

3.3.1 Inspecting the oil level in axis-1 gearbox

Location of oil plug

The oil plug through which the oil level is inspected is located as shown in the figure.

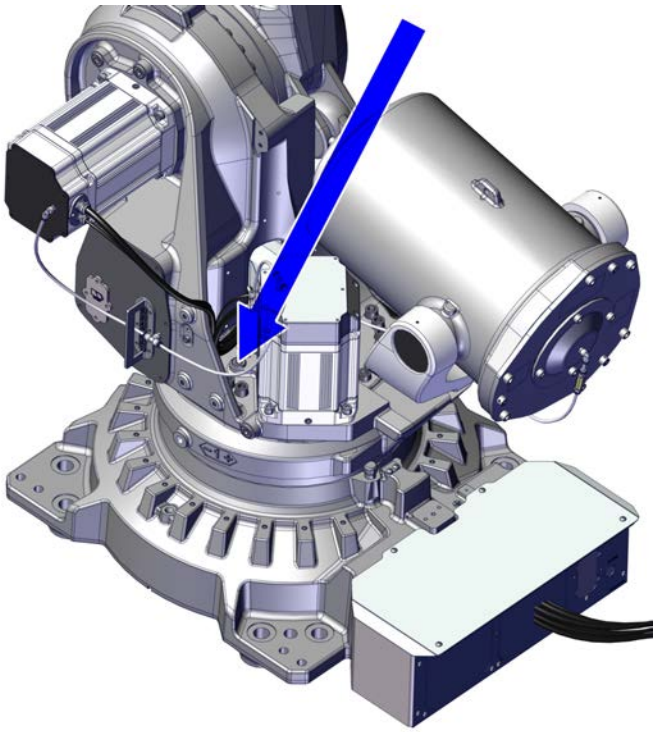


Figure 3.1:

xx2100000517

Required tools

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/2"	3HAC061327-059	Used on oil plug. Always replace when refitting oil plug.

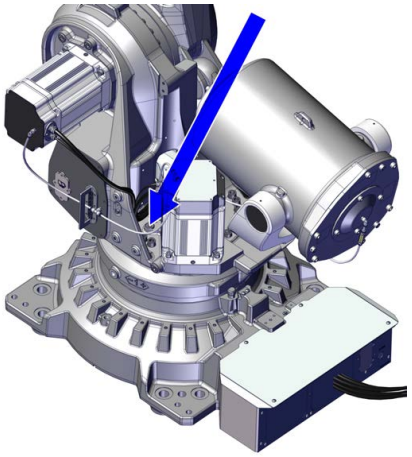
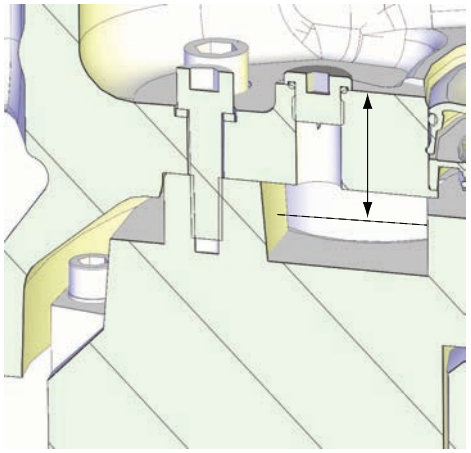
Required documents

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

Continues on next page

Inspecting the oil level in axis-1 gearbox

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

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
3	Make sure that the oil temperature is +25 °C ± 10 °C.	
4	Open the oil plug.	 xx2100000517
5	Check the oil level. Required oil level is: 58 mm ± 5 mm below the sealing surface of the oil plug.	 xx1300000692

Continues on next page

3.3.1 Inspecting the oil level in axis-1 gearbox

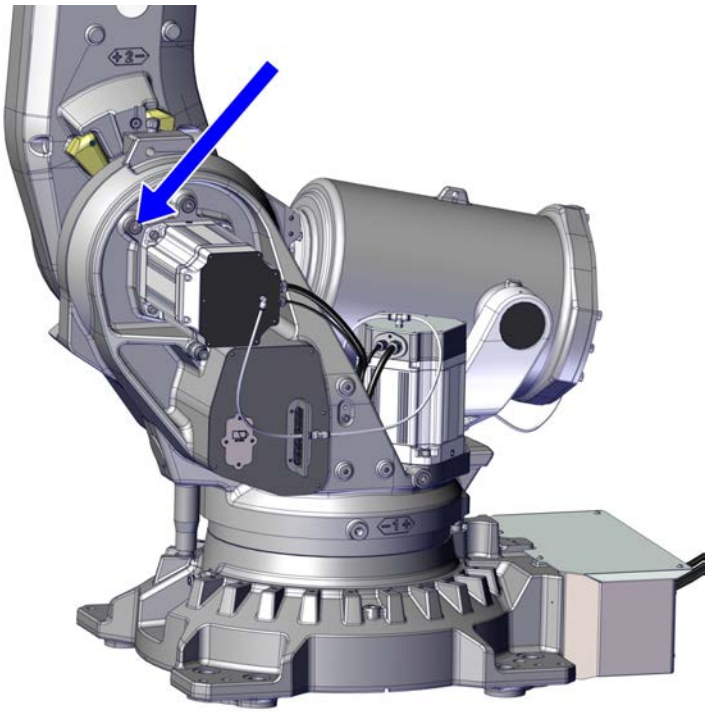
Continued

	Action	Note
6	Add or drain oil, if required.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*. Further information about how to drain or fill with oil is found in section *Changing oil, axis-1 gearbox on page 145*.
7	Refit the oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.
8	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

3.3.2 Inspecting the oil level in axis-2 gearbox

Location of the oil plug

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



xx2100000518

Required tools and equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/2"	3HAC061327-059	Used on oil plug. Always replace when refitting oil plug.

Required documents

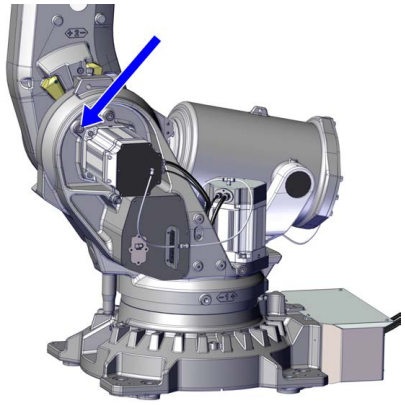
Document name	Document number
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*

Continues on next page

3.3.2 Inspecting the oil level in axis-2 gearbox
Continued

Inspecting the oil level in axis-2 gearbox

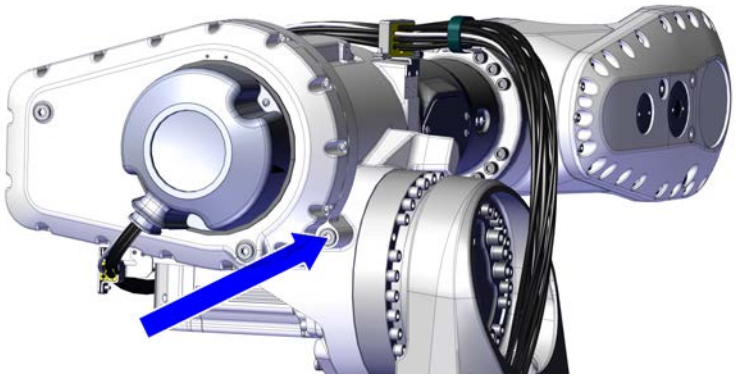
Use this procedure to inspect the oil level in the gearbox.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
3	Make sure that the oil temperature is +25 °C ± 10 °C.	
4	Open the oil plug.	 xx2100000518
5	Check the oil level. Required oil level is: 0-15 mm below the oil plug hole.	
6	Add or drain oil, if required.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*. Further information about how to drain or fill with oil is found in section *Changing oil, axis-2 gearbox on page 150*.
7	Refit the oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.
8	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

3.3.3 Inspecting the oil level in axis-3 gearbox

Location of oil plug

The gearbox has a level plug that is located as shown in the figure.



xx2100000519

Tightening torque: 24 Nm

Required tools

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/2"	3HAC061327-059	Used on oil plug. Always replace when refitting oil plug.

Required documents

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

Inspecting the oil level in axis-3 gearbox

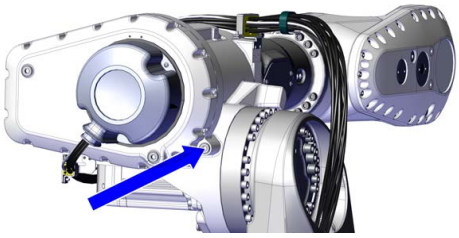
Use this procedure to inspect the oil level in the gearbox.

	Action	Note
1	Run the robot to calibration position.	

Continues on next page

3.3.3 Inspecting the oil level in axis-3 gearbox

Continued

	Action	Note
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
3	Make sure that the oil temperature is +25 °C ± 10 °C.	
4	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
5	Open the oil plug.	 xx2100000519
6	Check the oil level. Required oil level is: 0 - 20 mm below the oil plug hole.	
7	Add or drain oil, if required.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*. Further information about how to drain or fill with oil is found in section *Changing oil, axis-3 gearbox on page 155*.
8	Refit the oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.
9	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

3.3.4 Inspecting the oil level in axis-4 gearbox

Location of oil plug

The gearbox has a level plug that is located as shown in the figure.

xx2100000525

Tightening torque: 24 Nm

Required tools

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/2"	3HAC061327-059	Used on oil plug. Always replace when refitting oil plug.

Required documents

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

Inspecting the oil level in axis-4 gearbox

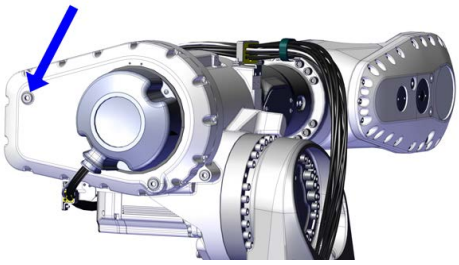
Use this procedure to inspect the oil level in the gearbox.

	Action	Note
1	Run the robot to calibration position.	

Continues on next page

3.3.4 Inspecting the oil level in axis-4 gearbox

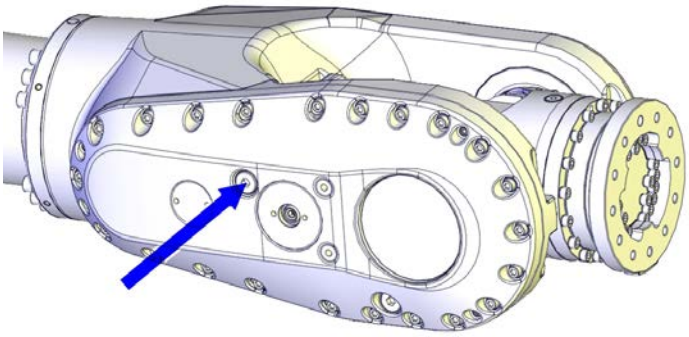
Continued

	Action	Note
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
3	Make sure that the oil temperature is +25 °C ± 10 °C.	
4	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
5	Open the oil plug.	 xx2100000525
6	Check the oil level. Required oil level is: 0 - 10 mm below the oil plug hole.	
7	Add or drain oil, if required.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*. Further information about how to drain or fill with oil is found in section *Changing oil, axis-4 gearbox on page 160*.
8	Refit the oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.
9	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

3.3.5 Inspecting the oil level in axis-5 gearbox

Location of oil plug

The gearbox has a level plug that is located as shown in the figure.



xx1200000959

Tightening torque: 24 Nm

Required tools

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/2"	3HAC061327-059	Used on oil plug. Always replace when refitting oil plug.

Required documents

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

Inspecting the oil level in axis-5 gearbox

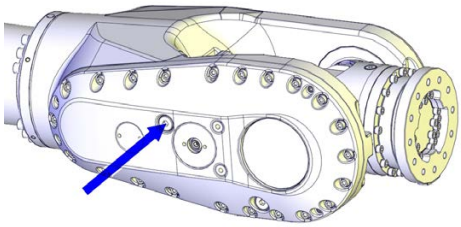
Use this procedure to inspect the oil level in the gearbox.

	Action	Note
1	Run the robot to calibration position.	

Continues on next page

3.3.5 Inspecting the oil level in axis-5 gearbox

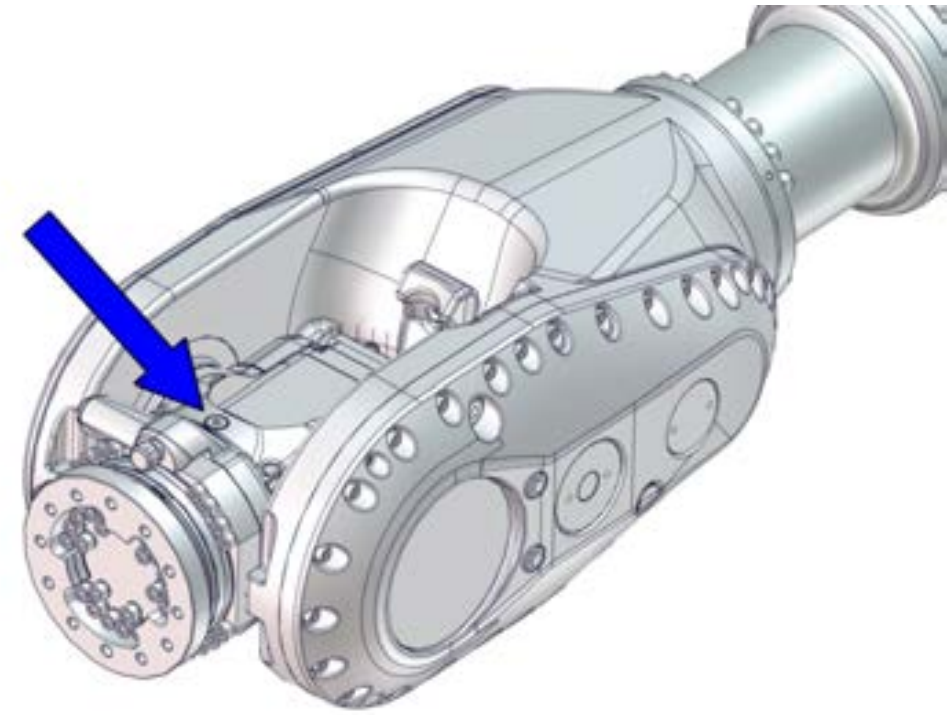
Continued

	Action	Note
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
3	Make sure that the oil temperature is +25 °C ± 10 °C.	
4	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
5	Open the oil plug.	 xx1200000959
6	Check the oil level. Required oil level is: 0 - 10 mm below the oil plug hole.	
7	Add or drain oil, if required.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*. Further information about how to drain or fill with oil is found in section *Changing oil, axis-5 gearbox on page 164*.
8	Refit the oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.
9	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

3.3.6 Inspecting the oil level in axis-6 gearbox

Location of oil plug

The oil plug through which the oil level is inspected is located as shown in the figure.



xx1600002049

Tightening torque: 20 Nm

Required tools

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/4"	3HAC061327-060	Used on oil plug. Always replace when refitting oil plug.

Required documents

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

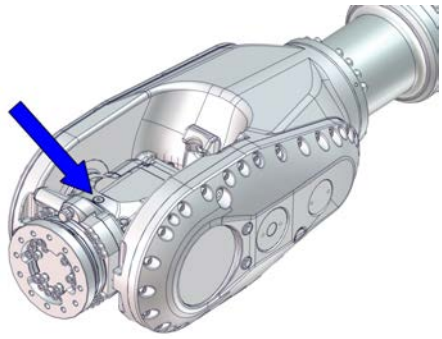
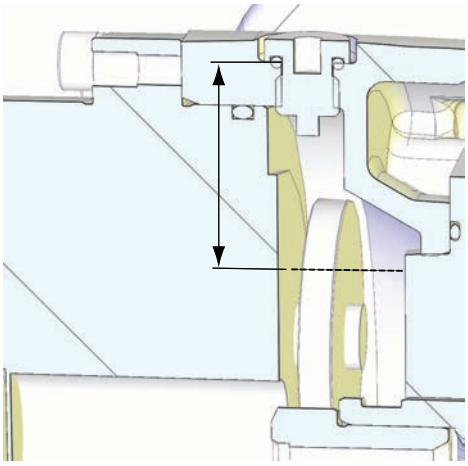
Continues on next page

3.3.6 Inspecting the oil level in axis-6 gearbox
Continued

Inspecting the oil level in axis-6 gearbox

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

The procedure includes two alternative positions for axis 5, where one of the positions makes it possible to use the filling plug as a level plug.

	Action	Note
1	Run the robot to calibration position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
3	Make sure that the oil temperature is +25 °C ± 10 °C.	
4	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
5	Open the oil plug.	 xx1600002049
6	**Method 1** Check the oil level. Required oil level is: • 50 mm ± 5 mm below the sealing surface of the oil plug.	 xx1300000693

Continues on next page

	Action	Note
7	**Method 2** Rotate axis 5 +77°. Required oil level is: 0 - 10 mm below the oil plug hole.	
8	Add or drain oil, if required.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*. Further information about how to drain or fill with oil is found in section *Changing oil, axis-6 gearbox on page 168*.
9	Refit the oil plug with a new o-ring.	O-ring, G 1/4": 3HAC061327-060 Tightening torque: 20 Nm.
10	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

3.3.7 Inspecting the balancing device

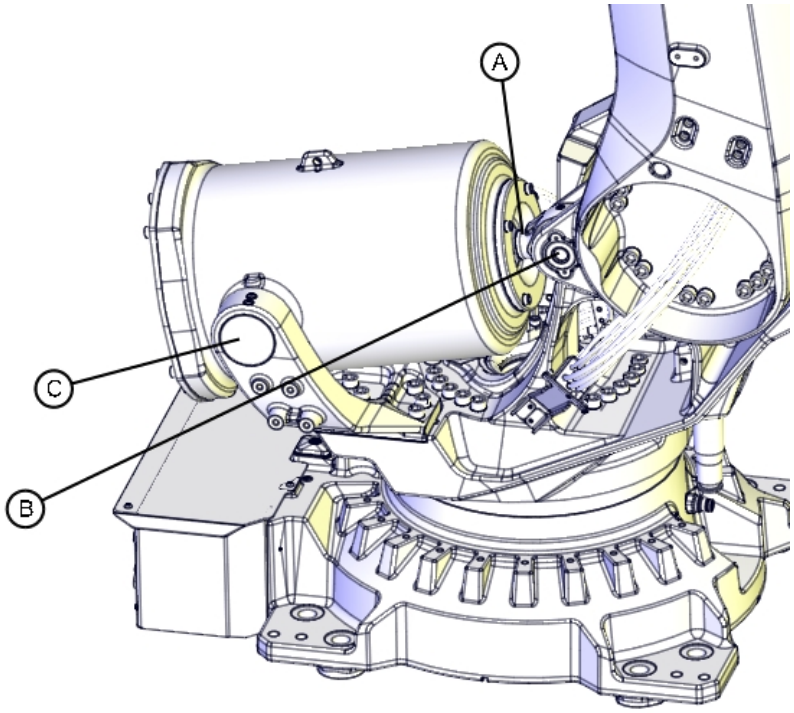
General

Several points are to be checked on the balancing device during the inspection. This section describes how to perform the inspection regarding:

- dissonance
- damage
- leakage
- contamination / lack of free space.

Inspection points, balancing device

The balancing device is located at the top rear of the frame as shown in the figure. The figure also shows the inspection points, further described in the instructions.



xx1300000413

A	Piston rod (inside balancing device)
B	Link ear
C	Rear attachments of the balancing device (cradle bearing)

Required tools

Visual inspection, no tools are required.

Required material

Equipment	Article number	Note
Maintenance kit, link ear	3HAC064119-001	The maintenance kit contains bearing grease and Loctite.

Continues on next page

Equipment	Article number	Note
Maintenance kit, cradle	3HAC064403-001	The maintenance kit contains all necessary parts to replace the bearing.

Check for dissonance

The check points are shown in the figure *Inspection points, balancing device on page 128*.

	Check points	Action
1	Check for dissonance from the bearing at the link ear and the bearings at the rear attachments.	If dissonance is detected, perform maintenance according to maintenance kits and instructions in section *Replacing spherical roller bearing, link ear on page 388* and *on page ?*.
2	Check for dissonance from the balancing device (a tapping sound, caused by the springs inside the cylinder).	If dissonance is detected, replace the balancing device or consult ABB Service. How to replace the device is detailed in section *Replacing the balancing device on page 403*. This section also specifies the spare part number.
3	Check for dissonance from the piston rod (squeaking may indicate worn plain bearings, internal contamination or insufficient lubrication).	If dissonance is detected, wipe clean the piston rod. If dissonance continues after the piston rod is cleaned, perform maintenance according to given instructions in *Maintenance kit, complete*.

Check for damage

Check for damage, such as scratches, general wear, uneven surfaces or incorrect positions.

The check points are shown in the figure *Inspection points, balancing device on page 128*.

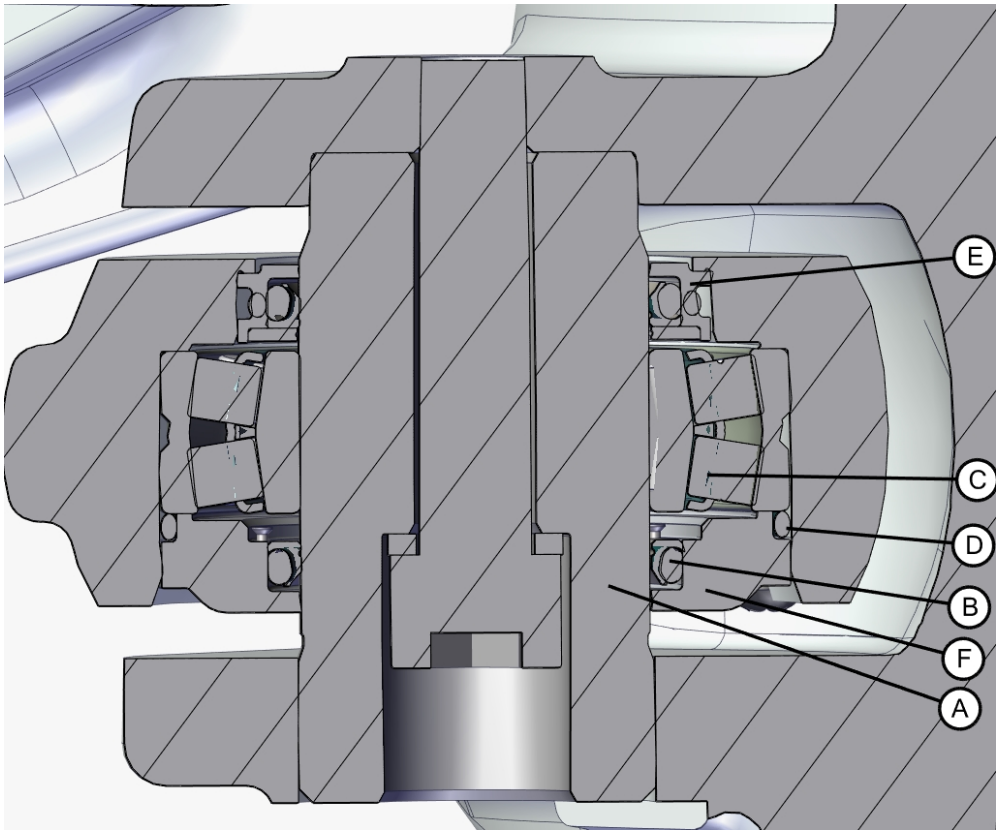
	Check points	Action
1	Check for damage on the part of the piston rod that is visible at the front of the balancing device.	If damage is detected, perform maintenance according to given instructions in Maintenance kit, complete.

Continues on next page

3.3.7 Inspecting the balancing device
Continued

Check for leakage

Leaks at o-rings, radial sealings etc. are not acceptable and must be attended to immediately to avoid damage to the bearing.



xx1700001598

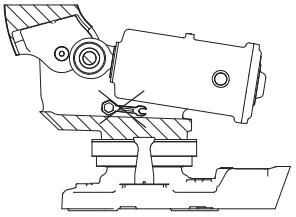
A	Shaft
B	Turcon Roto VL Seal
C	Spherical roller bearing
D	O-ring, 85x3
E	End cover
F	End cover

	Action	Note
1	Clean the area at the front ear from contamination.	
2	Run the robot for some minutes, in order to move the balancing device piston.	
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot Before entering the robot working area.	

Continues on next page

	Action	Note
4	Check the area around the o-ring and radial sealings at the front ear, for leakage.	
5	Replace o-ring and radial sealings if leaks are detected.	The o-ring and radial sealings are included in the Maintenance kit, bearings and seals already assembled with sealing spacers and sealing rings. Article number for the kit is specified in *Required material on page 128*. Replacement of the complete bearing is described in section *Replacing the balancing device on page 403*.

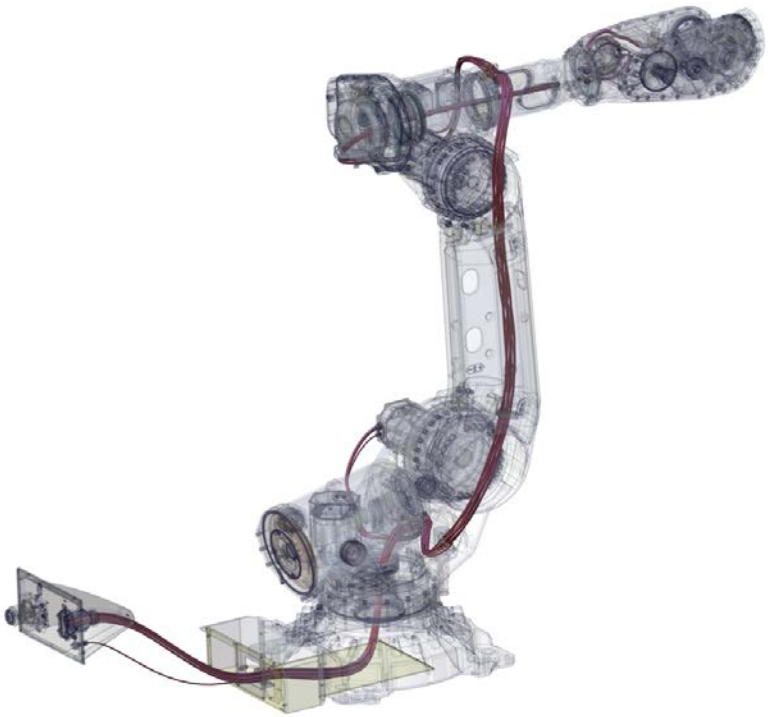
Check for contamination / lack of free space

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot Before entering the robot working area.	
2	Check that there are no obstacles inside the frame, that could prevent the balancing device from moving freely. Keep the areas around the balancing device clean and free from objects, such as service tools.	 xx1300000423

3.3.8 Inspecting the cable harness

Location of cable harness

The cable harness is located as shown in the figure.



xx1700001801

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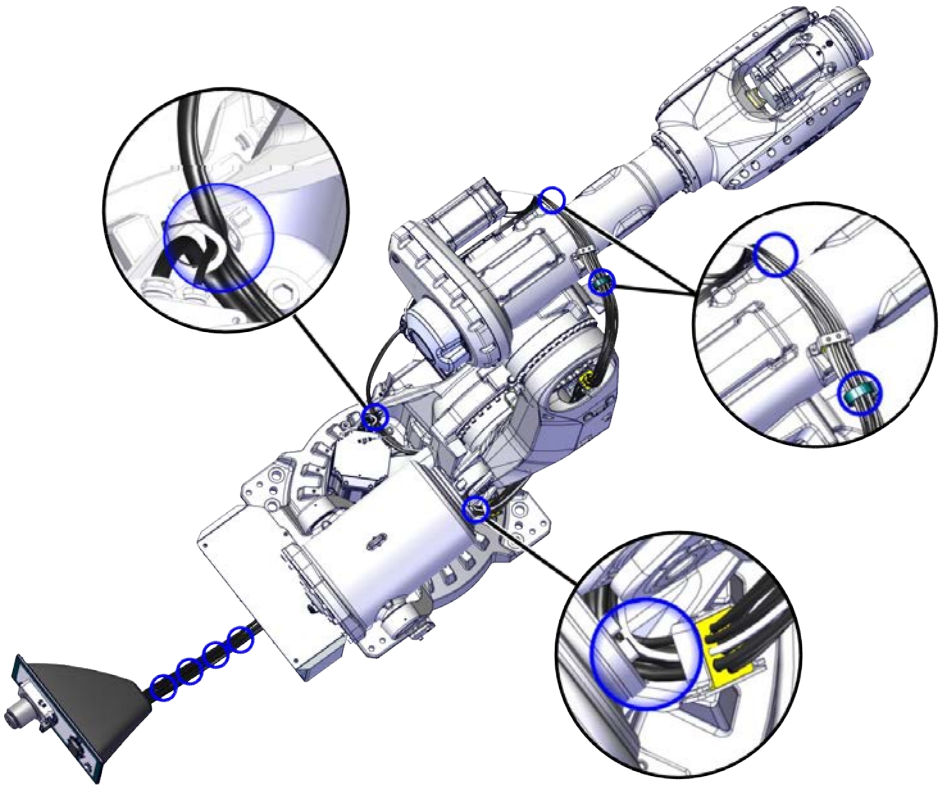
Location of velcro straps



xx2300000974

-	Velcro strap, 3HAC12625-1 (8 pcs)

Required tools

Visual inspection, no tools are needed.

Inspecting the cable harness

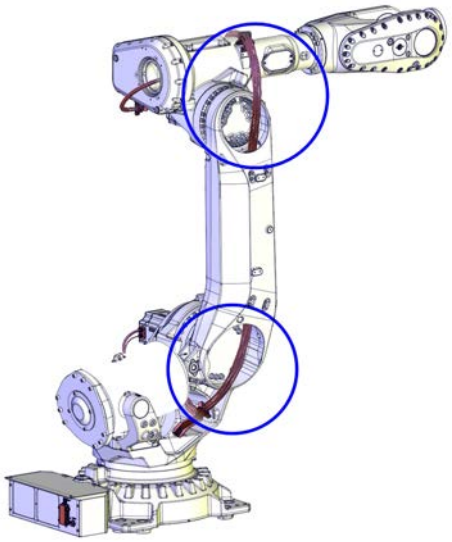
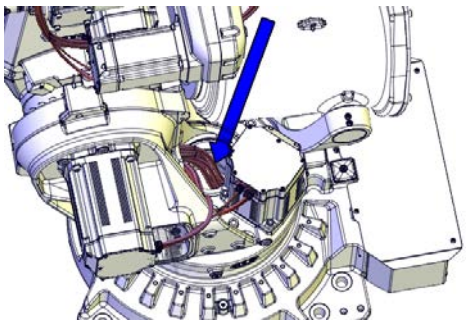
Use this procedure to inspect cable harness of axes 1-6.

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

Continues on next page

3.3.8 Inspecting the cable harness

Continued

	Action	Note
2	Make an overall inspection of the cable harness in order to detect wear and damage. Pay special attention to the areas of axis-2 and axis-3 movement, shown in the figure. Make sure the cabling is not damaged between the cable brackets in these areas.	 xx1300001095
3	Check that all visible cable brackets and attachments are properly secured, by following the cable harness from the base to the wrist.	
4	Check that all visible velcro straps are properly secured. **Note** Replace if damaged.	
5	Check the motor cables visually for any damage.	
6	Check the connectors at the base visually for any damage.	
7	Check the cabling going through the protection tube, to detect possible cable chafing, by using your hands inside the tube to feel the cables. Ensure that the cables are undamaged. Remove any objects that may cause possible cable chafing. Replace damaged cabling, if any.	 xx1300001094
8	Replace the cable harness if wear, cracks or damage is detected.	See *Removing the cable harness on page 207*.

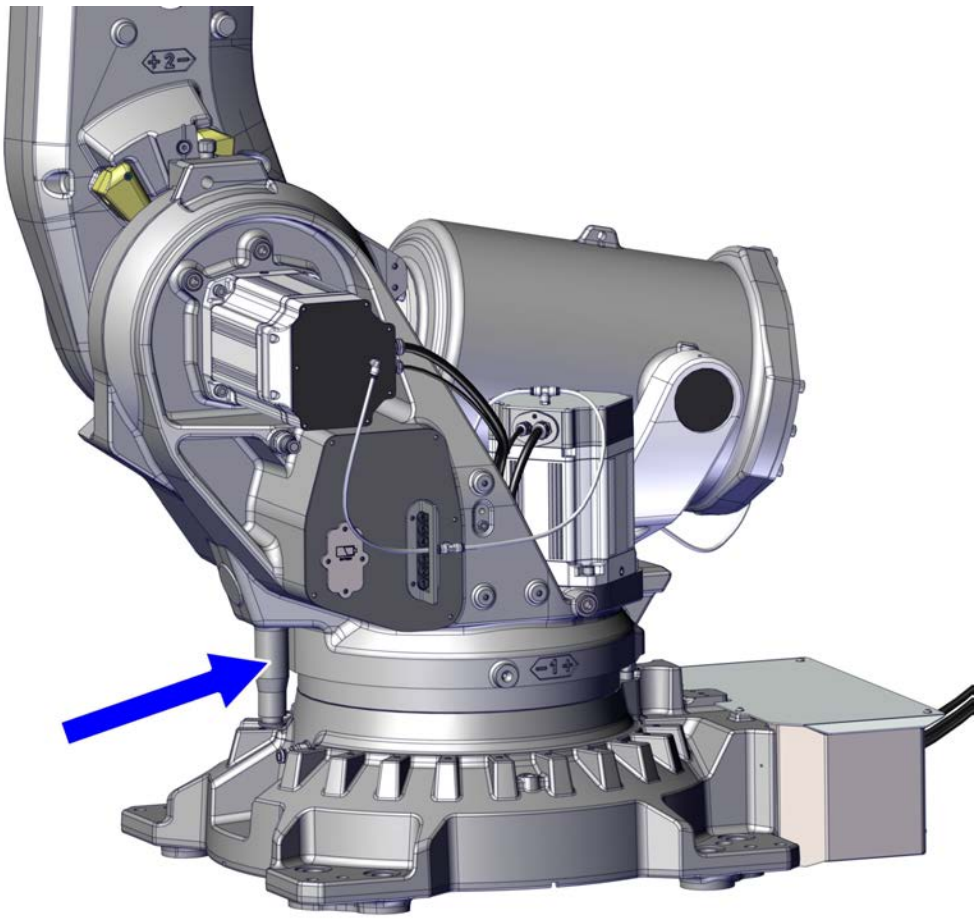
3.3.9 Inspecting the axis-1 mechanical stop pin

WARNING

Mechanical stop pin can not be fitted onto robot if the option 561-1 *Extended working range* is used for axis 1.

Location of mechanical stop pin

The axis-1 mechanical stop is located as shown in the figure.



xx1700001603

Required equipment

Visual inspection, no tools are required.

Continues on next page

3.3.9 Inspecting the axis-1 mechanical stop pin
Continued

Inspecting, mechanical stop pin

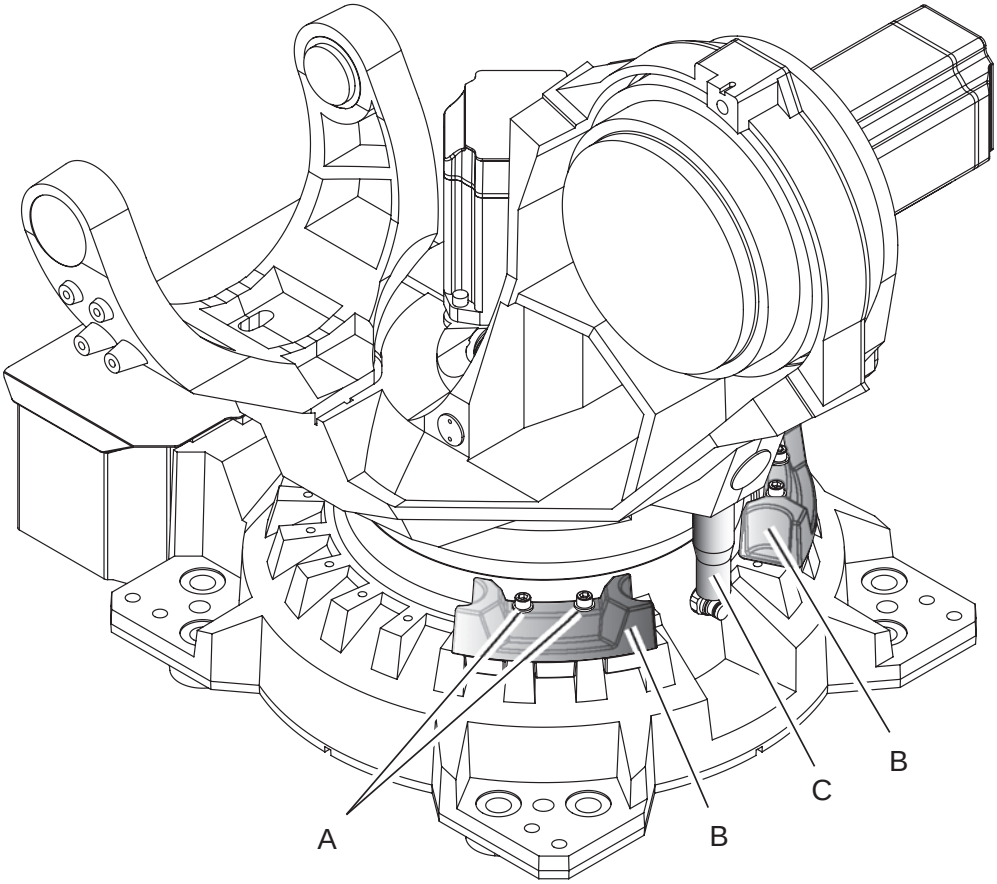
Use this procedure to inspect the axis-1 mechanical stop pin.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
2	Inspect the axis-1 mechanical stop pin. If the mechanical stop pin is bent or damaged, it must be replaced. **Note** The expected life of gearboxes can be reduced after collision with the mechanical stop.	

3.3.10 Inspecting the additional mechanical stops

Location of mechanical stops

The figure shows the location of additional mechanical stops.



xx1300001971

A	Stainless steel attachment screws M12x70 and stainless steel washers (2 pcs per additional mechanical stop)
B	Movable mechanical stop
C	Mechanical stop pin axis-1

Required equipment

Equipment etc.	Article number	Note
Movable mechanical stop axis 1	3HAC064612-001	Limits the robot working range by 15°. Includes attachment screws and an assembly drawing. • Mechanical stop • Attachment screws stainless steel M12x70 and stainless steel washers • Document for mechanical stop
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Continues on next page

3.3.10 Inspecting the additional mechanical stops
Continued

Inspecting, mechanical stops

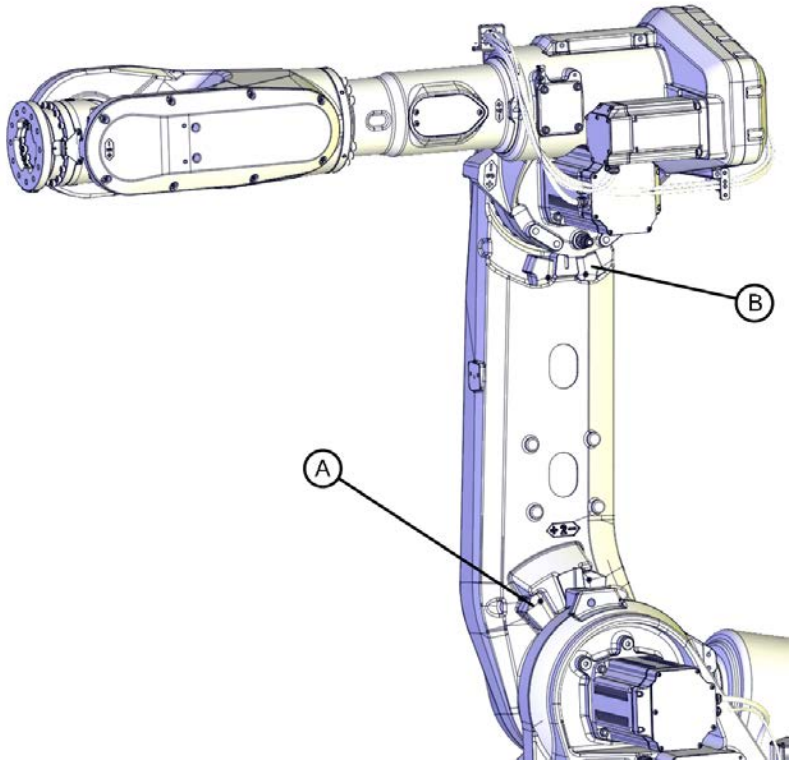
Use this procedure to inspect the additional mechanical stops.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	Make sure no additional stops are damaged.	Shown in figure *Location of mechanical stops on page 137*.
3	Make sure the stops are properly attached. Correct tightening torque, additional mechanical stops: • Axis 1 = 60 Nm.	
4	If any damage is detected, the mechanical stops must be replaced. Correct attachment screws: • Stainless steel M12x70 and stainless steel washers (2 pcs per additional mechanical stop)	Article number is specified in *Required equipment on page 137*.

3.3.11 Inspecting the dampers

Location of dampers

The figure below shows the location of all the dampers to be inspected.



xx1300000414

A	Axis-2 damper, 2 pcs
B	Axis-3 damper, 2 pcs

Required equipment

Visual inspection, no tools are required.

Inspecting, dampers

The procedure below details how to inspect the dampers.

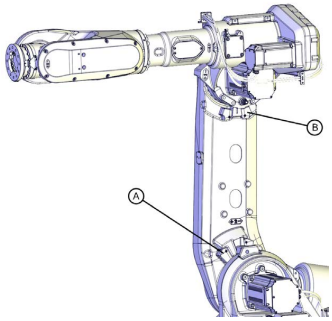
Note

A damaged damper must be replaced.

Continues on next page

3.3.11 Inspecting the dampers

Continued

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot Before entering the robot working area.	
2	Check all dampers for damage, cracks or existing impressions larger than 1 mm.	 xx1300000414 A – Axis-2 damper, 2 pcs B – Axis-3 damper, 2 pcs
3	Check attachment screws for deformation.	
4	If any damage is detected, the damper must be replaced with a new one. Attachment screws: M6x60. Locking liquid: Loctite 2400 (or equivalent Loctite 243).	Spare part number is found in *Product manual, spare parts - IRB 6700/IRB 6700Inv*.

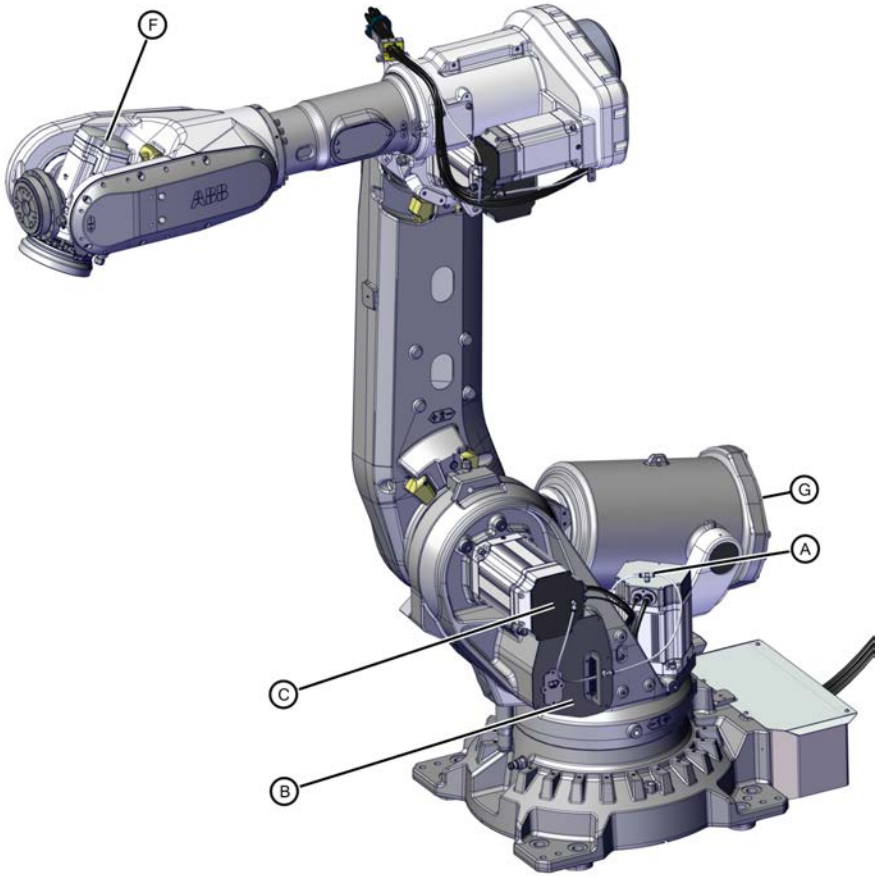
3.3.12 Inspecting the overpressure system

General

There is a constant overpressure in the Foundry Prime system, to avoid dirt or chemicals inside the robot. It is necessary to check the overpressure every 12 months to ensure correct function.

Inspection points

The following points on the robot must be inspected.



xx1700001382

A	Motor cover axis 1
B	Battery cover
C	Motor cover axis 2
D	Motor cover axis 3
E	Motor cover axis 4
F	Motor cover axis 6
G	Connection to balancing device

Continues on next page

3.3.12 Inspecting the overpressure system

Continued

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Inspecting the overpressure system

Use this procedure to inspect that there is no blockage of the air flow in the overpressure system.

	Action	Note
1	**CAUTION** Make sure that all supplies for electrical power are turned off. **DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Check the flow value on the flow sensor. If the flow value exceeds 1.5 l/min, see *Repairing the overpressure leakage*.	Note the value to be able to compare to the following values.
3	Loosen the cover and check if the flow value increases on the sensor before closing the cover. Perform this for all the following covers, one cover at each time: 1 Axis-1 motor cover 2 Battery cover 3 Axis-2 motor cover 4 Axis-3 motor cover 5 Axis-4 motor cover 6 Axis-6 motor cover 7 Wrist housing cover If the value on the flow sensor does not increase when opening the covers then the reason can be a hose that is blocked or disconnected, or a leakage within the overpressure system. For information on how to repair a leakage, see *Repairing the overpressure leakage*.	The flow value shall increase when opening each cover and return to starting value when closing the covers.
4	Perform a visual inspection of the connection to the balancing device.	

3.4 Analyzing activities

3.4.1 Analyzing the water content in gearbox oil

Analysis of the water content

It is recommended to check for water content in the oil every 12 month.

> **Note**
>
> When the oil is analyzed for water, the oil level must also be checked. See *Inspection activities on page 114*.

Recommendations

Recommendations for oil in axes 1, 2, 3 and 6

If water content is:

- 0-1.5 vol %; measure water content in oil again after 12 months of operation
- 1.5- 2 vol %; change oil in gear latest within 12 months
- >2 vol %; change oil in gear latest within 6 months
- >3 vol %; it is recommended to replace the gearbox, see *Gearboxes on page 523*

If water content in oil remains <1.5 vol %; change oil at latest after 20 000 hours of operation.

Recommendations for oil in axes 4 and 5

No oil analysis is nesessary. Change oil periodically, at latest every 18 months.

3.5 Replacement/changing activities

3.5.1 Type of lubrication in gearboxes

Introduction

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

Type and amount of oil in gearboxes

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

Location of gearboxes

The figure shows the location of the gearboxes.

Equipment

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

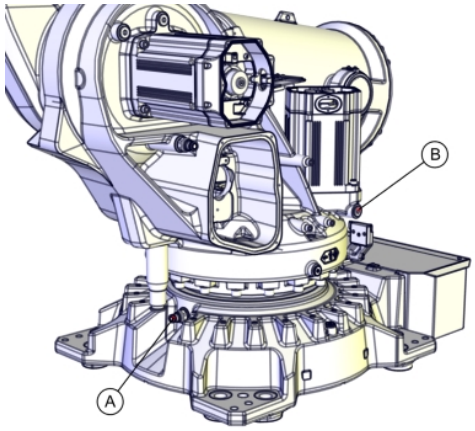
3.5.2 Changing oil, axis-1 gearbox

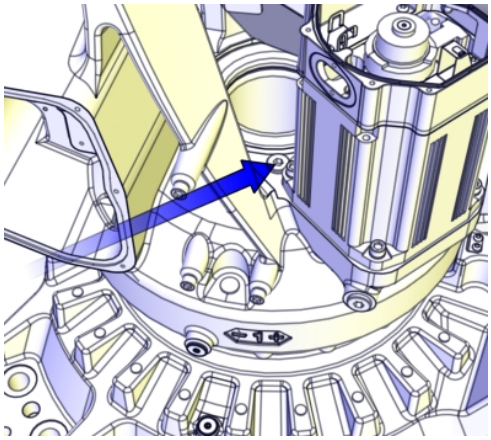
Usage of oil dispenser

The oil change procedure in this section describes usage of an oil dispenser.

Location of oil plugs

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

<table>
<tr>
<td> 

xx1500001654</td>
<td> 
xx1500001644</td>
</tr>
<tr>
<td>A Oil hole with nipple (Used for both draining and filling with an oil dispenser).
B Level plug (IRB 6700 - 300/2.70, IRB 6700 - 245/3.00)</td>
<td>Oil plug.
Used for both ventilation and level measurement on manipulator types:
• IRB 6790 - 235/2.65, IRB 6790 - 205/2.80</td>
</tr>
<tr>
<td>Tightening torque: 24 Nm.</td>
<td>Tightening torque: 24 Nm.</td>
</tr>
</table>

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/2"	3HAC061327-059	Used on oil plug. Always replace when refitting oil plug.

Required tools and equipment

Equipment, etc.	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 144*.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Continues on next page

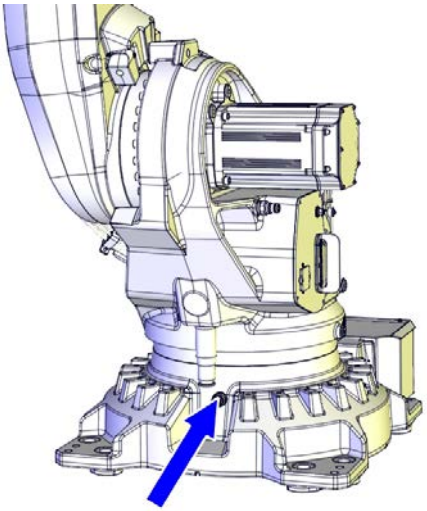
3.5.2 Changing oil, axis-1 gearbox
Continued

Required documents

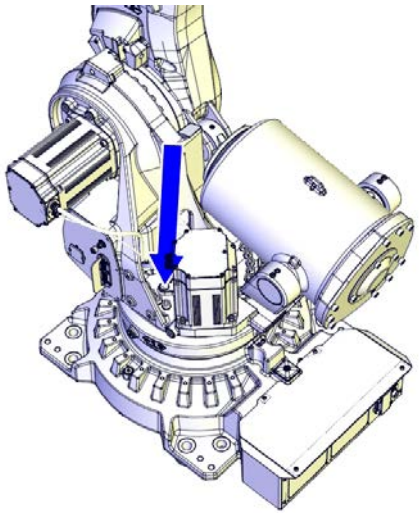
Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

Draining the axis-1 gearbox

Use this procedure to drain the gearbox.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
3	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let the excess pressure out.	
4	Remove the protective cap from the nipple of the oil hole and connect the oil dispenser.	 xx1200000948

Continues on next page

	Action	Note
5	Remove the plug from the vent hole. **WARNING** Open the vent hole while using the dispenser, to avoid damaging vital parts in the gear.	 xx1200000950
6	Suck out the oil with the oil dispenser. **Note** There will be some oil left in the gear after draining.	
7	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See section *Decommissioning on page 667* for more information.	
8	Remove the oil dispenser. Refit the protective cap on the nipple.	
9	Refit the vent hole oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.

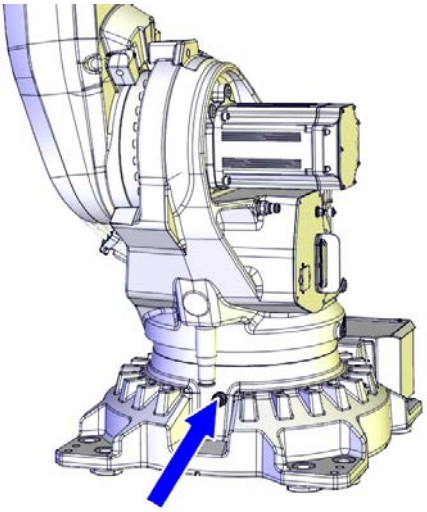
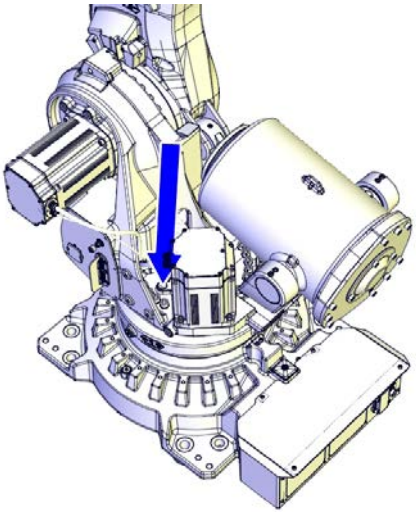
Filling oil into the axis-1 gearbox

Use this procedure to refill the gearbox with oil.

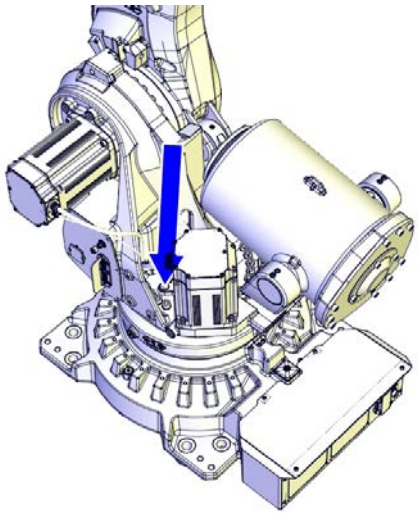
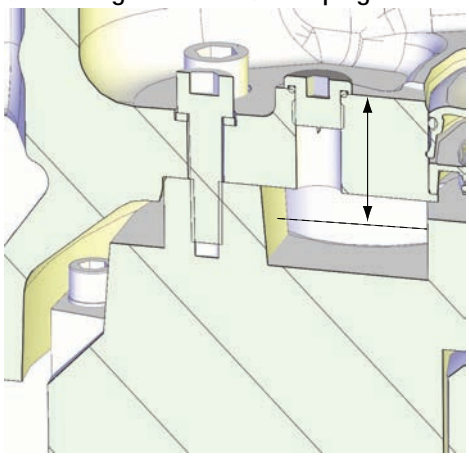
	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	

Continues on next page

3.5.2 Changing oil, axis-1 gearbox
Continued

	Action	Note
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
3	Remove the protective cap from the nipple of the oil hole and connect the oil dispenser.	 xx1200000948
4	Remove the plug from the vent hole. **Note** The vent hole is opened to let out air during the filling process.	 xx1200000950
5	Refill the gearbox with oil with the oil dispenser. **Note** The amount of oil to be filled depends on the amount previously being drained.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.

Continues on next page

	Action	Note
6	Inspect the oil level.	 xx1200000950 Required oil level: 58 mm ± 5 mm below the sealing surface of the oil plug.  xx1300000692
7	Remove the oil dispenser and refit the protective cap to the nipple.	
8	Refit the vent hole oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.
9	**Note** After all repair and maintenance work involving oil, always wipe the robot clean from all surplus oil. The robot color can otherwise be discolored.	
10	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

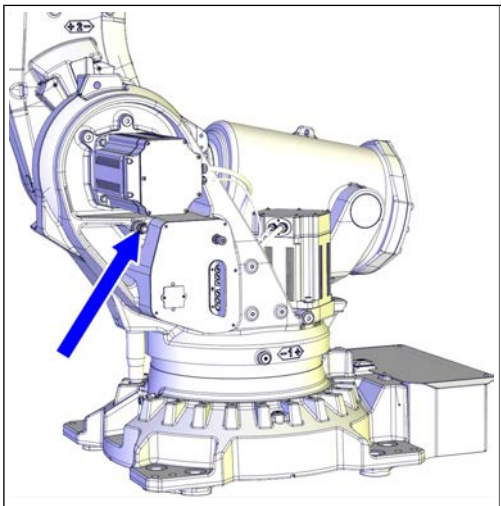
3.5.3 Changing oil, axis-2 gearbox

Usage of oil dispenser

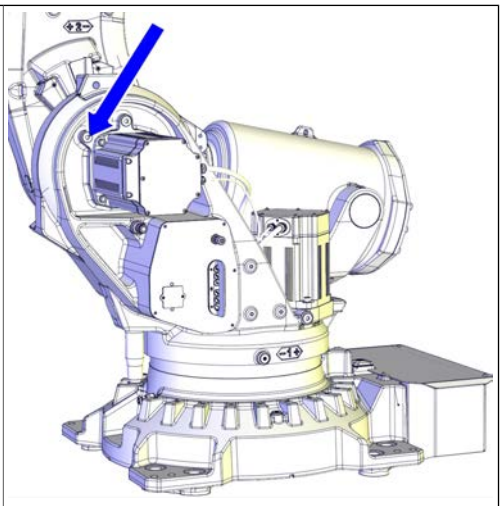
The oil change procedure in this section describes usage of an oil dispenser.

Location of oil plugs

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



xx1200000951



xx1200000952

Oil hole with nipple Used for both draining and filling with an oil dispenser.	Vent hole plug/level plug
Tightening torque: N/A.	Tightening torque: 24 Nm.

Required tools and equipment

Equipment, etc.	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 144*.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/2"	3HAC061327-059	Used on oil plug. Always replace when refitting oil plug.

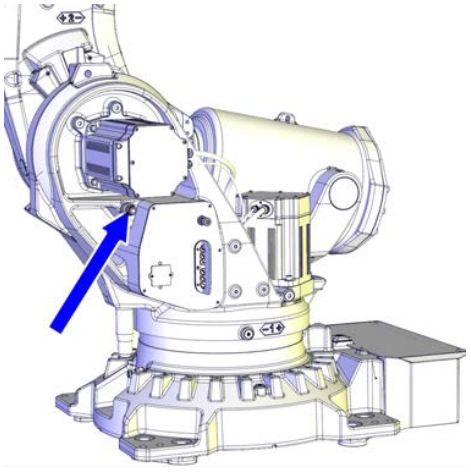
Continues on next page

Required documents

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

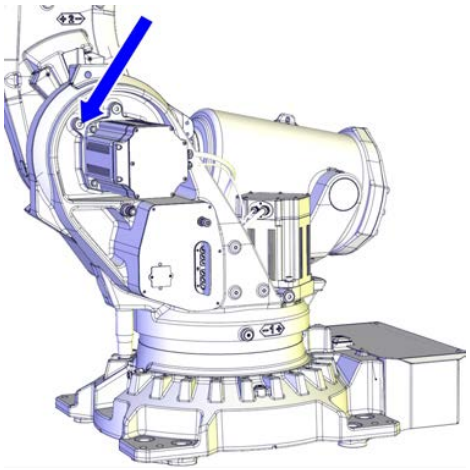
Draining the axis-2 gearbox

Use this procedure to drain the gearbox.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
3	**CAUTION** The gearbox can contain an *excess pressure* that can be hazardous. Open the oil plug carefully in order to let the excess pressure out.	
4	Remove the protective cap from the nipple of the oil hole and connect the oil dispenser.	 xx1200000951

Continues on next page

3.5.3 Changing oil, axis-2 gearbox
Continued

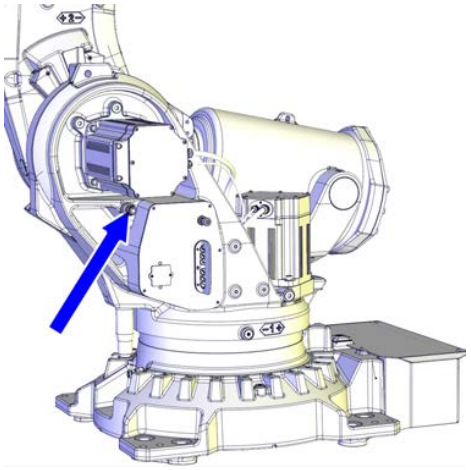
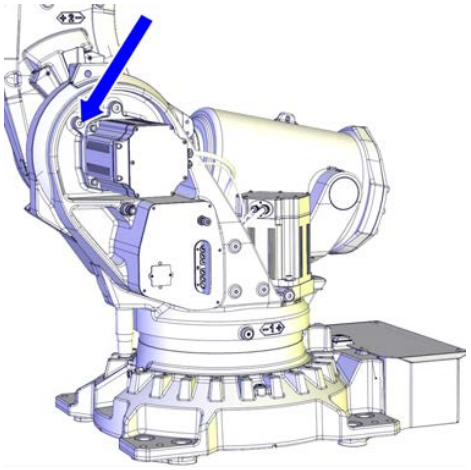
	Action	Note
5	Remove the plug from the vent hole. **WARNING** Open the vent hole while using the dispenser, to avoid damaging vital parts in the gear.	 xx1200000952
6	Suck out the oil with the oil dispenser. **Note** There will be some oil left in the gear after draining.	
7	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See section *Decommissioning on page 667* for more information.	
8	Refill oil or: 1 Remove the oil dispenser 2 Refit the protective cap on the nipple. 3 Refit the vent hole oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Vent hole plug, tightening torque: 24 Nm.

Filling oil into the axis-2 gearbox

Use this procedure to refill the gearbox with oil.

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

Continues on next page

	Action	Note
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
3	Remove the protective cap from the nipple of the oil hole and connect the oil dispenser.	 xx1200000951
4	Remove the plug from the vent hole. **Note** The vent hole is opened to let air out during the filling process.	 xx1200000952
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.

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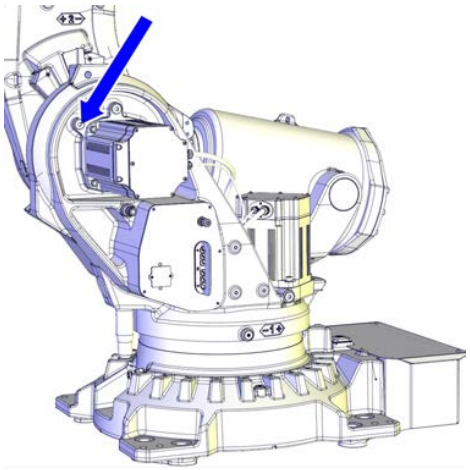
3.5.3 Changing oil, axis-2 gearbox
Continued

	Action	Note
6	Inspect the oil level at the vent hole (level plug).	 xx1200000952 Required oil level is: 0-15 mm below the oil plug hole. More information is found in *Inspecting the oil level in axis-2 gearbox on page 118*.
7	Remove the oil dispenser. Apply Mercasol on the nipple. Refit the protective cap on the nipple.	
8	Refit the vent hole oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.
9	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

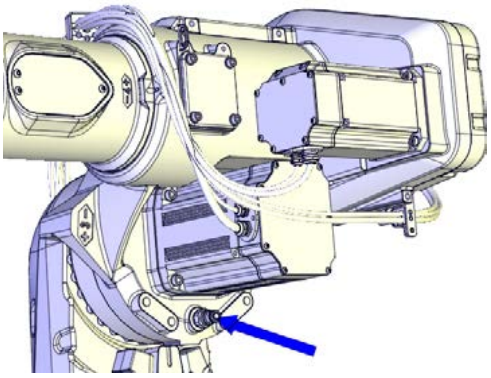
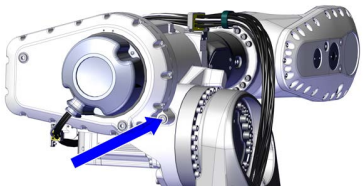
3.5.4 Changing oil, axis-3 gearbox

Usage of oil dispenser

The oil change procedure in this section describes usage of an oil dispenser.

Location of oil plugs

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

<table>
<tr><td> 
xx1200000954</td><td> 
xx2100000519</td></tr>
<tr><td>Oil hole with nipple
Used for both draining and filling with an oil dispenser.</td><td>Level/vent plug</td></tr>
<tr><td>Tightening torque: 24 Nm.</td><td>Tightening torque: 24 Nm.</td></tr>
</table>

Required tools and equipment

Equipment, etc.	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 144*.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/2"	3HAC061327-059	Used on oil plug. Always replace when refitting oil plug.

Continues on next page

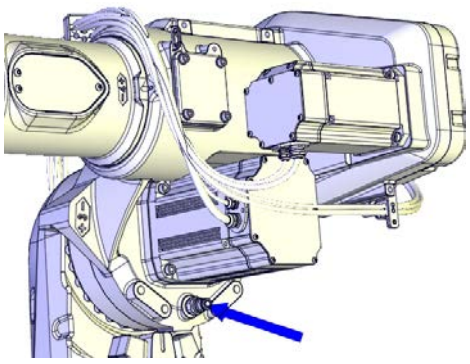
3.5.4 Changing oil, axis-3 gearbox
Continued

Required documents

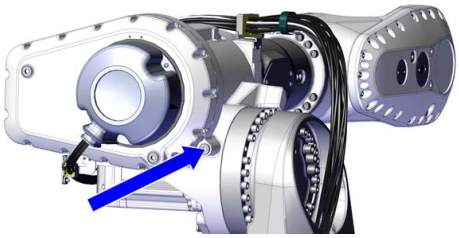
Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

Draining the axis-3 gearbox

Use this procedure to drain the gearbox.

	Action	Note
1	Run the robot to calibration position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
4	**CAUTION** The gearbox can contain an *excess pressure* that can be hazardous. Open the oil plug carefully in order to let the excess pressure out.	
5	Remove the protective cap from the nipple of the oil hole and connect the oil dispenser.	 xx1200000954

Continues on next page

	Action	Note
6	Remove the plug from the vent hole. **WARNING** Open the vent hole while using the dispenser, to avoid damaging vital parts in the gear.	 xx2100000519
7	Suck out the oil with the oil dispenser. **Note** There will be some oil left in the gear after draining.	
8	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See*Decommissioning on page 667* for more information.	
9	Remove the oil dispenser. Refit the protective cap on the nipple.	
10	Refit the vent hole oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.

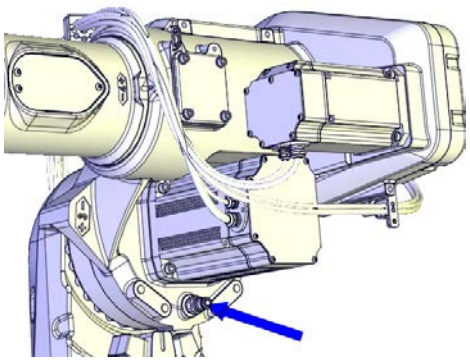
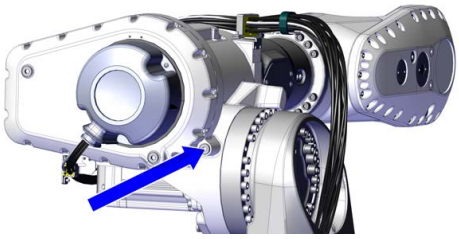
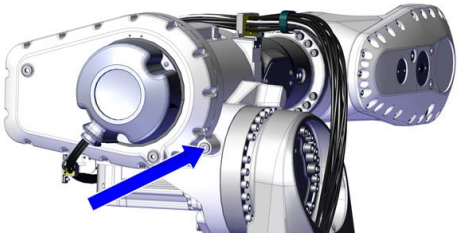
Filling oil into the axis-3 gearbox

Use this procedure to refill the gearbox with oil.

	Action	Note
1	Run the robot to calibration position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	

Continues on next page

3.5.4 Changing oil, axis-3 gearbox
Continued

	Action	Note
4	Remove the protective cap from the nipple of the oil hole and connect the oil dispenser.	 xx1200000954
5	Remove the plug from the vent hole. **Note** The vent hole is opened to let air out during the filling process.	 xx2100000519
6	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.
7	Inspect the oil level at the vent hole (level plug).	 xx2100000519 Required oil level is: 0 - 20 mm below the oil plug hole. More information is found in *Inspecting the oil level in axis-3 gearbox on page 119*.
8	Remove the oil dispenser. Refit the protective cap on the nipple.	
9	Refit the vent hole oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.

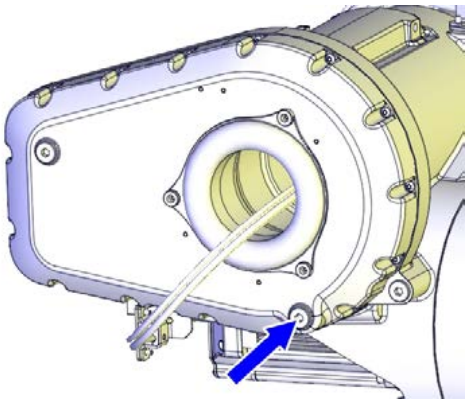
Continues on next page

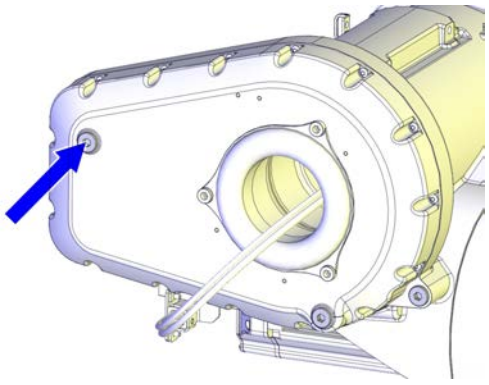
	Action	Note
10	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

3.5.5 Changing oil, axis-4 gearbox

Location of oil plugs

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


xx1200000956


xx1200000957

Oil drain plug	Oil fill plug/level plug
Tightening torque: 24 Nm.	Tightening torque: 24 Nm.

Required tools and equipment

Equipment, etc.	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 144*.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/2"	3HAC061327-059	Used on oil plug. Always replace when refitting oil plug.

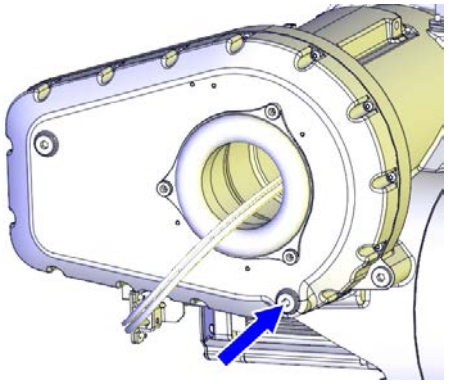
Required documents

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

Continues on next page

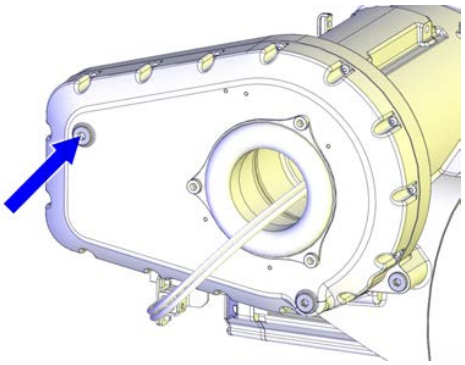
Draining the axis-4 gearbox

Use this procedure to drain the gearbox.

	Action	Note
1	Run the robot to calibration position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
4	**CAUTION** The gearbox can contain an *excess pressure* that can be hazardous. Open the oil plug carefully in order to let the excess pressure out.	
5	Place the oil collecting vessel underneath the oil drain plug.	
6	Remove the oil plug from the drain hole and let the oil run into the vessel.	 xx1200000956

Continues on next page

3.5.5 Changing oil, axis-4 gearbox
Continued

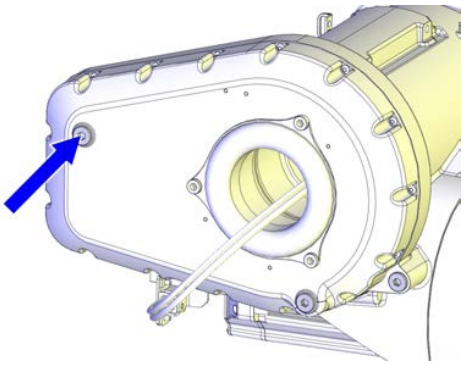
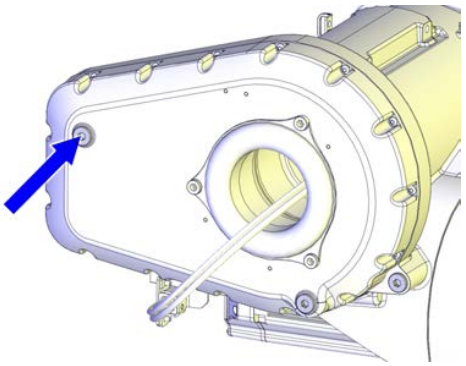
	Action	Note
7	Remove the oil plug from the fill/level hole. **Note** The level hole is opened to speed up the drainage.	 xx1200000957
8	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See *Decommissioning on page 667* for more information.	
9	Refill oil or refit the oil plugs with new o-rings.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.

Filling oil into the axis-4 gearbox

Use this procedure to refill the gearbox with oil.

	Action	Note
1	Run the robot to calibration position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	

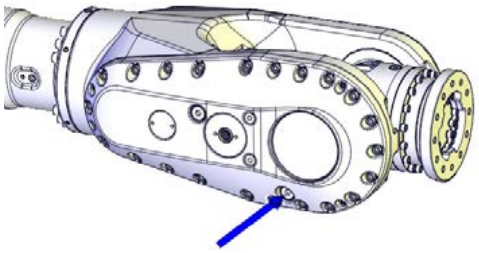
Continues on next page

	Action	Note
4	Open the fill/level plug.	 xx1200000957
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.
6	Inspect the oil level.	The level is measured at the fill hole.  xx1200000957 Required oil level is: 0 - 10 mm below the oil plug hole. See *Inspecting the oil level in axis-4 gearbox on page 121*.
7	Refit the oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.
8	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

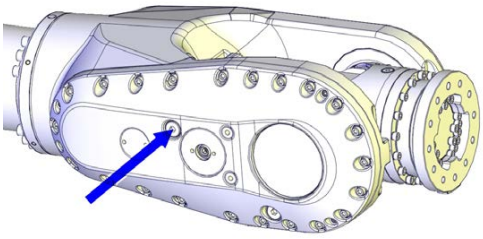
3.5.6 Changing oil, axis-5 gearbox

Location of oil plugs

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



xx1200000958



xx1200000959

Oil drain plug	Oil fill plug/level plug
Tightening torque: 24 Nm.	Tightening torque: 24 Nm.

Required tools and equipment

Equipment, etc.	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 144*.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/2"	3HAC061327-059	Used on oil plug. Always replace when refitting oil plug.

Required documents

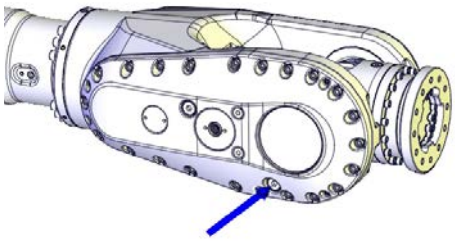
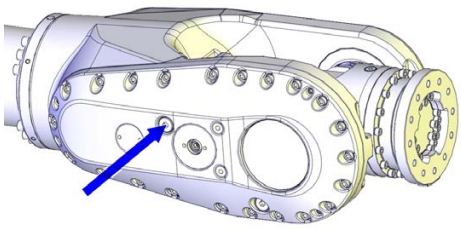
Document name	Document number	Note
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*	

Draining the axis-5 gearbox

Use this procedure to drain the gearbox.

	Action	Note
1	Run the robot to calibration position.	

Continues on next page

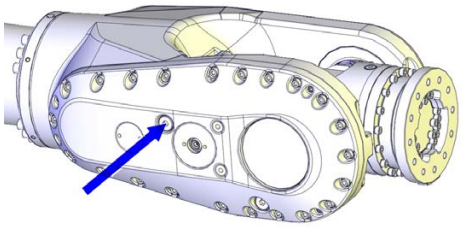
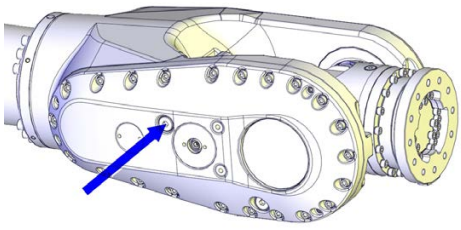
	Action	Note
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
4	**CAUTION** The gearbox can contain an *excess pressure* that can be hazardous. Open the oil plug carefully in order to let the excess pressure out.	
5	Remove the oil plug from the drain hole and let the oil run into the vessel.	 xx1200000958
6	Place the oil collecting vessel underneath the oil drain plug.	
7	Remove the oil plug from the fill/level hole. **Note** The fill hole is opened to speed up the drainage.	 xx1200000959
8	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See section *Decommissioning on page 667* for more information.	
9	Refill oil or refit the oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.

Continues on next page

3.5.6 Changing oil, axis-5 gearbox
Continued

Filling oil into the axis-5 gearbox

Use this procedure to refill the gearbox with oil.

	Action	Note
1	Run the robot to calibration position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
4	Open the fill/level plug.	 xx1200000959
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.
6	Inspect the oil level at the oil fill/level hole (level plug).	 xx1200000959 Required oil level is: 0 - 10 mm below the oil plug hole. More information is found in *Inspecting the oil level in axis-5 gearbox on page 123*.
7	Refit the oil plug with a new o-ring.	O-ring, G 1/2": 3HAC061327-059 Tightening torque: 24 Nm.

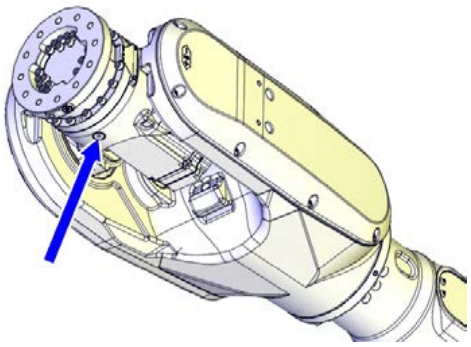
Continues on next page

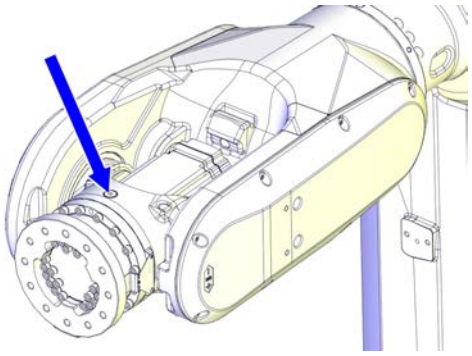
	Action	Note
8	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

3.5.7 Changing oil, axis-6 gearbox

Location of oil plugs

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


xx1200000962


xx1200000963

Oil drain plug	Oil fill plug
Tightening torque: 20 Nm.	Tightening torque: 20 Nm.

Required tools and equipment

Equipment, etc.	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 144*.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables and wear parts

Consumables	Article number	Note
Lubricating oil	-	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*.
O-ring, G 1/4"	3HAC061327-060	Used on oil plug. Always replace when refitting oil plug.

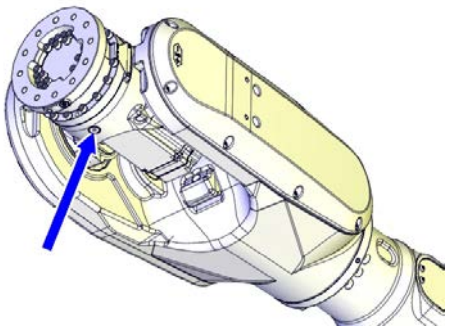
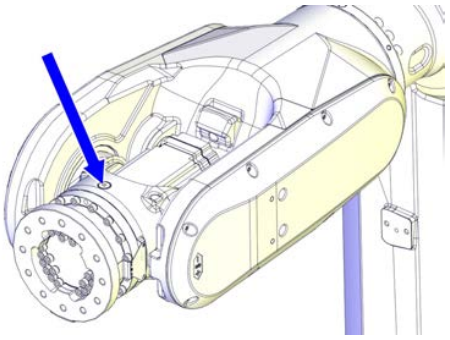
Required documents

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

Continues on next page

Draining the axis-6 gearbox

Use this procedure to drain the gearbox.

	Action	Note
1	Jog the robot to calibration position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
4	**CAUTION** The gearbox can contain an *excess pressure* that can be hazardous. Open the oil plug carefully in order to let the excess pressure out.	
5	Place the oil collecting vessel underneath the oil drain plug.	
6	Remove the oil plug from the drain hole and let the oil run into the vessel.	 xx1200000962
7	Remove the oil plug from the fill hole. **Note** The fill hole is opened to speed up the drainage.	 xx1200000963

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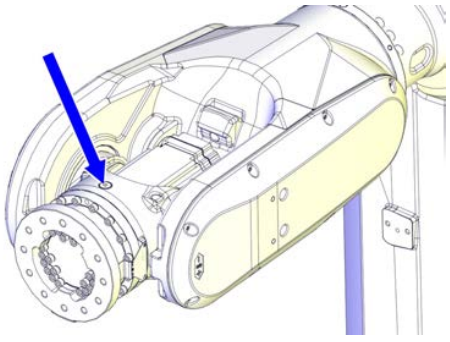
3.5.7 Changing oil, axis-6 gearbox
Continued

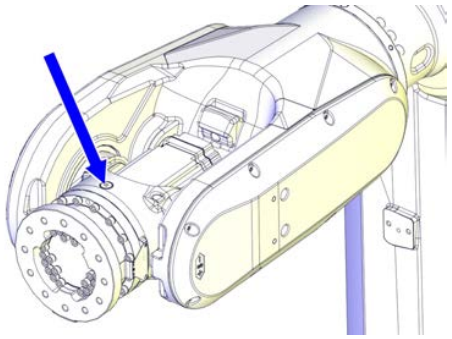
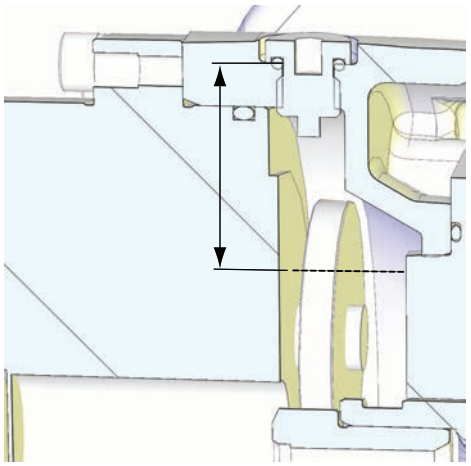
	Action	Note
8	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See section *Decommissioning on page 667* for more information.	
9	Refill oil or refit the oil plugs with new o-rings.	O-ring, G 1/4": 3HAC061327-060 Tightening torque: 20 Nm.

Filling oil into the axis-6 gearbox

Use this procedure to refill the gearbox with oil.

	Action	Note
1	Jog axis 5 to horizontal position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 32*.	
4	Open the fill plug.	 xx1200000963
5	Refill the gearbox with oil. **Note** The amount of oil to be filled depends on the amount previously being drained.	Type of oil and total amount is detailed in *Technical reference manual - Lubrication in gearboxes*.

Continues on next page

	Action	Note
6	Check the oil level. **Note** The level is measured at the fill hole.	**Method 1:**  xx1200000963 • 50 mm ± 5 mm below the sealing surface of the oil plug.  xx1300000693 More information is found in *Inspecting the oil level in axis-6 gearbox on page 126*. **Method 2:** Rotate axis 5 +77°. Required oil level is: 0 - 10 mm below the oil plug hole.
7	Refit the oil plug with a new o-ring.	O-ring, G 1/4": 3HAC061327-060 Tightening torque: 20 Nm.
8	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

3.5.8 Replacing the SMB battery

Note

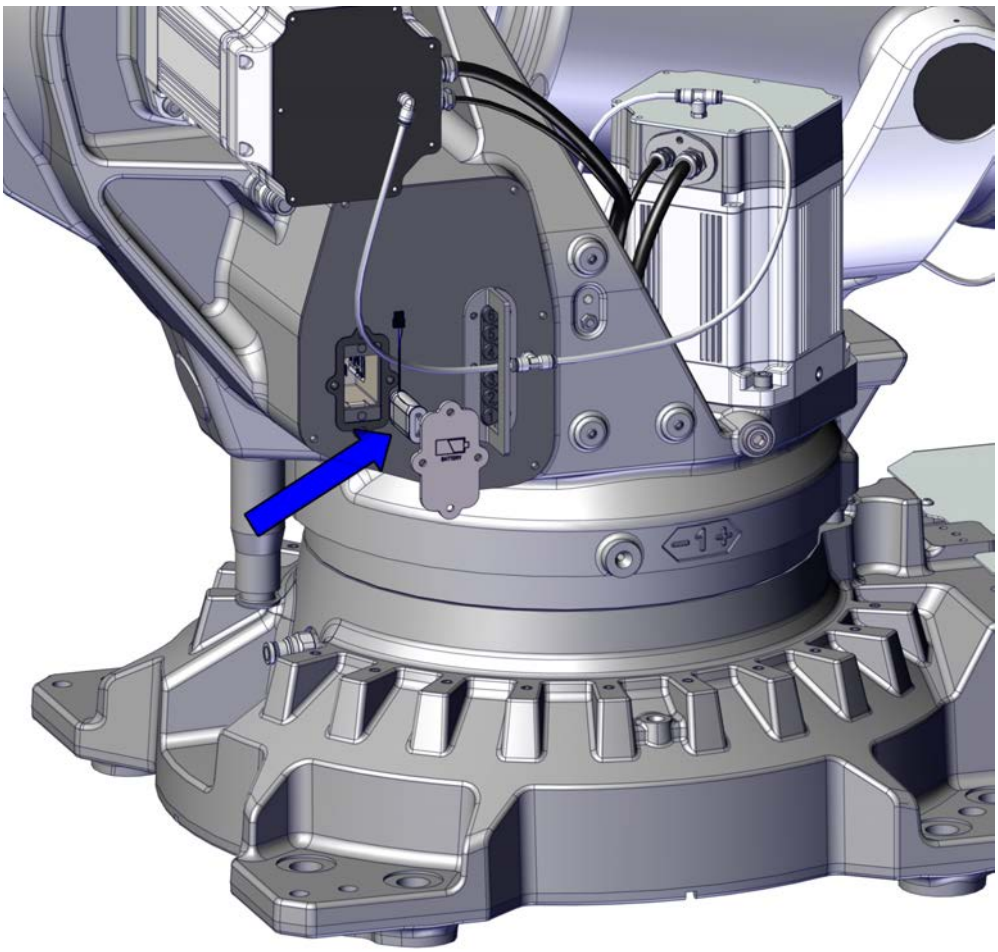
The battery low alert (38213 **Battery charge low**) is displayed when the battery needs to be replaced. The recommendation to avoid an un-synchronized robot is to keep the power to the controller turned on until the battery is to be replaced.

WARNING

See *Hazards related to batteries on page 34*.

Location of SMB battery

The SMB battery (SMB = serial measurement board) is located on the frame as shown in the figure below.



xx1700001632

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Required tools

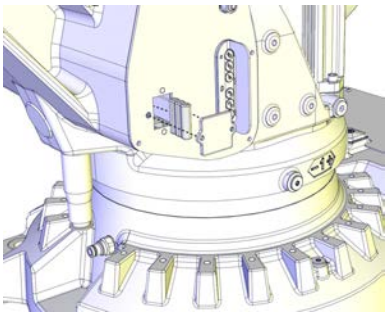
Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required spare parts

Spare part	Article number	Note
Battery unit	See *Product manual, spare parts - IRB 6790*	Battery includes protection circuits. Only replace with the specified spare part or an ABB-approved equivalent.

Removing the battery

Use this procedure to remove the SMB battery.

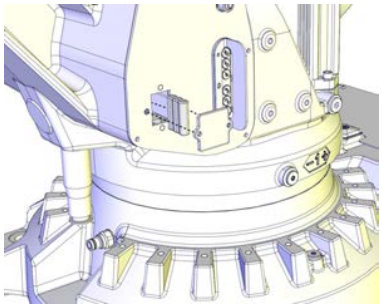
	Action	Note
1	Jog the robot to its calibration position.	This is done in order to facilitate updating of the revolution counter.
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 51*.	
4	Remove the SMB battery cover by unscrewing the attachment screws. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	 xx1200001069
5	Pull out the battery and disconnect the battery cable.	
6	Remove the SMB battery. Battery includes protection circuits. Only replace with a specified spare part or with an ABB- approved equivalent.	

Continues on next page

3.5.8 Replacing the SMB battery
Continued

Refitting the battery

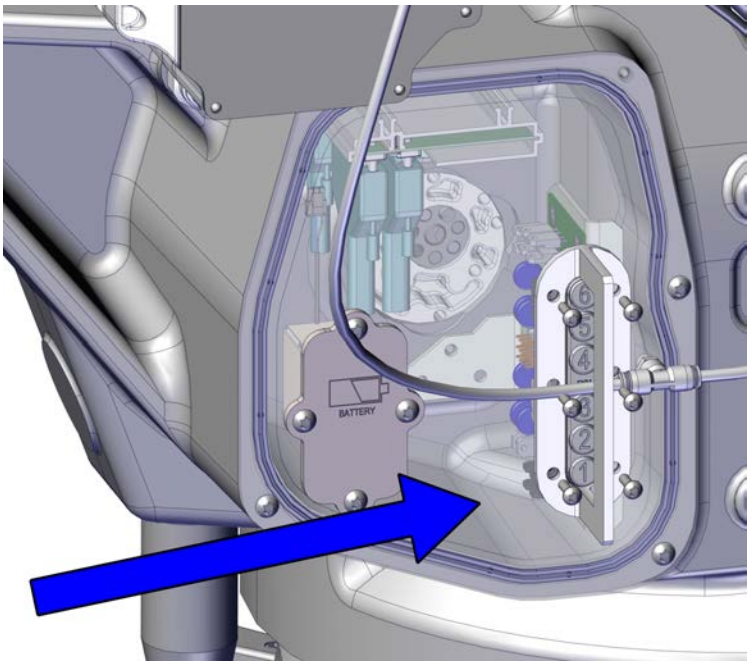
Use this procedure to refit the SMB battery.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
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 51*.	
3	Connect the battery cable and install the battery pack into the SMB/battery recess.	 xx1200001069
4	Secure the SMB battery cover with its attachment screws.	
5	Update the revolution counters.	See *Updating revolution counters on IRC5 robots on page 644*.
6	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

3.5.9 Replacing the desiccant bag

Location of desiccant bag

The desiccant bag is located inside the SMB/BU recess, as shown in the figure.



xx2100000964

Spare part

Equipment, etc.	Article number	Note
Desiccant bag	3HAC080620-001	
Gasket	3HAC044074-002	Replace if damaged

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
SMB cover	M6x16 Stainless steel A2-70 (5 pcs) 9ADA619-56		5 pcs

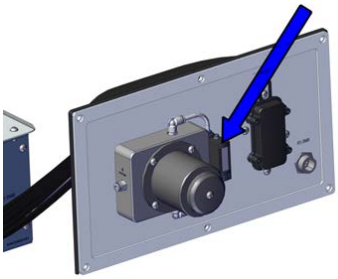
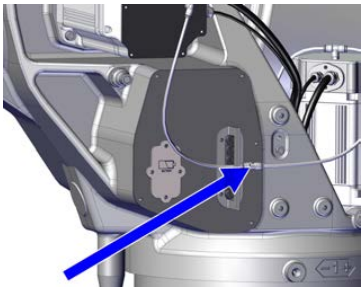
Continues on next page

3.5.9 Replacing the desiccant bag
Continued

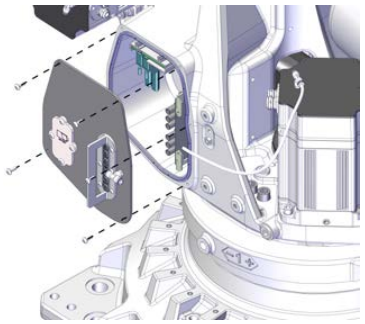
Removing the SMB cover

Use these procedures to remove cover and replace desiccant bag.

Removing the SMB cover

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	
3	Check the leak flow value on the flow sensor (if not already checked and noted). Note the value to be able to compare it when repair is completed.	 xx1700001593
4	**CAUTION** Turn off the air pressure supply.	
5	Disconnect air hose from air fitting on SMB cover.	 xx2100000591

Continues on next page

	Action	Note
6	Remove the screws and remove the SMB cover. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	 xx2100000965

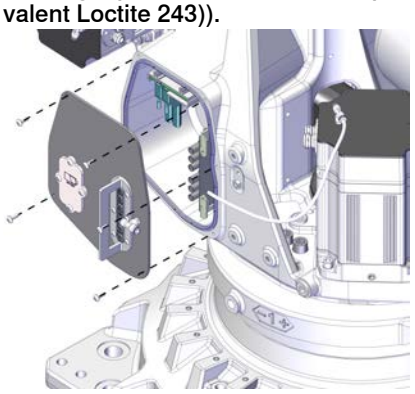
Replace desiccant bag

Replace desiccant bag

	Action	Note
1	Replace desiccant bag	

Refitting the SMB cover

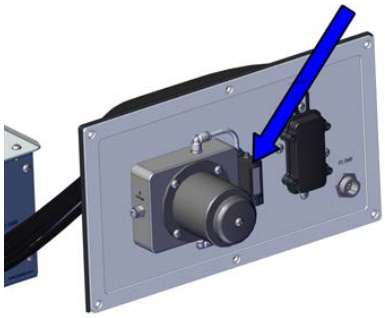
Refitting the SMB cover

	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	
2	Check the gasket on the SMB cover. Replace gasket if damaged.	Gasket SMB-cover: 3HAC044074-002.
3	Secure the SMB cover with the attachment screws. If cabling is used for 7th axis (option), refit the connector R2.FB7 to the SMB cover and tighten with 6 Nm.	Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx2100000965

Continues on next page

3.5.9 Replacing the desiccant bag
Continued

Concluding procedures

	Action	Note
1	Turn on the air pressure supply to the overpressure system.	
2	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
3	Update the revolution counters.	See *Updating revolution counters on IRC5 robots on page 644*.
4	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

3.6 Cleaning activities

3.6.1 Cleaning the IRB 6790

DANGER

Turn off all:

- electric power supply
- hydraulic pressure supply

to the robot, before entering the safeguarded space.

General

To secure high uptime it is important that the IRB 6790 is cleaned regularly. The frequency of cleaning depends on the environment in which the product works.

Oil spills

Oil spills from gearboxes

Use the following procedure if any oil spills are detected that can be suspected to originate from a gearbox.

1. Inspect that the oil level in the suspected gearbox is according to the recommendations, see *Inspection activities on page 114*.
2. Write down the oil level.
3. Inspect the oil level again after, for example, 6 months.
4. If the oil level is decreased then replace the gearbox.

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.
- Never point the water jet at connectors, joints, sealings, or gaskets.
- Do not use compressed air to clean the robot.
- Never use solvents that are not approved by ABB to clean the robot.
- Do not spray from a distance closer than 0.4 m.
- Do not remove any covers or other protective devices before cleaning the robot.

Continues on next page

Cleaning methods

The following table defines what cleaning methods are allowed depending on the protection type.

Protection type	Cleaning method			
	Vacuum cleaner	Wipe with cloth	Rinse with water	High pressure water or steam
Foundry Prime	Yes	Yes. With cleaning detergent, spirit or isopropyl alcohol. See *Washing detergents on page 180*.	Yes.	Yes[i]. Cleaning detergents may be used. See *Washing detergents on page 180*.

i Perform according to section *Cleaning with water and steam on page 180*.

Cleaning with water and steam

Instructions for rinsing with water

ABB robots with protection types *Standard*, *Foundry Plus*, *Wash*, or *Foundry Prime* can be cleaned by rinsing with water (water cleaner), provided that the robot is not equipped with the option of motor cooling fans.[1]

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 700 kN/m^2 (7 bar) [I]
- Fan jet nozzle should be used, min. 45° spread
- Minimum distance from nozzle to encapsulation: 0.4 meters
- Maximum flow: 20 liters/min[I]

I Typical tap water pressure and flow

Instructions for steam or high pressure water cleaning

ABB robots with protection types *Foundry Plus*, *Wash*, or *Foundry Prime* can be cleaned using a steam cleaner or high pressure water cleaner.[2]

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 2500 kN/m^2 (25 bar)
- Fan jet nozzle should be used, min. 45° spread
- Minimum distance from nozzle to encapsulation: 0.4 meters
- Maximum water temperature: 80° C

Additional cleaning instructions for Foundry Prime robots

Washing detergents

- Do not use washing detergents containing organic acids, e.g. acetic acid.
- The washing detergent must be cleansed continuously.
- The detergent pH value and concentration must be checked regularly.
- Allowed pH of the washing detergent is 7-10.

1 See *Cleaning methods on page 180* for exceptions.

2 See *Cleaning methods on page 180* for exceptions.

Continues on next page

Washing detergent with pH 6-7 is allowed for short periods, provided the robot is rinsed properly with tap water afterwards.

- The user must follow the recommendations regarding detergent concentration and pH value.
- Recommendations given by the detergent manufacturer for the specific detergent in question must be followed.
- Requirements for washing detergents for cleaning the robot are equal to the requirements made for the washing detergents used in the operating environment of the robot. See *Operating environment, robot on page 44*.
  Washing and cleaning detergents with corrosion inhibitor is recommended.

Note

If the pH value or the detergent concentration is varying from its original specification, it can become very corrosive.

Temperature of cleaning bath

- Maximum temperature <60ºC.

  Ambient temperature must not be higher than +50 °C (122 °F).

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.

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4 Repair

4.1 Introduction

Structure of this chapter

This chapter describes repair activities for the IRB 6790. Each procedure contains the information required to perform the activity, for example spare parts numbers, required special tools, and materials.

WARNING

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

Report replaced units

Note

When replacing a part on the IRB 6790, 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 IRB 6790 is connected to power, always make sure that the IRB 6790 is connected to protective earth and a residual current device (RCD) before starting any repair work.

For more information see:

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

4.2 General procedures

4.2.1 Performing a leak-down test

When to perform a leak-down test

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

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

Required equipment

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

Performing a leak-down test

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

4.2.2 Mounting instructions for bearings

General

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

Equipment

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

Assembly of all bearings

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

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

Assembly of tapered bearings

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

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

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

Greasing of bearings

Note

This instruction is not valid for solid oil bearings.

Continues on next page

4.2.2 Mounting instructions for bearings
Continued

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

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

Grease the different types of bearings as following description:

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

4.2.3 Mounting instructions for sealings

General

This section describes how to mount different types of sealings.

Equipment

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

Rotating sealings

The following procedures describe how to fit rotating sealings.

CAUTION

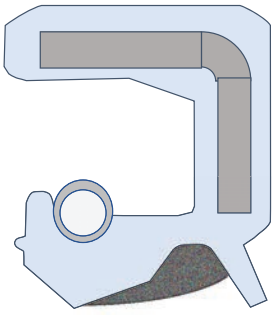
Please observe the following before commencing any assembly of sealings:

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

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

Radial sealings

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



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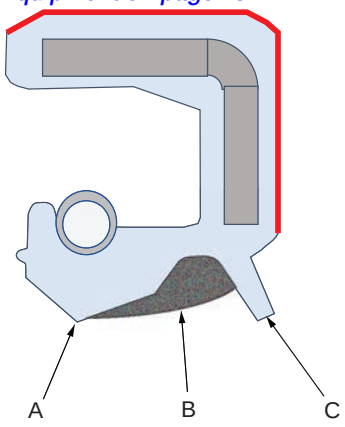
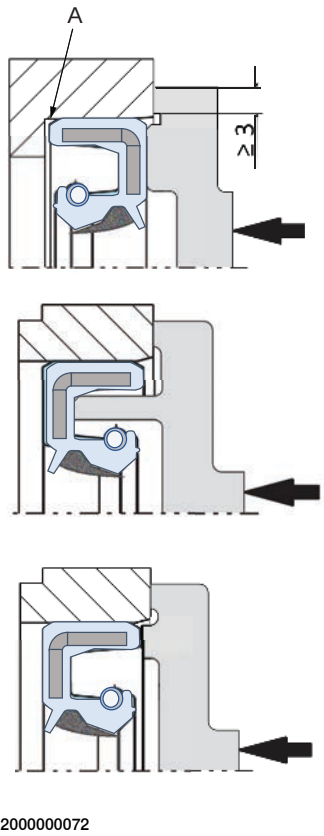
4.2.3 Mounting instructions for sealings

Continued

	Action	Note
1	Check the sealing to ensure that: • The sealing is of the correct type. • There is no damage on the main lip.	
2	Inspect the shaft surface before mounting. If scratches or damage are found, the shaft must be replaced since it may result in future leakage. Do not try to grind or polish the shaft surface to get rid of the defect.	
3	Lubricate the sealing with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the sealing.) Fill 2/3 of the space between the dust lip and the main lip with grease. If the sealing is without dust lip, just lubricate the main lip with a thin layer of grease.	Article number is specified in *Equipment on page 187*.  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

4.2.3 Mounting instructions for sealings

Continued

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

4.2.4 Painting damaged nickel coated surfaces with touch up paint

Required consumables

Consumable	Article number	Note
Touch up paint Foundry Prime / Foundry Prime 2 / Foundry Prime 3, Grey	3HAC035355-001	The grey touch up paint is used on all Foundry Prime robots, regardless of the original color of the robot.

Painting damaged nickel coated surfaces with touch up paint

	Action	Note
1	Use Touch up paint Foundry Prime, grey to paint the damage.  **Note** Always read the instruction in the product data sheet in the paint repair kit for Foundry Prime.	3HAC035355-001

4.2.5 The brake release buttons may be jammed after service work

Description

The brake release unit has push-buttons for the brake release of each axis motor. When service work is performed inside the SMB recess that includes removal and refitting of the brake release unit, the brake release buttons may be jammed after refitting.

DANGER

If the power is turned on while a brake release button is jammed in depressed position, the affected motor brake is released. This may cause serious personal injuries and damage to the robot.

Elimination

To eliminate the danger after service work has been performed inside the SMB recess, follow the procedure below.

	Action
1	Make sure the power is turned off.
2	Remove the push-button guard, if necessary.
3	Verify that the push-buttons of the brake release unit are working by pressing them down, one by one. Make sure none of the buttons are jammed in the tube.
4	If a button gets jammed in the depressed position, the alignment of the brake release unit must be adjusted so that the buttons can move freely in their tubes.

4.3 Lifting associated procedures

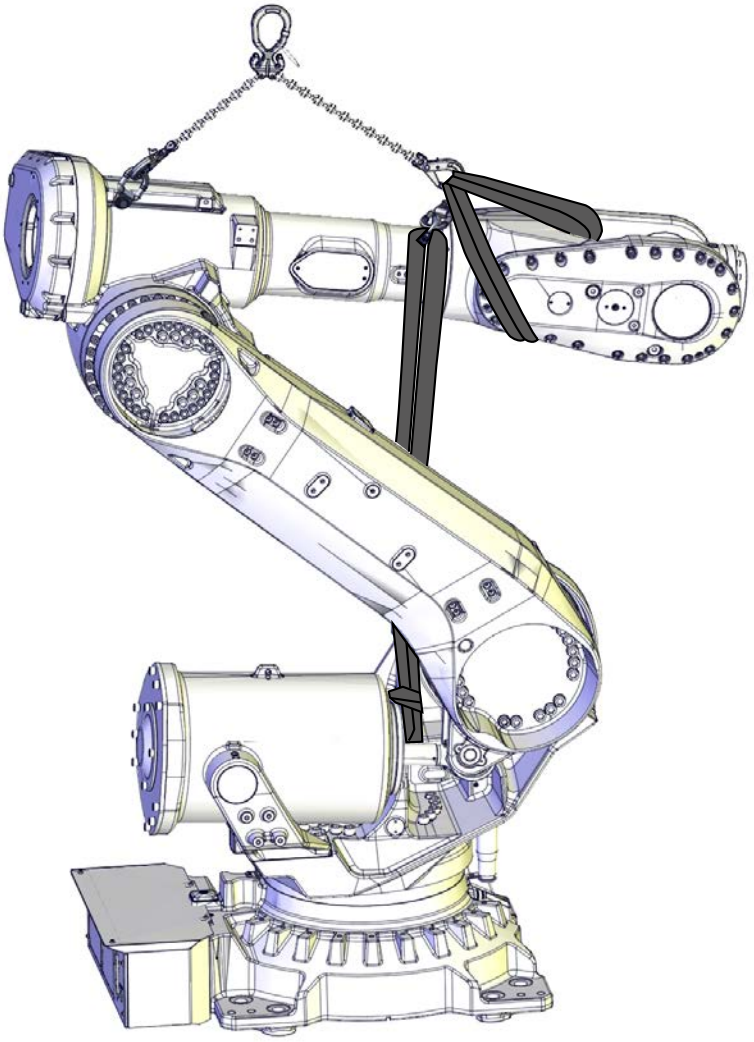
4.3.1 Attaching lifting accessories to complete arm system

Definition of the complete arm system

The complete arm system consists of the following parts of the robot:

- upper arm
- wrist
- lower arm
- frame

Attachment points of lifting accessory



Required tools

Equipment, etc.	Article number	Note
Lifting eye	3HAC16131-1	M12

Continues on next page

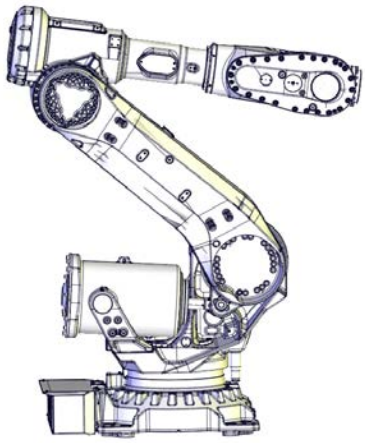
4.3.1 Attaching lifting accessories to complete arm system
Continued

Equipment, etc.	Article number	Note
Lifting eye	3HAC16131-1	M12
Fender washer	-	Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.
Lifting shackle	-	SA-10-8-NA1
Roundsling, 1.5 m	-	Length: 1.5 m. Lifting capacity: 2,000 kg.
Roundsling, 1 m	-	Length: 1 m, lifting capacity: 1,000 kg.
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Attaching the lifting accessories

Robot position

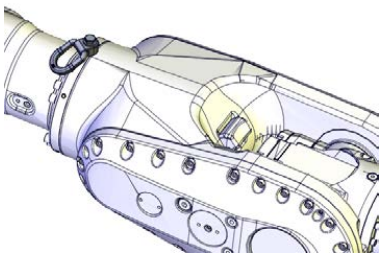
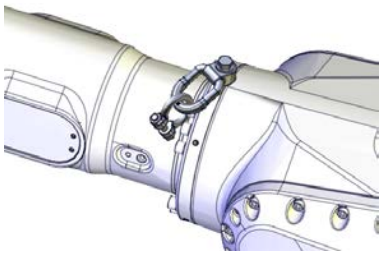
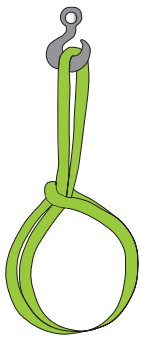
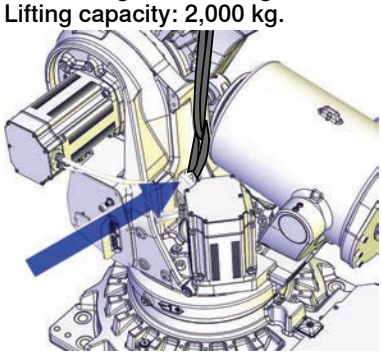
Use this procedure to jog the robot into position.

	Action	Note
1	Jog the robot into position: • Axis 1: no significance as long as the robot is secured to the foundation. • Axis 2: -40° • Axis 3: +65° (approximately) • Axis 4: calibration position (0°) • Axis 5. +90° • Axis 6: calibration position (0°)	 xx1200001132
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	

Continues on next page

Attaching lifting accessories to the arm system

Use this procedure to attach the lifting accessories.

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**CAUTION** The complete arm system weigh (according to variants) 1,100 kg. All lifting accessories used must be sized accordingly.	
3	Fit a lifting eye to the wrist. **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1  xx1200001133
4	Fit a lifting shackle in the wrist lifting eye.	Lifting shackle: SA-10-8-NA1  xx1200001234
5	Run a roundsling through the hole in the frame. Attach the roundsling choked. See figure!  xx1400000730	Roundsling, 1.5 m: Length: 1.5 m. Lifting capacity: 2,000 kg.  xx1200001209

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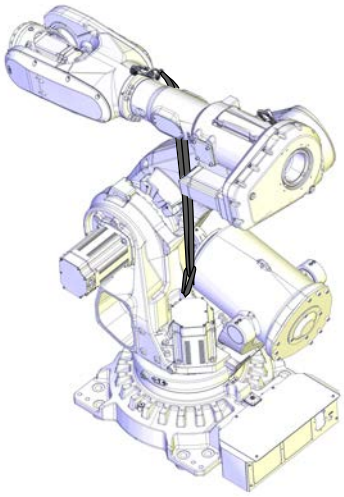
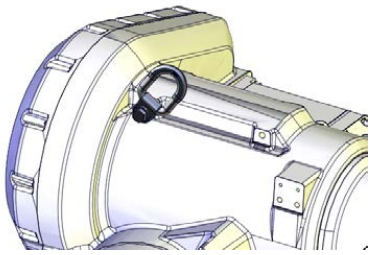
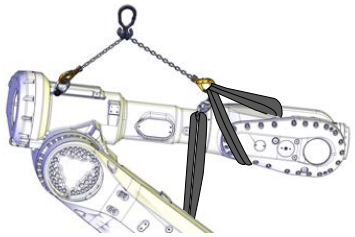
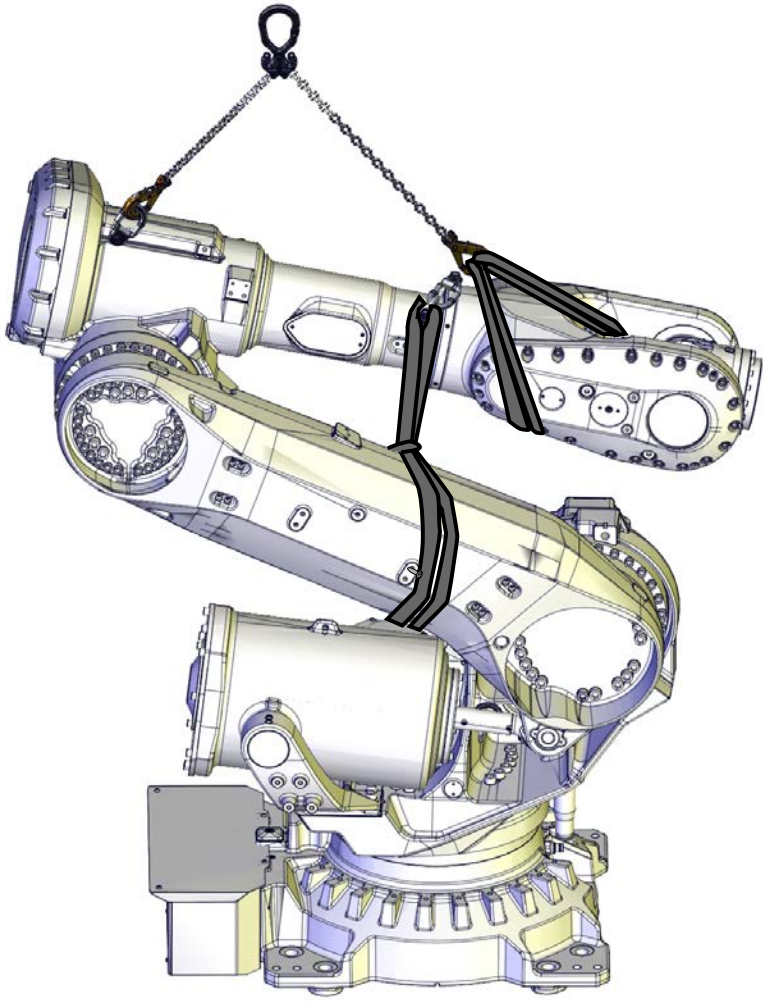
4.3.1 Attaching lifting accessories to complete arm system

Continued

	Action	Note
6	Attach the roundsling to the shackle on the wrist.	 xx1200001235
7	Jog axis-3 slowly until the roundsling is stretched (approximately +58°), to carry the weight of the lower arm and frame. **WARNING** Without the roundsling the weight of the lower arm and frame is applied to the axis-3 gear during lifting, which risks to damage the gear.	
8	Fit a lifting eye in the arm house, with a fender washer underneath.  xx1400002196 Fender washer **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1 Fender washer. Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.  xx1200001134
9	Attach the Lifting accessory (chain) to an overhead crane (or similar) and then to the lifting eye in the arm house and to a roundsling run through the wrist.	Lifting accessory (chain): 3HAC15556-1 Roundsling, 1 m: Length: 1 m, lifting capacity: 1,000 kg.  xx1200001236

4.3.2 Attaching lifting accessories to an un-separated lower and upper arm

Attachment points of lifting accessory



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Required tools

Equipment, etc.	Article number	Note
Lifting eye	3HAC16131-1	M12
Lifting eye	3HAC16131-1	M12
Fender washer	-	Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.
Lifting shackle	-	SA-10-8-NA1
Roundsling, 1.5 m	-	Length: 1.5 m. Lifting capacity: 2,000 kg.
Roundsling, 1 m	-	Length: 1 m, lifting capacity: 1,000 kg.
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.

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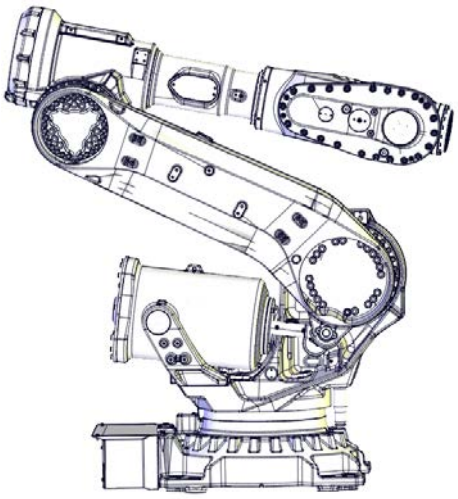
4.3.2 Attaching lifting accessories to an un-separated lower and upper arm
Continued

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Attaching lifting accessories to the lower and upper arm

Robot position

Use this procedure to jog the robot into position.

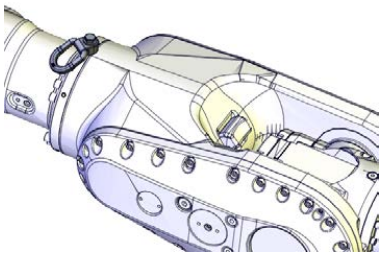
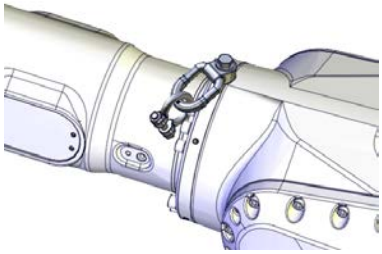
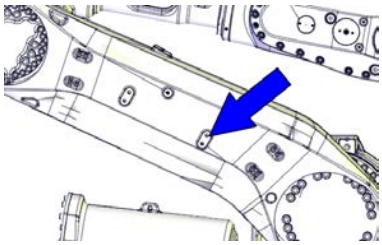
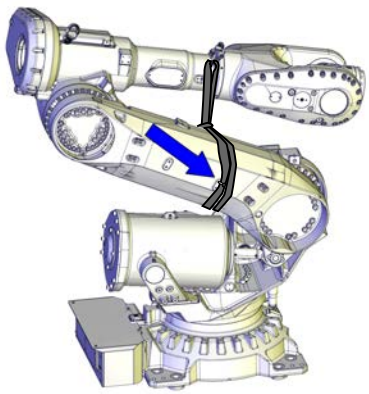
	Action	Note
1	**Note** When jogging the axis-2 into position check that the balancing device ear and the ear on the lower arm is not colliding!	
2	Jog the robot into position: • Axis-1: no significance as long as the robot is secured to the foundation • Axis-2: -45° • Axis-3: +65° (approximately) • Axis-4: 0° • Axis-5: 0° • Axis-6: 0°.	 xx1200001250
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	

Attaching lifting accessories to the lower and upper arm

Use this procedure to attach the lifting accessories.

	Action	Note
1	**CAUTION** The lower and upper arms together weigh (according to variants) 510 kg. All lifting accessories used must be sized accordingly!	

Continues on next page

	Action	Note
2	Fit a lifting eye to the wrist. **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1  xx1200001133
3	Fit a lifting shackle in the wrist lifting eye.	Lifting shackle: SA-10-8-NA1  xx1200001234
4	Insert a M8x50 securing screw, not more than 10-15 mm, into the screw hole shown in the figure. This is done to secure the roundsling from gliding when lifting. **Note** Save the stop screw installed, to refit after the lifting eye is removed.	 xx1200001251
5	Run a roundsling around the lower arm, beneath the securing screw.	Roundsling, 1.5 m: Length: 1.5 m. Lifting capacity: 2,000 kg.  xx1200001252

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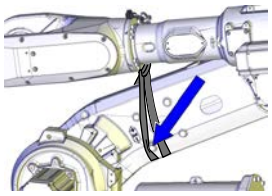
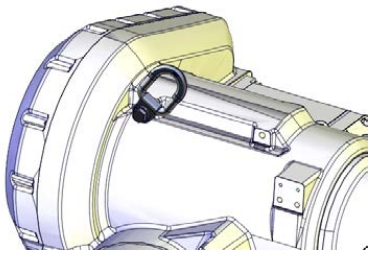
4.3.2 Attaching lifting accessories to an un-separated lower and upper arm

Continued

	Action	Note
6	Adjust the roundsling on the other side of the lower arm, so that the roundsling runs on the left side of the most lower of the four bosses. This will prevent the roundsling from gliding.	 xx1200001253
7	Attach the roundsling to the shackle on the wrist.	
8	Stretch the roundsling between the wrist and the lower arm by slowly jogging the axis-3. **Note** Make sure the roundsling is stretched, in order to carry the weight of the lower arm.	
9	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
10	Fit a lifting eye in the arm house, with a fender washer underneath.  xx1400002196 **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1 Fender washer: Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.  xx1200001134

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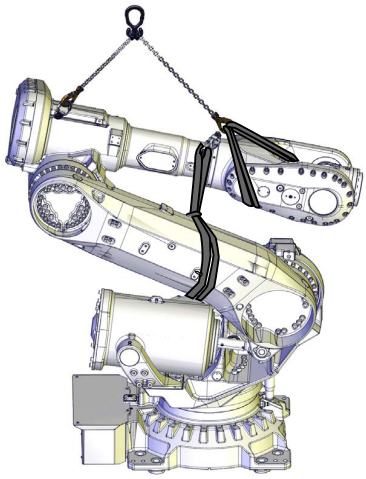
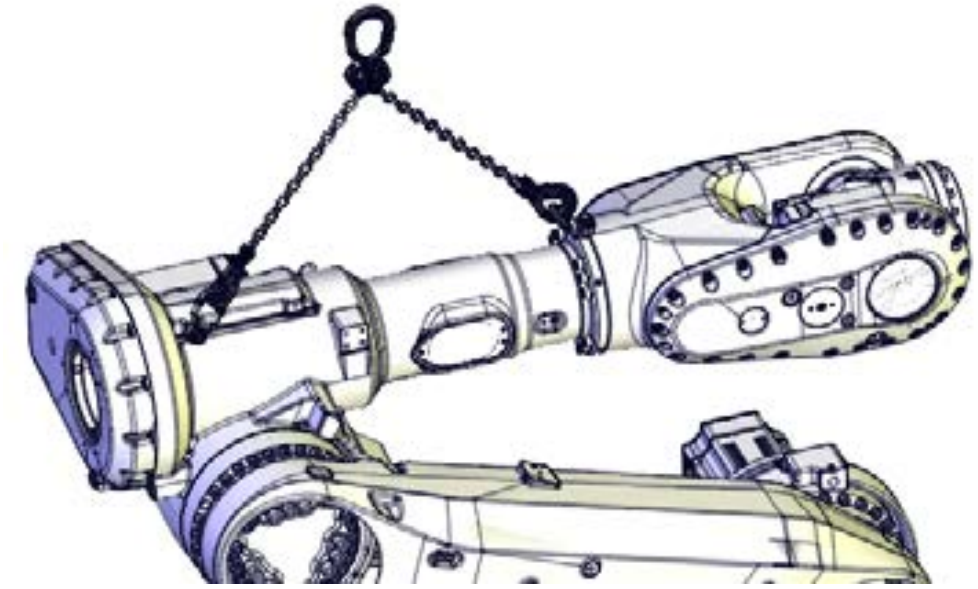
	Action	Note
11	Attach the Lifting accessory (chain) to an overhead crane (or similar), then to the lifting eye in the arm house and to a roundsling run through the wrist.	Lifting accessory (chain): 3HAC15556-1 Roundsling, 1 m: Length: 1 m, lifting capacity: 1,000 kg.  xx1200001254
12	Raise the overhead crane to stretch the chains and roundslings. Verify that the roundsling between the wrist and the lower arm is stretched.	
13	To release the brake, connect the 24 VDC power supply. Connect to connector R2.MP2, axis-2 motor: • + = pin 2 • - = pin 5	

4.3.3 Attaching lifting accessories to the upper arm

Attachment points of lifting accessory



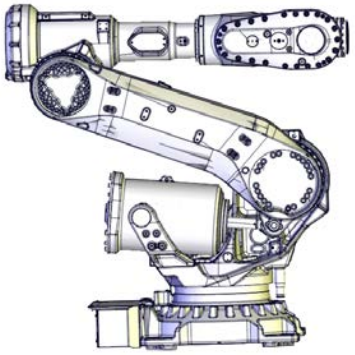
xx1200001308

Required equipment

Equipment, etc.	Article number	Note
Lifting eye	3HAC16131-1	M12
Lifting eye	3HAC16131-1	M12
Fender washer	-	Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Continues on next page

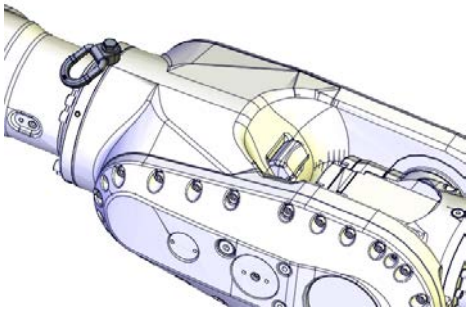
Robot position

	Action	Note
1	Jog the robot to the position: • Axis-1: no significance • Axis-2: -65° • Axis-3: +65° • Axis-4: 0° • Axis-5: no significance • Axis-6: no significance	 xx1200001255

Attaching lifting accessories

Attaching the lifting accessories to the upper arm

Use this procedure to attach the lifting accessories to the upper arm.

	Action	Note
1	**CAUTION** The weight of the complete upper arm (including the wrist) is 360 kg All lifting accessories used must be sized accordingly.	
2	Fit a lifting eye to the wrist. **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1  xx1200001133

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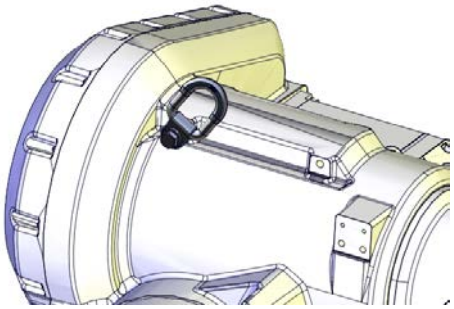
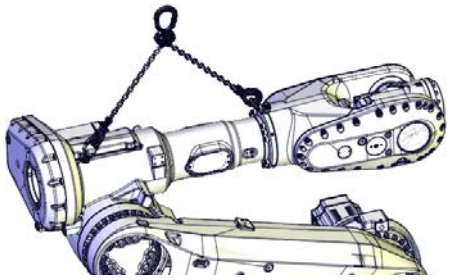
4.3.3 Attaching lifting accessories to the upper arm

Continued

	Action	Note
3	Fit a lifting eye in the arm house, with a fender washer underneath.  xx1400002196 **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1 Fender washer: Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.  xx1200001134
4	Attach the upper arm lifting accessory (chain) to an overhead crane (or similar) and then to the lifting eye in the arm house and in the wrist.	Lifting accessory (chain): 3HAC15556-1  xx1200001308
5	Raise the lifting accessories to take the weight of the upper arm.	
6	In case of necessary adjustments, use the shortening loops on the lifting accessory (chain) to find the level position.	 xx1400002197

4.4 Complete robot

4.4.1 Repairing the overpressure leakage

Location of pressurized air

The pressurized air is sent from the air block and divided into the balancing cylinder via OUT 1 and the robot system via OUT 2. The robot system includes all the motor connection boxes, wrist housings, the SMB cavity, and the harness.

Required tools and equipment

Equipment	Article number	Note
Leakage detection spray	-	Not supplied by ABB
Ultrasonic leakage detector	-	Not supplied by ABB
Vulcanizing tape, for example Black Bull Tape from Innotec	-	Not supplied by ABB

Preparations before locating and repairing a leakage

Use this procedure to prepare before locating and repairing a leakage.

Preparations

	Action	Note
1	Jog the robot to a position that allows access to all motor connection boxes, the SMB cavity and the harness.	
2	Note the value of the flow sensor.	

Locating the leakage

The method of finding a leakage depends on the placement and size of the leakage.

A minor flow leakage can be detected either by visible bubbles using leak detection spray or by using an ultrasonic leakage detector (for example LD 500/510 from CS-instruments) that identifies the high frequency sound that is created when air is forced through a tiny opening. A major flow leakage can be detected by following the air flow path to check for a disconnected or broken hose, harness or seal.

Use this procedure to localize the leakage.

	Action	Note
1	Check that the hose connected between the flow sensor and the connection point on the air block is connected properly.	
2	Check that the R1.MP connector and the sealed SMB cable on the interface plate do not have any air flow leakage.	
3	Check that the air hose and the different connections that run along the path of the pressurized air flow are not damaged.	Pay attention to damage from extensive exposure of fluids or metal fragments on the harness.

Continues on next page

4.4.1 Repairing the overpressure leakage

Continued

	Action	Note
4	Check the motor connection boxes and the SMB cavity for air flow leakage. If a repair recently has been performed and there is still a leakage, perform these checks along the path of the pressurized air flow: • Check the cable gland, the gland carrier and the cover. • Check the torque of the screws. • Check the seals. • Check both the front and back of the SMB cavity.	

Repairing the leakage

Use this procedure to repair the leakage.

Repairing the leakage

	Action	Note
1	Depending on what is leaking: • If a connection to a hose is leaking, reconnect the hose. • If a connector is leaking, tighten the connector or apply sealant. • If the harness is leaking, apply vulcanizing tape (for example Black Bull Tape from Innotec) according to instructions from the manufacturer. • If a seal is leaking, replace the seal.	Make sure that the repair is adequate compared to the working environment.

Concluding procedure

Use this procedure to conclude the work.

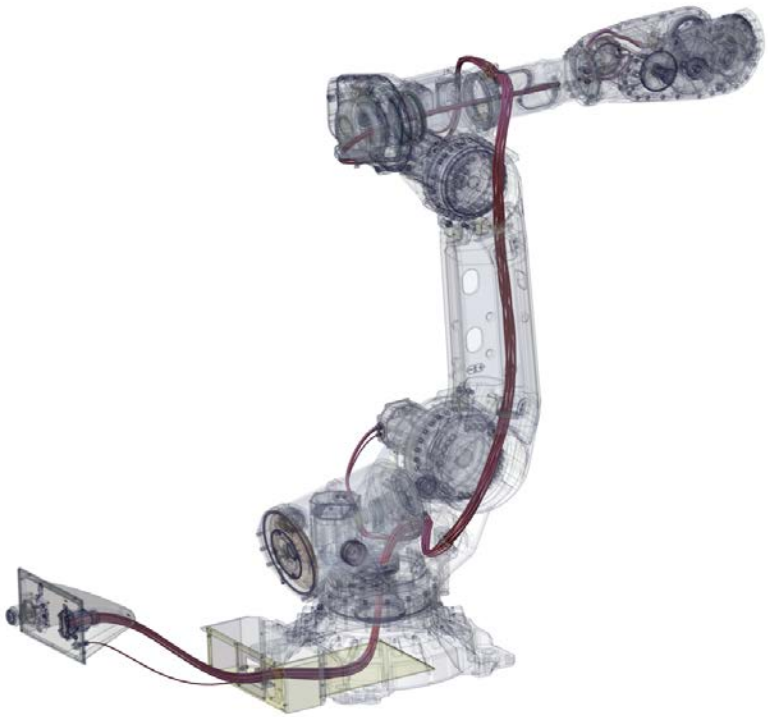
Concluding procedure

	Action	Note
1	Verify that the overpressure system is working properly, see *Inspecting the overpressure system*.	
2	Set the flow sensor after a repair, see *Set the flow sensor*.	
3	If the leakage still remains, contact ABB Service.	

4.4.2 Removing the cable harness

Location of the cable harness

The cable harness is located as shown in the figure.



xx1700001801

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

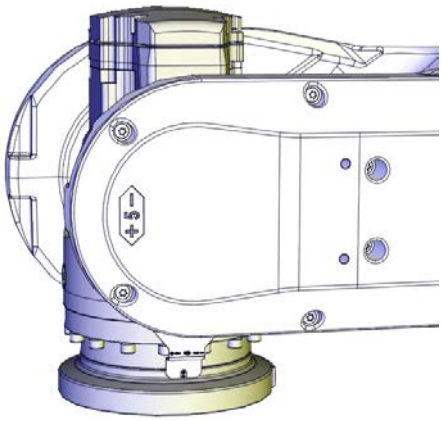
Preparations before removing the cable harness

Note

Handle the cables carefully to avoid any scratches or damage that lead to leakage when the system is pressurized.

Continues on next page

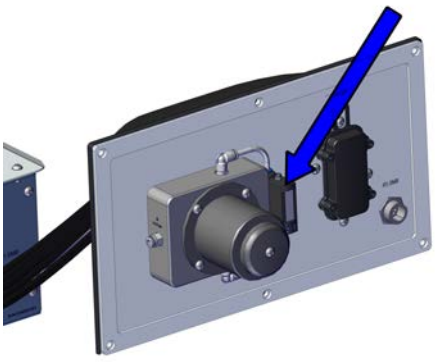
4.4.2 Removing the cable harness
Continued

	Action	Note
1	Jog the robot to the specified position: • Axis 1: 0° • Axis 2: -60° • Axis 3: +60° • Axis 4: 0° • Axis 5: +90° • Axis 6: No significance. **Note** The specified position is a recommended position. Axis-5 must be oriented as close as possible to +90° to be able to open the axis-6 motor cover and to remove the axis-6 motor cables, and in order to avoid the spiral of the cable harness in the carrier, being unwound or placed in the wrong position. Depending on what tool is used, the other axes may need to be jogged to another position.	 xx1200001081
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	

Removing the cable harness - upper arm and wrist

These procedures describe how to remove the cable harness in the upper arm and wrist.

Disconnecting the air hose from air fittings

	Action	Note
1	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593

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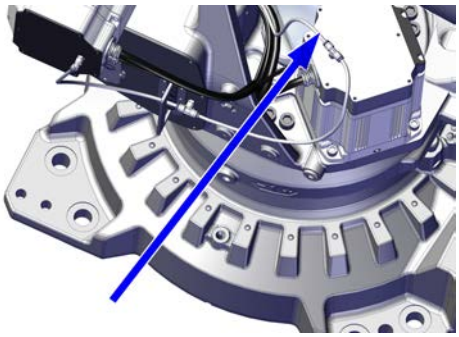
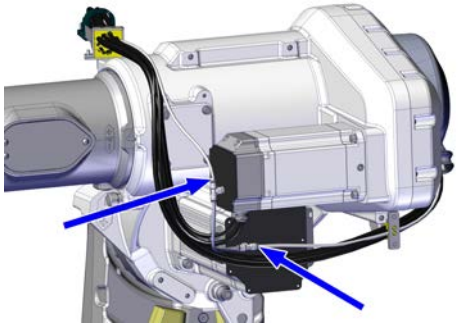
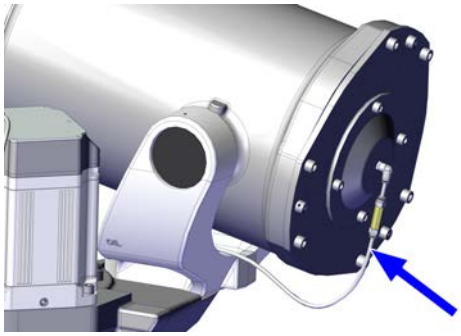
	Action	Note
2	**CAUTION** Turn off the air pressure supply.	
3	Disconnect air hose from air fitting on motor axis-1.	 xx2100000528
4	Disconnect air hose from air fittings on motor axis-3 and axis-4 .	 xx2100000527
5	Disconnect air hose from air fitting on flow valve on balancing cylinder.	 xx2100000566

Retrieving access to the wrist cabling

Use this procedure to remove the wrist cover to retrieve access to the axis-5 and axis-6 motor cables.

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

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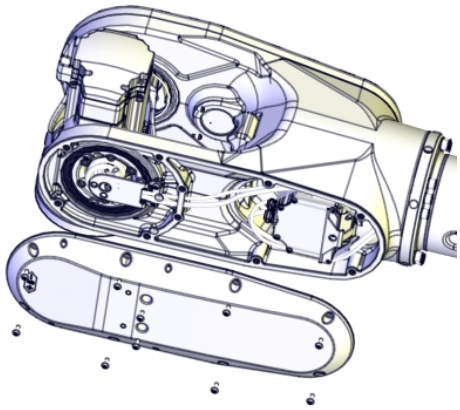
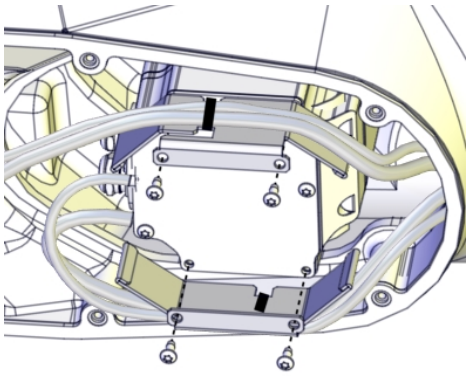
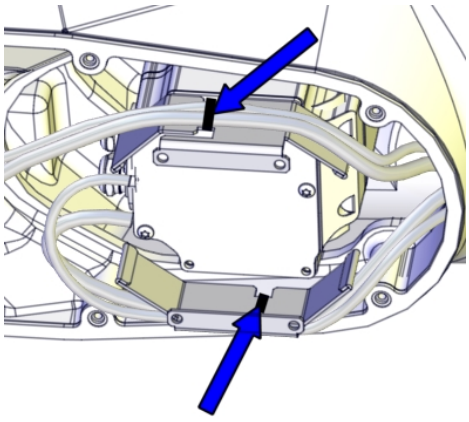
4.4.2 Removing the cable harness

Continued

	Action	Note
2	Remove the wrist cover.	 xx1300002247
3	Remove the heat protection plates from the motor with the cabling still attached to the plate.	 xx1500001030
4	Cut the cable ties that hold the cable harness to the plate. **Note** Keep the heat protection plate until refitting. **Tip** If removing the plate only for replacing the motor, the cabling does not need to be loosened from the plate.	 xx1500001029

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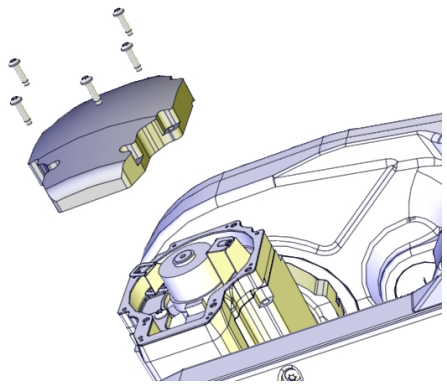
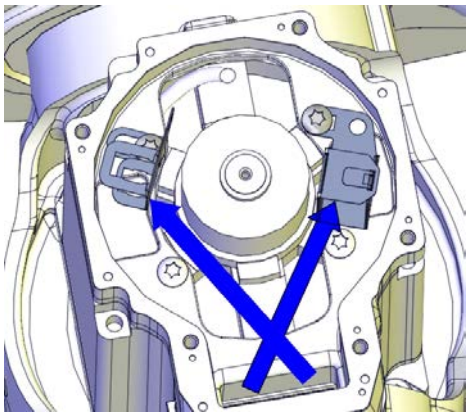
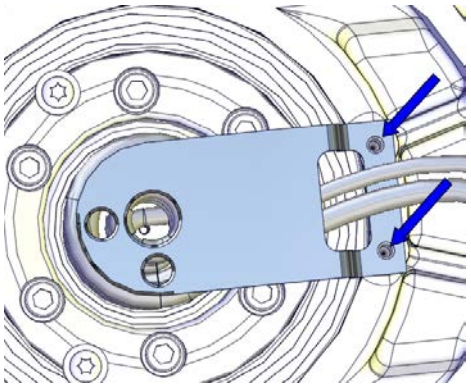
Disconnecting the axis-6 motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Unscrew the attachment screws and remove the motor cover.	 xx1200001080
3	Disconnect the motor cables.	 xx1300000488
4	Unscrew the attachment screws that hold the cable bracket.	 xx1300000484

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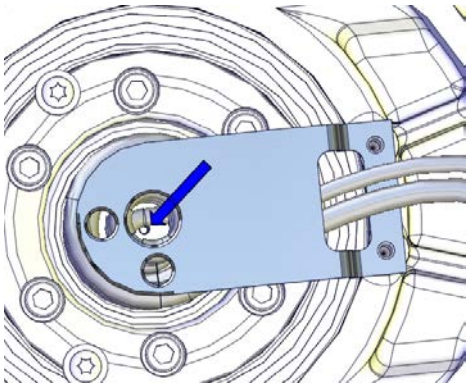
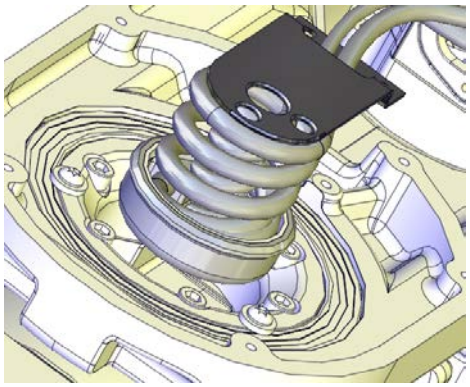
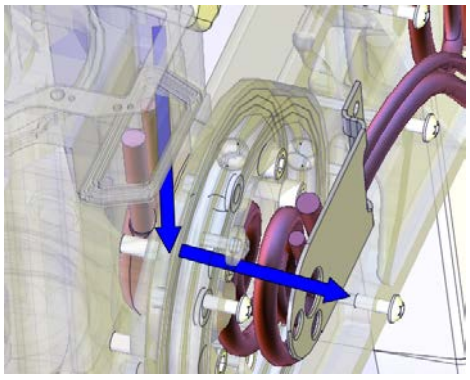
4.4.2 Removing the cable harness

Continued

	Action	Note
5	Unscrew the M4 screw that holds the carrier. **Note** The screw is located at the bottom of the carrier. **Note** The parts are sealed with flange sealant Loctite 5400 (or equivalent Loctite 577). Remove the part carefully.	 xx1300000485
6	Pull out the carrier from its position.	 xx1300001113
7	Pull out the axis-6 motor cables by holding the cables with one hand at the motor and the other at the carrier.	 xx1300000666

Disconnecting the axis-5 motor cables

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

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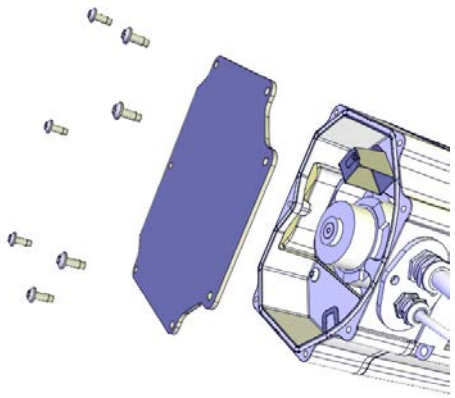
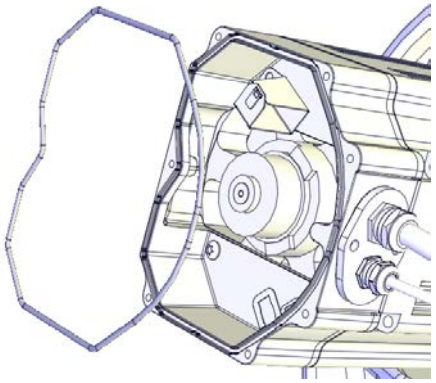
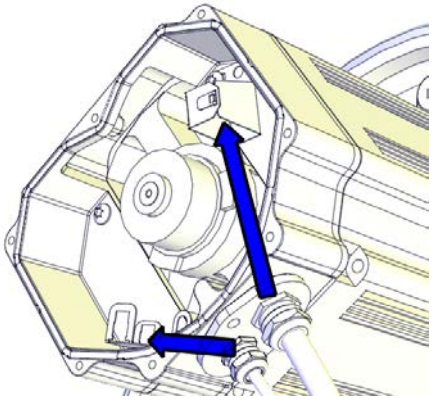
	Action	Note
2	Unscrew the attachment screws and washers and remove the motor cover.	 xx1200001135
3	Make sure the o-ring is present.	 xx1200001070
4	Disconnect the motor cables.	 xx1200001066

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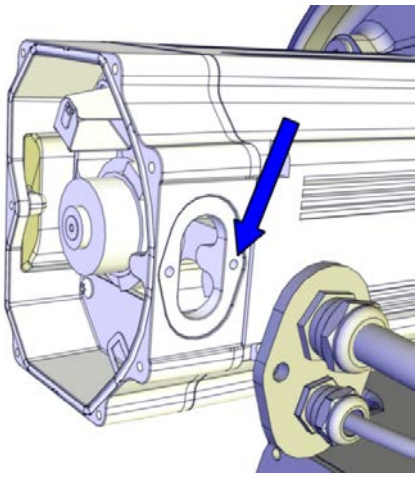
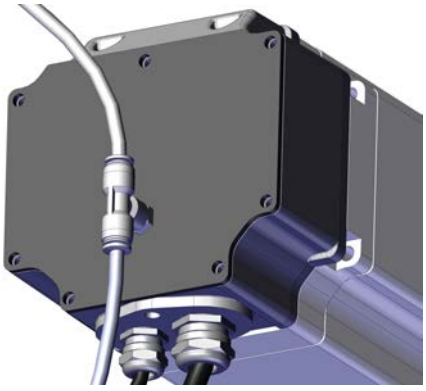
4.4.2 Removing the cable harness

Continued

	Action	Note
5	Remove the cable gland cover by performing the following steps: 1 Open the inner screw a little (the one the arrow is pointing at). No need to remove this screw from the motor. 2 Remove the outer screw. 3 Slide the cable gland cover away from the inner screw. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable exit hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1300000656
6	Use caution and pull out the motor cables.	

Disconnecting the axis-3 and axis-4 motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Disconnect air hose from air fitting on motor cover.	 xx2100000568

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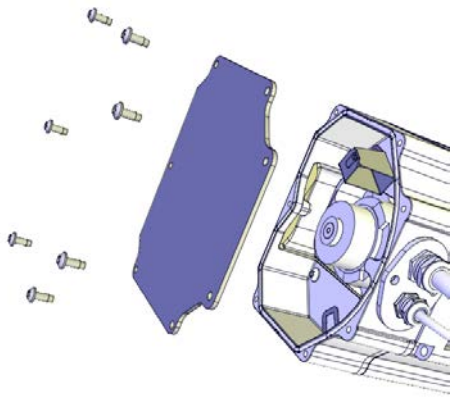
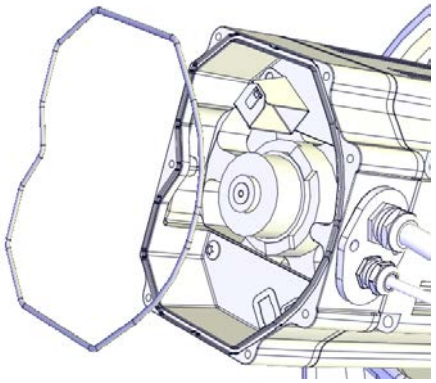
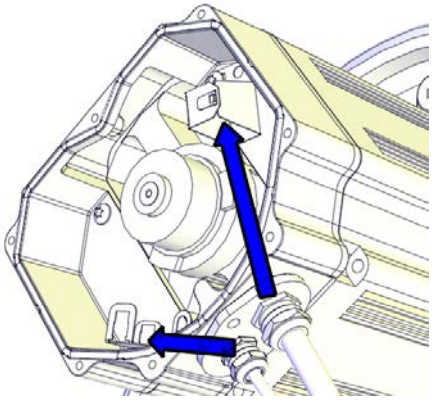
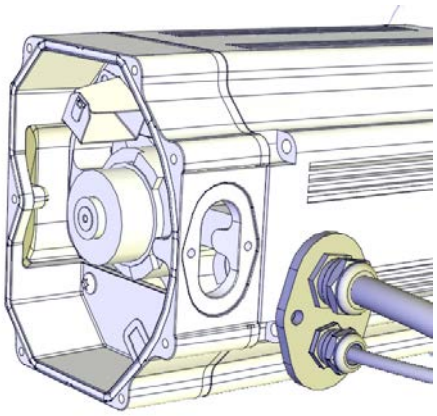
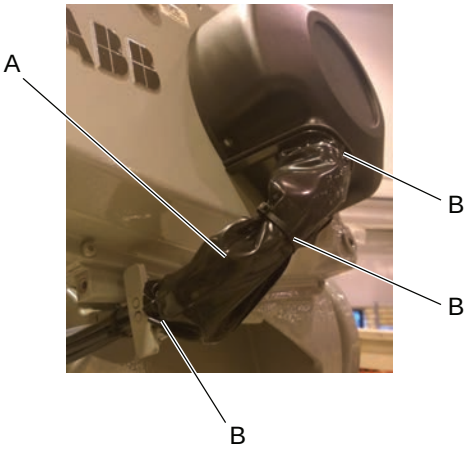
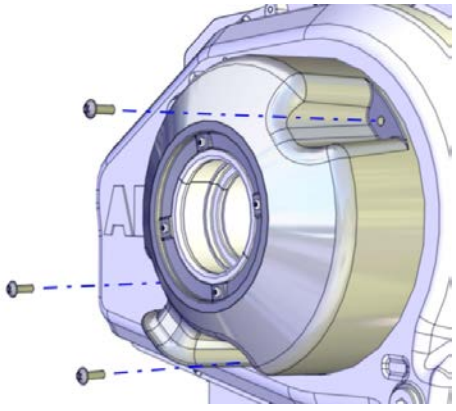
	Action	Note
3	Unscrew the attachment screws and washers and remove the motor cover. **Note** Axis 3 and 4 motors only: Be careful not to damage the air hose or air nipple.	 xx1200001135
4	Make sure the o-ring is present.	 xx1200001070
5	Disconnect the motor cables.	 xx1200001066

Continues on next page

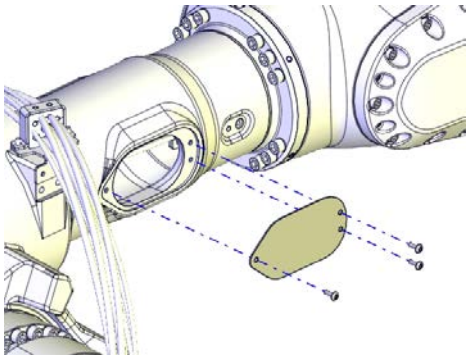
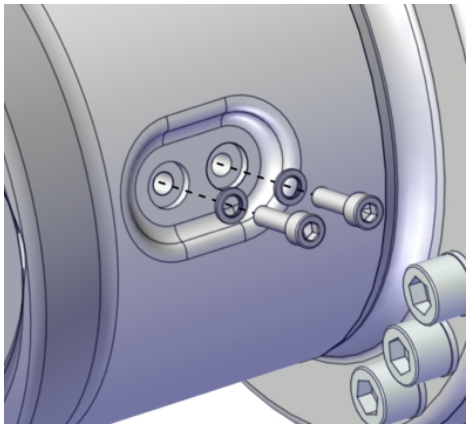
4.4.2 Removing the cable harness
Continued

	Action	Note
6	Remove the cable gland cover. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable gland hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1200001067
7	Use caution and pull out the motor cables.	

Removing the cable harness - wrist and upper arm

	Action	Note
1	Remove the cable protection by cutting the cable ties and opening the zipper.	 xx1700001802 A Cable protection B Cable ties
2	Remove the cover. **Note** Use caution not to damage the gasket, not to loose the washers on the cover sealing or not to loose the inserts fitted on the cover.	 xx1200000045

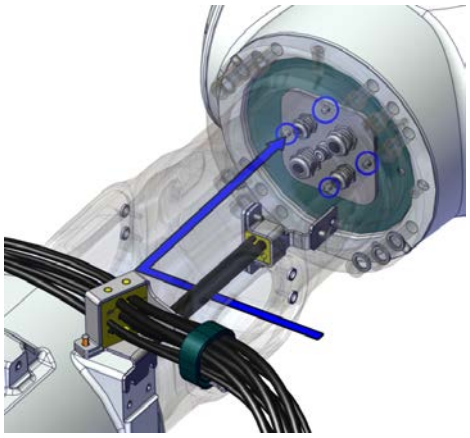
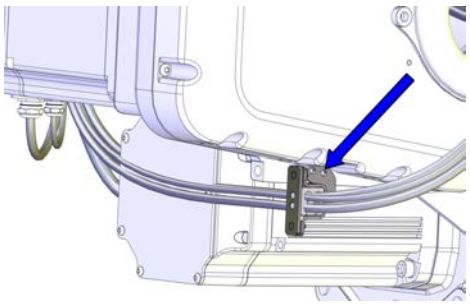
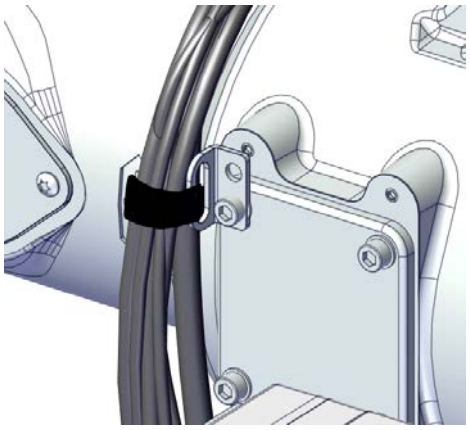
Continues on next page

	Action	Note
3	If the cabling is to be replaced by a new cable harness, remove the cover insert to use it on the new cabling.	 xx1700001803
4	**Tip** Use tape and tie the axis-5 and axis-6 connectors and carrier into a bundle (if not already done). This is done to facilitate the removal and to avoid damaging the parts. This will also make it easier to run the cable harness through the inside of the upper arm.	 xx1300000668
5	Remove the side cover on the arm tube.	 xx1300000557
6	Unscrew the screws and remove the sealing washers, holding the metal clamp inside the arm tube.	 xx1700001809

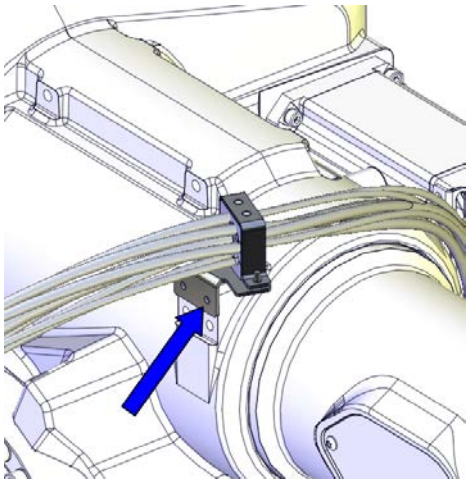
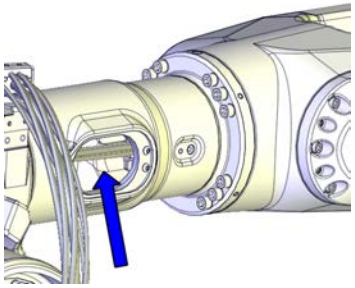
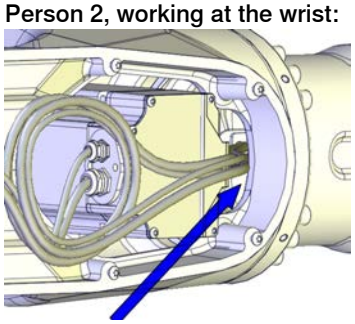
Continues on next page

4.4.2 Removing the cable harness

Continued

	Action	Note
7	Remove the four nuts at the cable plate between the wrist and the upper arm tube, by reaching into the upper arm tube through the arm tube side hole.	 xx1700001567
8	Remove the arm house metal clamp.	 xx1300000543
9	Open the velcro strap at the cable fixing bracket.	 xx1700001810 Cable fixing bracket.

Continues on next page

	Action	Note
10	Remove the metal clamp on top of the arm house.	 xx1300000541
11	Remove the cable harness out from the wrist. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side hole and take a hold of the cable harness. • Person 2: Take a hold on the cable harness inside the wrist. • Together: Move the cable harness past the axis-5 motor and into the arm tube.	Person 1, working at the side hole:  xx1300000745 Person 2, working at the wrist:  xx1300000746

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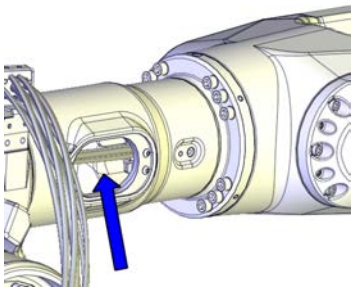
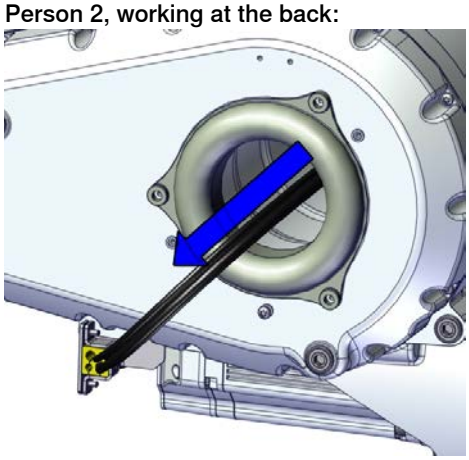
4.4.2 Removing the cable harness
Continued

	Action	Note
12	Remove the cable harness out of the arm tube, at the back of the upper arm. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side hole and take a hold of the cable harness. • Person 2: Take a hold on the cable harness at the back of the robot. • Together: Move the cable harness out of the arm tube.	Person 1, working at side hole:  xx1300000745 Person 2, working at the back:  xx1700001568

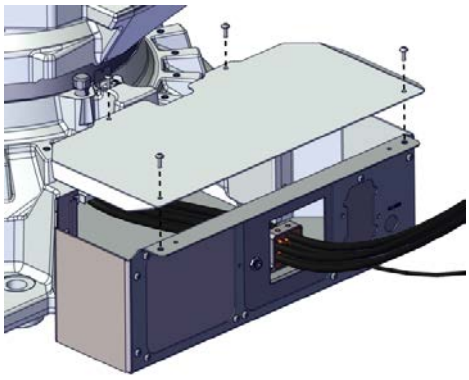
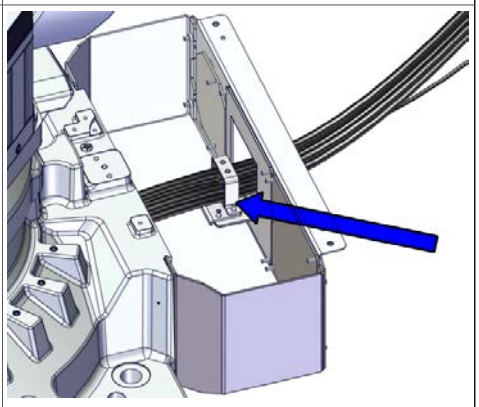
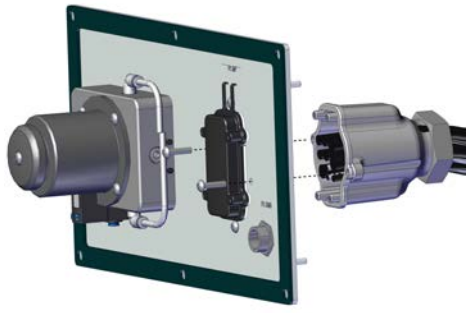
Removing the cable harness - base, frame and lower arm

These procedures describes how to remove the cable harness from base, frame and lower arm.

Preparations before removing the cable harness in the base

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**CAUTION** Turn off the air pressure supply.	

Continues on next page

	Action	Note
3	Remove the base cover.	 xx1700001580
4	Remove the metal clamp inside the base.	 xx1700001584
5	Remove the cover that protects the R1.MP and R1.SMB connectors.	 xx1700001581
6	Disconnect connectors: • R1.MP • R1.SMB	 xx1700001582

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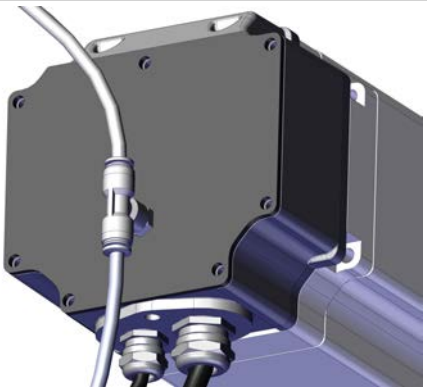
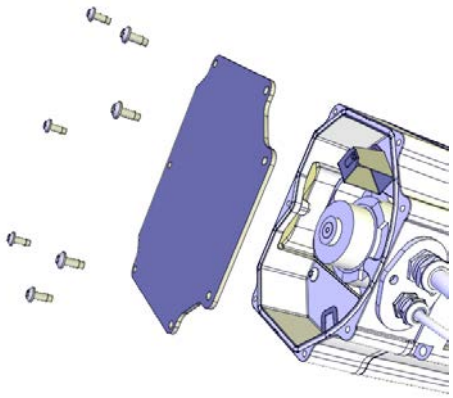
4.4.2 Removing the cable harness

Continued

	Action	Note
7	Disconnect the earth cable.	Screw dimension : M6x16 Washer dimension : 6.4x17x3

Disconnecting the axis-1 and axis-2 motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Disconnect air hose from air fitting on motor cover.	 xx2100000568
3	Unscrew the attachment screws and washers and remove the motor cover. **Note** Axis 3 and 4 motors only: Be careful not to damage the air hose or air nipple.	 xx1200001135

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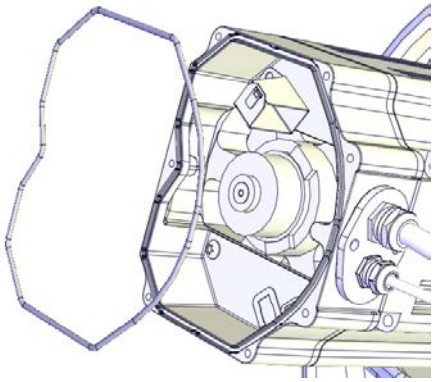
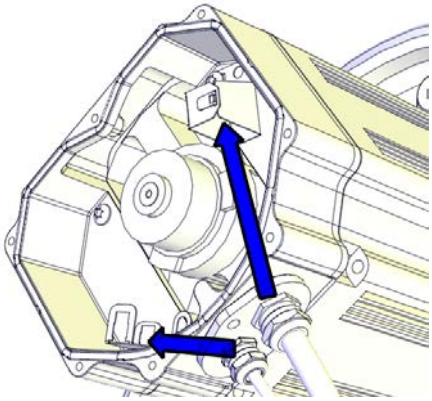
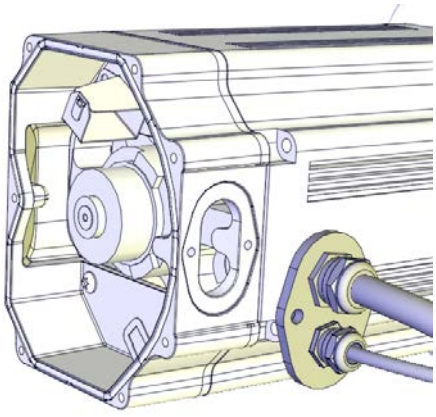
	Action	Note
4	Make sure the o-ring is present.	 xx1200001070
5	Disconnect the motor cables.	 xx1200001066
6	Remove the cable gland cover. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable gland hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1200001067
7	Use caution and pull out the motor cables.	

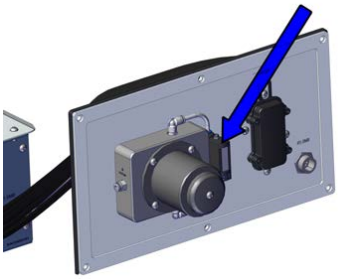
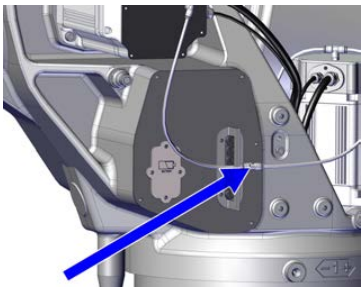
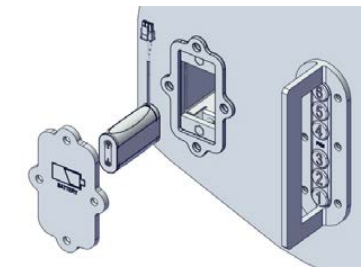
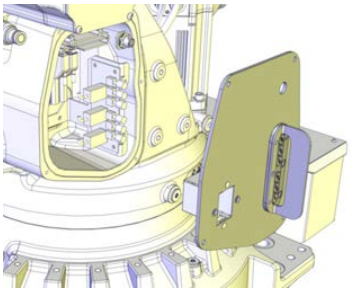
Preparations before disconnecting the SMB unit

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

Continues on next page

4.4.2 Removing the cable harness

Continued

	Action	Note
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	
3	Check the leak flow value on the flow sensor (if not already checked and noted). Note the value to be able to compare it when repair is completed.	 xx1700001593
4	**CAUTION** Turn off the air pressure supply.	
5	Disconnect air hose from air fitting on SMB cover.	 xx2100000591
6	Open the small cover on the SMB cover, disconnect the battery cable and remove the battery.	 xx1700001806
7	Remove the SMB cover. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	 xx1300000669

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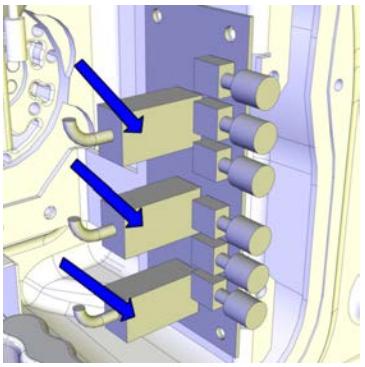
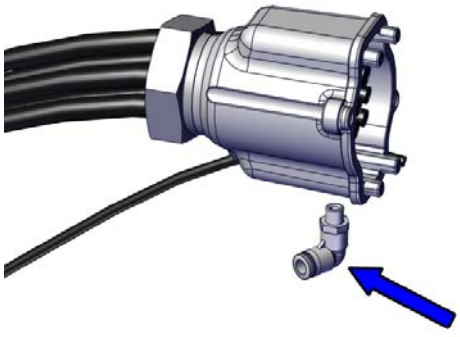
Disconnecting the brake release unit

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	
3	Take a picture or make notes of how the robot cabling is positioned in regard to the brake release board.	
4	Remove the connectors X8, X9 and X10 from the brake release board.	 xx1300000670

Removing the cable harness in the frame

	Action	Note
1	Remove the air coupling from the R1.MP connector.	 xx1700001583

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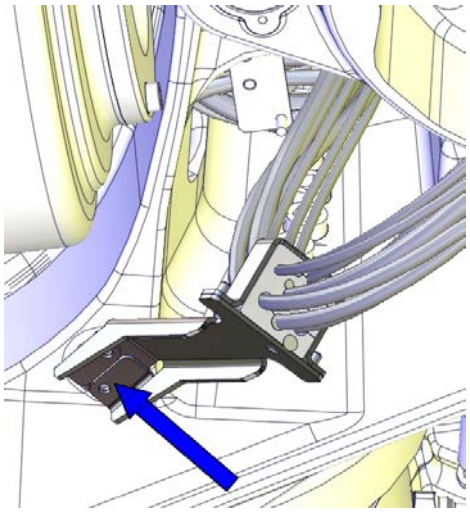
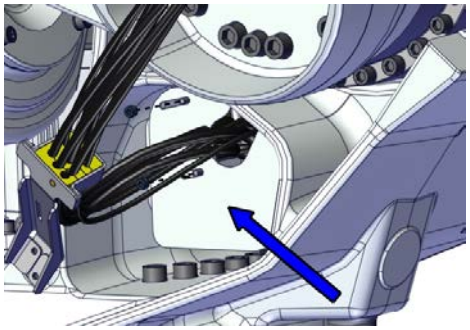
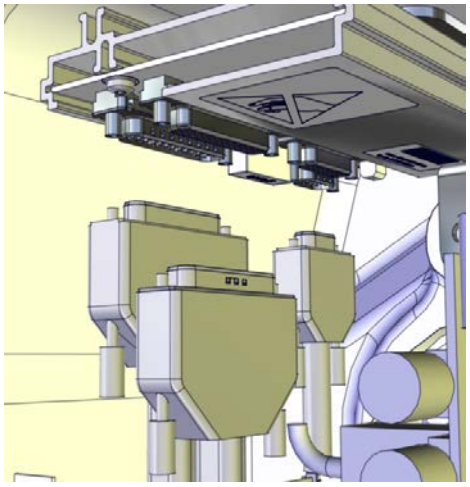
4.4.2 Removing the cable harness

Continued

	Action	Note
2	Unscrew the attachment screws that hold the metal clamp frame.	 xx1300000542
3	Remove the cable protection plate by removing the two nuts.	 xx1700001585
4	Disconnect connectors on the SMB unit.	 xx1300001114

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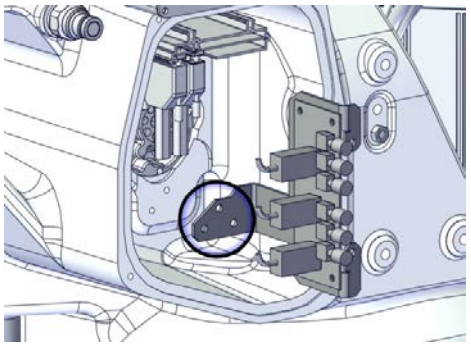
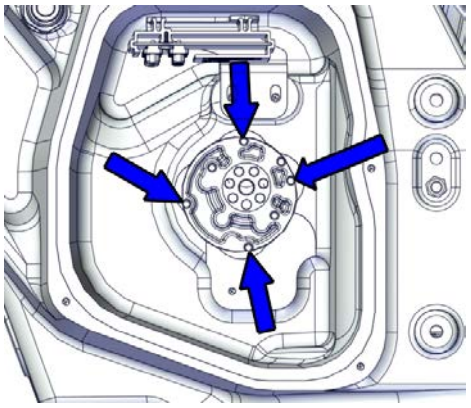
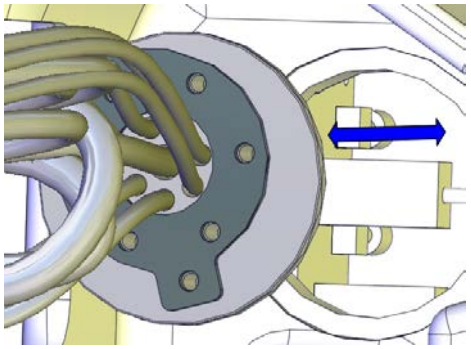
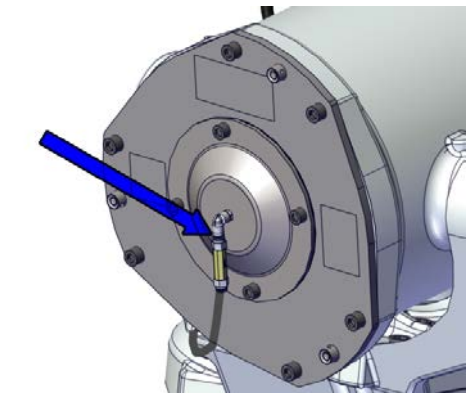
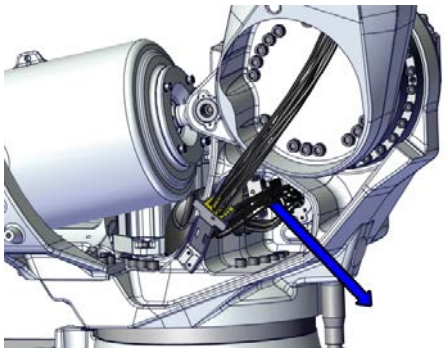
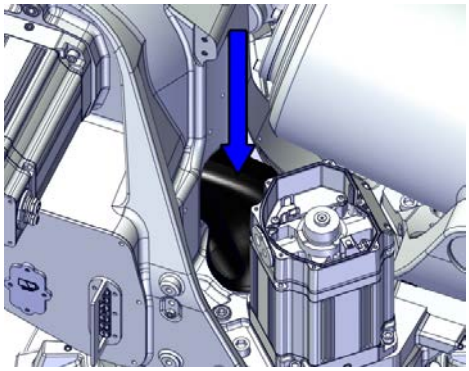
	Action	Note
5	Unscrew the attachment screws that secure the brake release unit bracket. Remove the bracket with the brake release unit fitted.	 xx1700002154
6	Unscrew the attachment screws that hold the SMB/BU cover from inside the SMB recess.	 xx1700002155
7	Use caution and pull out the cable harness from the SMB recess.	 xx1300000560
8	Disconnect the air hose from the balancing device.	 xx1700002246

Continues on next page

4.4.2 Removing the cable harness

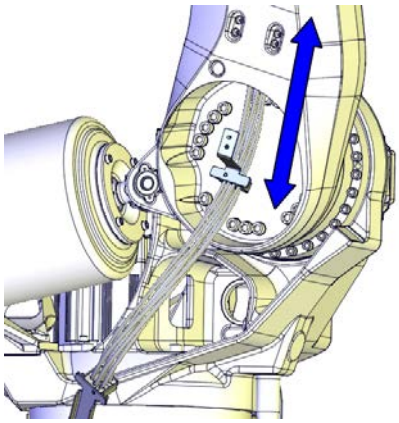
Continued

	Action	Note
9	Use caution and pull out the cable harness up from the base and out through the hole in the frame. **Tip** Keep a hand on the cable protection while pulling out the cable harness from the base, so it does not come loose.	 xx1700001586  xx1700001807

Removing the cable harness in the lower arm

	Action	Note
1	Loosen the axis-2 lower arm metal clamp and the axis-3 lower arm metal clamp located on the inside of the lower arm by removing the attachment screws. **Note** The screws are reached from the outside of the lower arm.	 xx1300000540

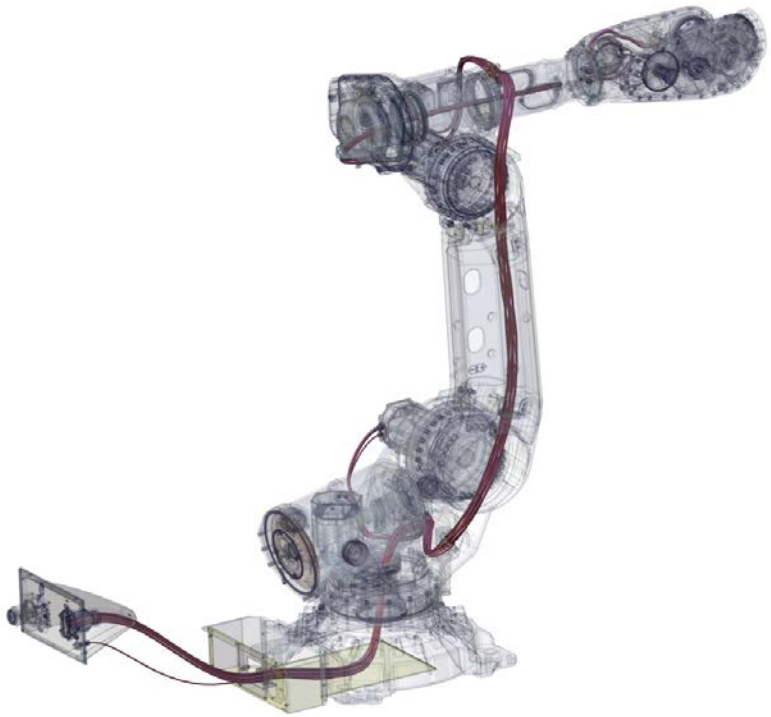
Continues on next page

	Action	Note
2	Use caution and pull the cable harness out.	 xx1300000733

4.4.3 Refitting the cable harness

Location of the cable harness

The cable harness is located as shown in the figure.



xx1700001801

Spare part

Spare part	Spare part number	Note
Cable harness	See *Product manual, spare parts - IRB 6790*	The spare part includes two screws and two sealing washers.
Cover insert	3HAC048520-001	Replace if damaged.
Cable protection, PU rubber	3HAC055411-001	Replace if damaged.

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Consumables

Consumable	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.
O-ring	21522012-429	D=84.5x3 Used on the SMB/BU cover.

Continues on next page

Consumable	Article number	Note
O-ring	3HAC067762-001	Used on axis-1 motor cover.
	3HAC067762-001	D=169.5x3 Used on axis-2 motor cover.
	3HAC067762-001	D=169.5x3 Used on axis-3 motor cover
	3HAC067744-001	D=119x3 Used on axis-4 motor cover.
	3HAC067744-001	D=119x3 Used on axis-5 motor cover.
Gasket	3HAC033489-002	Used on axis-6 motor cover.
Adapter	3HAC11774-3	At connector R1.MP Includes o-rings 3HAC061327-080
Cable ties	-	
Weatherstrip	3HAC053986-001	
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)
Sealant (grey)	3HAC026759-001	Sikaflex 521FC
Flange sealant	-	Loctite 574 (or equivalent)
Activator	3HAC074342-001	Loctite 7091
Flange sealant for conical fittings	-	Loctite 5400 (or equivalent Loctite 577)

Required documents

Document	Document number	Note
Description and installation information - Manipulator harness - IRB 6790	*9AKK108470A2987-001*	Additional installation information if the existing cable harness is 3HAC061214-001 and it is to be replaced by the new harness 3HAC090903-001.

Robot position

If the robot axes have been re-positioned after the cable harness has been removed, make sure to restore the initial robot position before refitting the cable harness.
See *Preparations before removing the cable harness on page 207*.

Refitting the cable harness - base, frame and lower arm

These procedures describe how to refit the cable harness in base, frame and lower arm.

Continues on next page

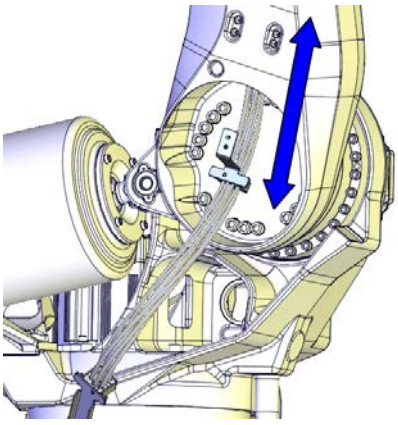
4.4.3 Refitting the cable harness
Continued

Also see additional installation information if the existing cable harness is 3HAC061214-001 and it is to be replaced by the new harness 3HAC090903-001.

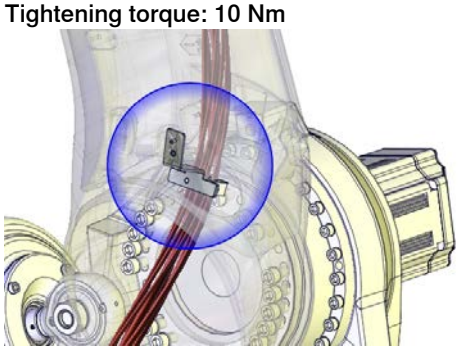
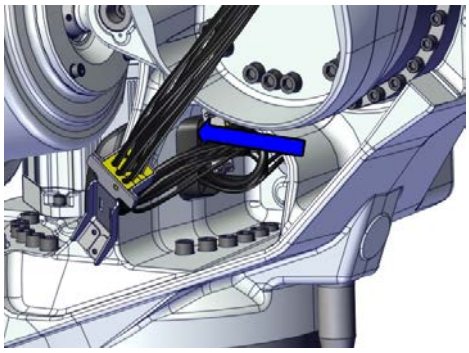
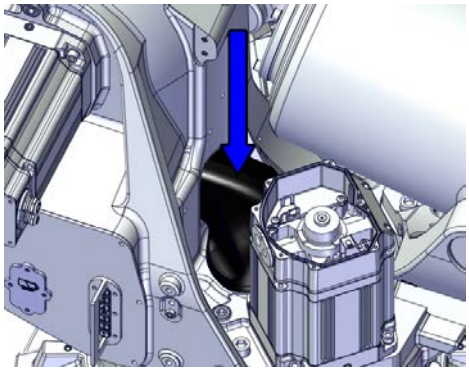
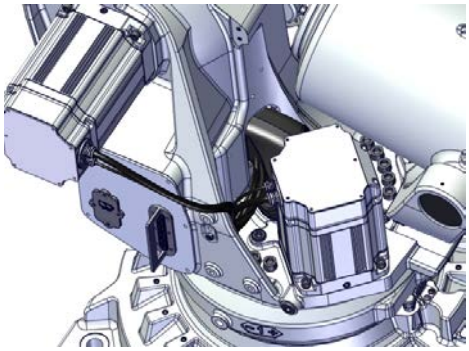
Preparations before refitting the cable harness in the base, frame and lower arm

Note

Handle the cables carefully to avoid any scratches or damage that lead to leakage when the system is pressurized.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
2	Tie the axis-5 and axis-6 connectors and carrier into a bundle with tape. This is done to facilitate the procedure and to avoid damaging the parts during the procedure. This will also make it easier to run the cable harness through the inside of the robot.	 xx1300000668
3	Run the cable harness through the lower arm.	 xx1300000733

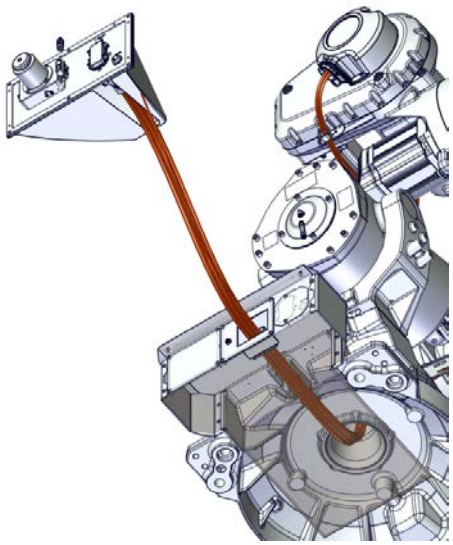
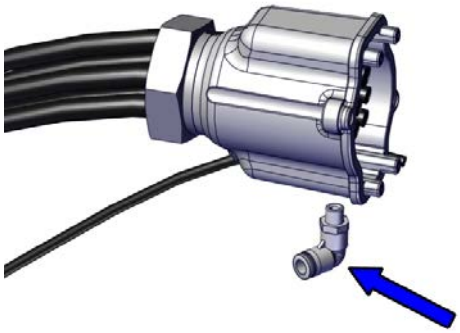
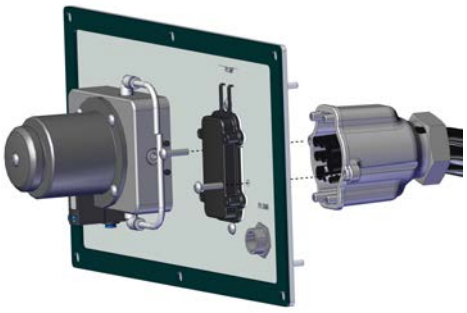
Continues on next page

	Action	Note
4	Secure the axis-2 lower arm cable bracket. **Note** Do not secure the axis-3 lower arm cable bracket at this point. **Note** Screws are reached from the outside of the lower arm.	Tightening torque: 10 Nm  xx1300000734
5	Run the R2.MP3-R2.MP6 and R1.SMB cables into the hole in the frame and through the cable protection into the base. **Tip** Keep a hand on the cable protection while pushing in the cable harness, so it does not come loose. **Note** If the cable protection has come loose, the axis-1 motor must be removed to have space for refitting.	 xx1700001589  xx1700001807
6	Run the R2.MP1, R2.MP2, R2.SMB1 and R2.SMB2 beside the cable protection and out to the axis-1 and axis-2 motors. Also run the air hose to the balancing device beside the cable protection.	 xx1700001588

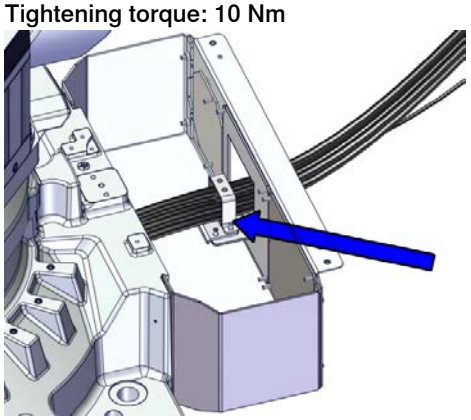
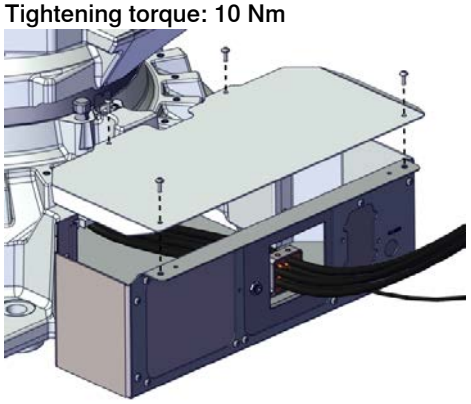
Continues on next page

4.4.3 Refitting the cable harness
Continued

Refitting the cable harness in the base

	Action	Note
1	Run the cables correctly aligned: • Make sure that the cables are not twisted. Each cable must be in line with its position on the base plate. • Make sure that the R1.SMB cable will run on the correct side of the R1.MP1, see the figure. **Note** Do not run the cables connected between the interface plate and the manipulator base submerged beneath detergent solution, since that kind of extensive exposure to fluids shortens the expected life of the cables significantly.	 xx1700001808
2	Seal and refit the air coupling to the connector R1.MP and reconnect the air pressure hose.	Tightening torque: 0.5 kg  xx1700001583
3	Connect connectors R1.MP and R1.SMB. Also connect the air hose that belongs to the balancing device. Check the adapter for dirt or wear. Clean or replace if needed.	Tightening torque for R1.SMB: 10 Nm. Adapter: 3HAC11774-3  xx1700001582

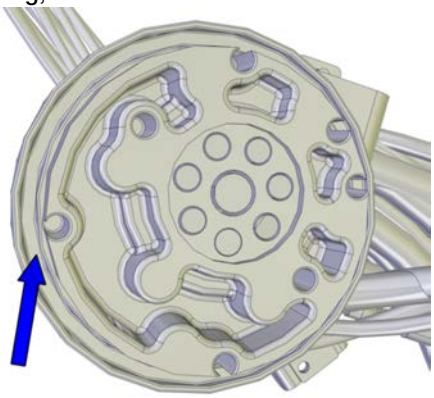
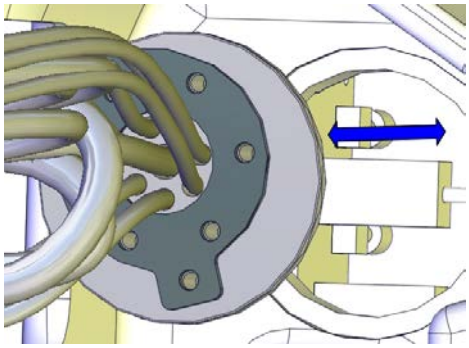
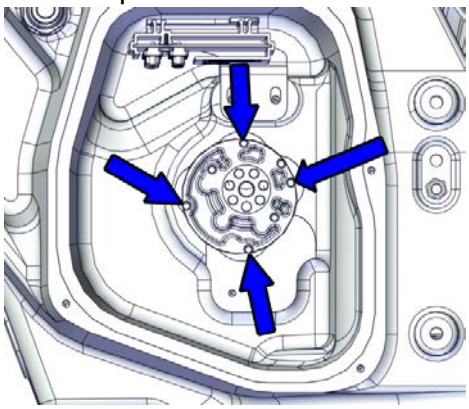
Continues on next page

	Action	Note
4	Refit the cover that protects the R1.MP and R1.SMB connectors.	Tightening torque: 6 Nm  xx1700001581
5	Connect the earth cable.	Screw dimension: M6x16. Washer dimension: 6.4x17x3.
6	Refit the metal clamp inside the base.	Tightening torque: 10 Nm  xx1700001584
7	Refit the base cover.	Tightening torque: 10 Nm  xx1700001580
8	Install the cabling between the base and the	

Continues on next page

4.4.3 Refitting the cable harness
Continued

Refitting the cable harness in the frame

	Action	Note
1	Remove the old sealant without damaging the equipment before removing the o-ring located on the SMB/BU cover.	O-ring, 21522012-429  xx1300000737 The figure shows the position of the o-ring.
2	Check the o-ring and replace if damaged.	
3	Wipe clean the contact surfaces and apply new sealant on top of the new o-ring after positioning it in the groove.	Sealant (grey): 3HAC026759-001 (Sikaflex 521FC)
4	Run the SMB/BU cables into the SMB recess.	 xx1300000560
5	Fit the SMB/BU cover in its hole with the attachment screws from inside the SMB recess without damaging the o-ring. **Note** Do not tighten the screws fully! It must still be possible to adjust the position of the cable harness by rotating the SMB/BU cover in its hole a little.	Screws: 4 pcs.  xx1700002155

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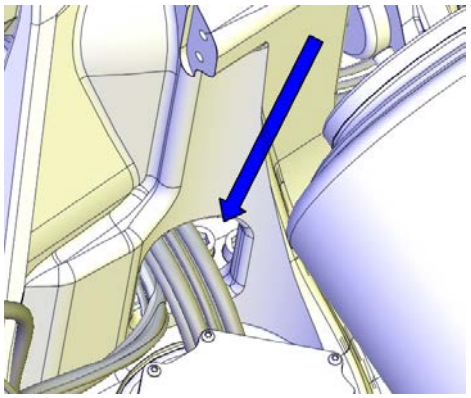
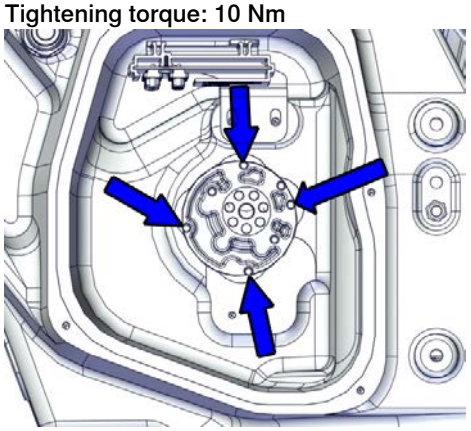
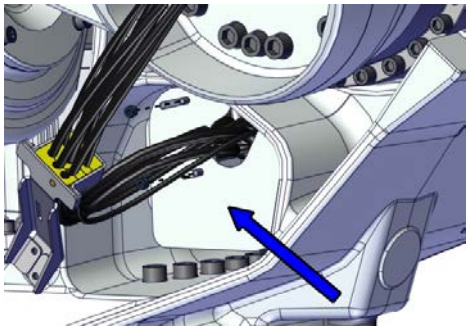
	Action	Note
6	Adjust the cables running through the hole in the frame by carefully moving the SMB/BU cover on its screws, while at the same time checking the position of the cable harness through the hole. **Note** The cables must be placed so that they don't rub against any part of the robot.	 xx1300000593
7	Secure the SMB/BU cover with its four attachment screws from inside the SMB/BU recess.	Tightening torque: 10 Nm  xx1700002155
8	Refit the cable protection plate with two nuts.	 xx1700001585

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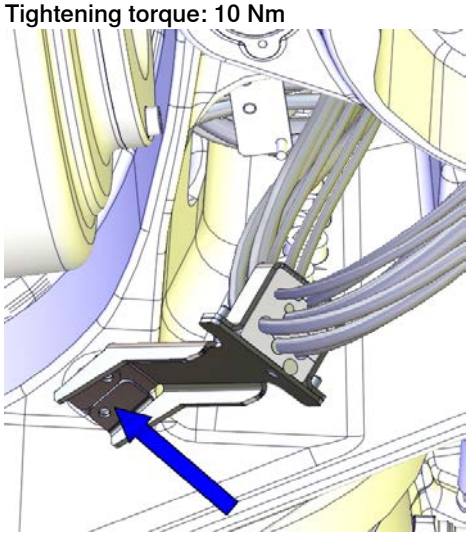
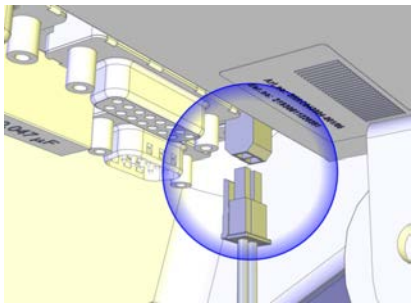
4.4.3 Refitting the cable harness
Continued

	Action	Note
9	Refit the frame metal clamp.	Tightening torque: 10 Nm  xx1300000542

Refitting and reconnecting the SMB and BU units

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	
3	Connect the battery cable to the SMB unit. Make sure the lock snaps into place during refitting.	 xx1300000729

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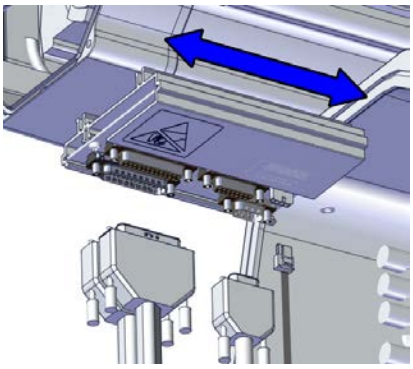
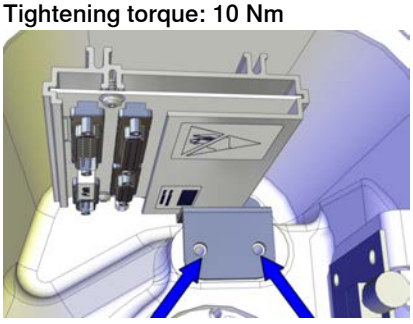
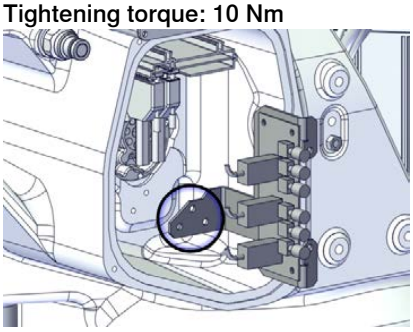
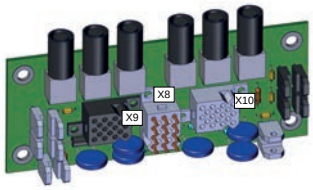
	Action	Note
4	Connect all connectors to the SMB board: • R1.SMB1-3, R1.SMB4-6 and R2.SMB	 xx1300000728
5	Push the SMB unit carefully into position and fit the bracket that secures the SMB unit.	Tightening torque: 10 Nm  xx1300000730
6	If removed, refit the bracket with the brake release unit fitted.	Tightening torque: 10 Nm  xx1700002154
7	If disconnected, reconnect the connectors X8, X9 and X10 to the brake release board. Be careful not to damage the sockets or pins. Make sure the connector and its locking arms are snapped down properly.	 xx1700000978

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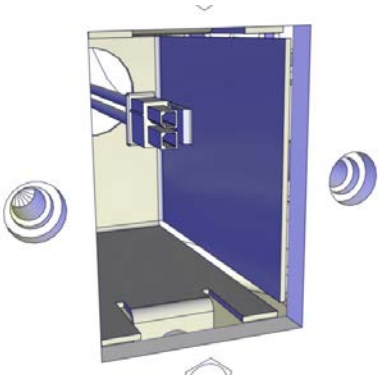
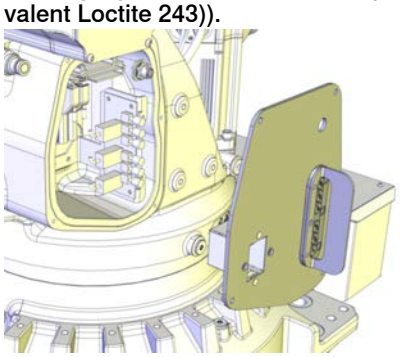
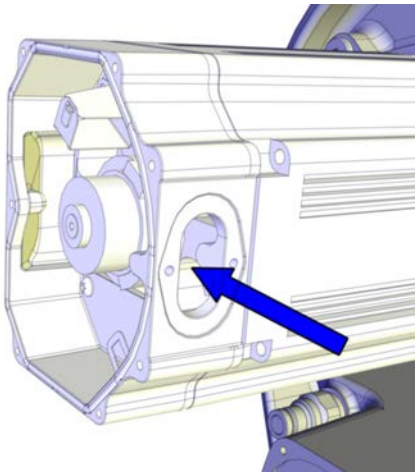
4.4.3 Refitting the cable harness

Continued

	Action	Note
8	Pull out the battery cable through the recess for the battery.	 xx1300000834
9	Check the sealing on the SMB cover. Replace sealing if damaged.	Gasket SMB-cover: 3HAC044074-002.
10	Secure the SMB cover with the attachment screws. If cabling is used for 7th axis (option), refit the connector R2.FB7 to the SMB cover and tighten with 6 Nm.	Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1300000669

Reconnecting the axis-1 and axis-2 motor cables

	Action	Note
1	Push the motor cables through the cable gland opening.	 xx1300000738

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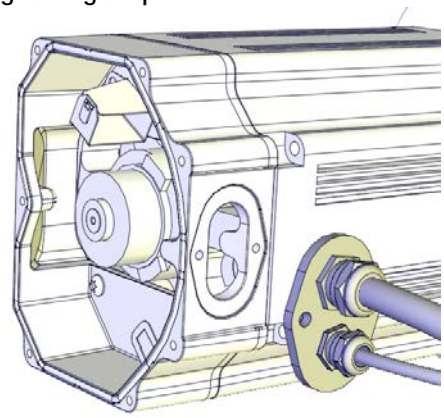
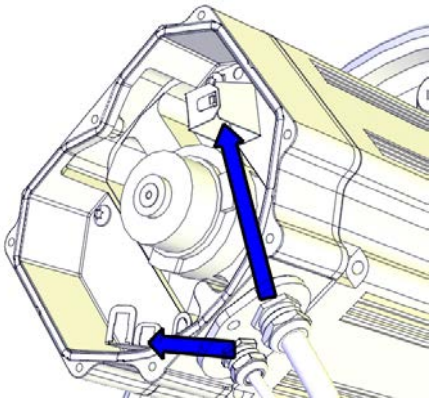
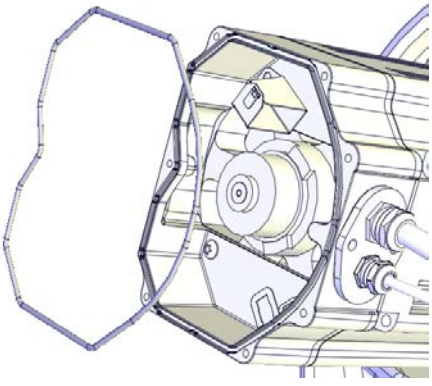
	Action	Note
2	Refit the cable gland cover. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001067
3	Connect the motor cables. Connect in accordance with the markings on the connectors.	 xx1200001066
4	Inspect the o-ring. **Note** Replace if damaged.	O-ring, axis-1: 3HAC067762-001 O-ring, axis-2: 3HAC067762-001 O-ring, axis-3: 3HAC067762-001 O-ring, axis-4: 3HAC067744-001  xx1200001070
5	Wipe clean o-ring and o-ring groove.	

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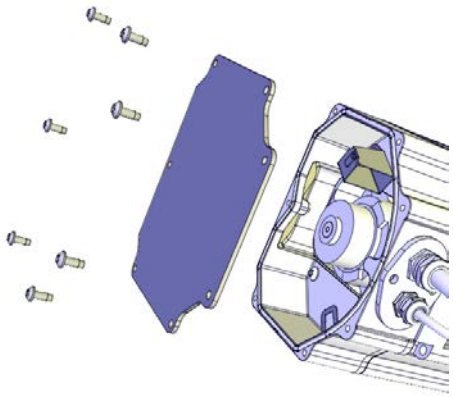
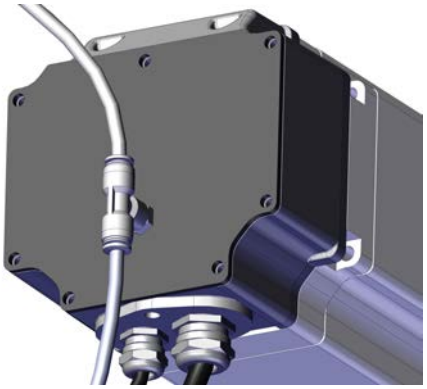
4.4.3 Refitting the cable harness

Continued

	Action	Note
6	Refit the o-ring. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	
7	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
8	Refit the motor cover with it's attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Attachment screws: M5x12 Stainless steel A2-70 (7 pcs) (9ADA619-44) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001135
9	Make sure that the covers are tightly sealed.	
10	Connect air hose to air fitting on motor. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000568

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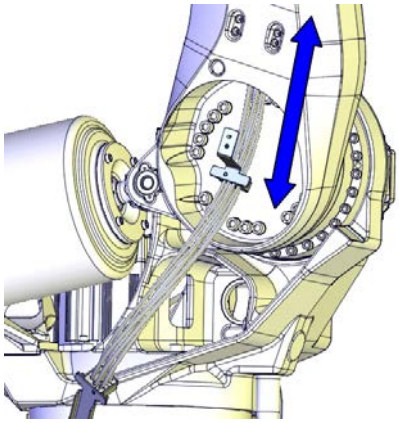
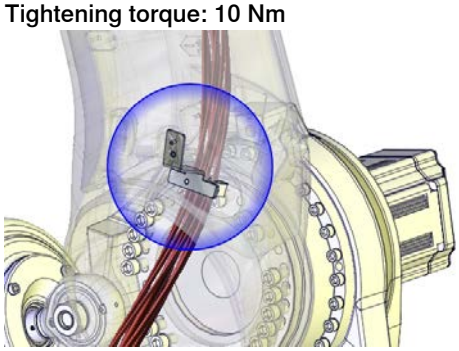
Refitting the cable harness - lower arm

	Action	Note
1	**Tip** Use tape and tie the axis-5 and axis-6 connectors and carrier into a bundle (if not already done). This is done to facilitate the procedure and to avoid damaging the parts during the procedure. This will also make it easier to run the cable harness through the inside of the robot.	 xx1300000668
2	Run the upper end of the cable harness up through the lower arm.	 xx1300000733
3	Refit the axis-2 lower arm metal clamp located on the inside of the lower arm. **Note** The screws are reached from the outside of the lower arm.	Tightening torque: 10 Nm  xx1300000734

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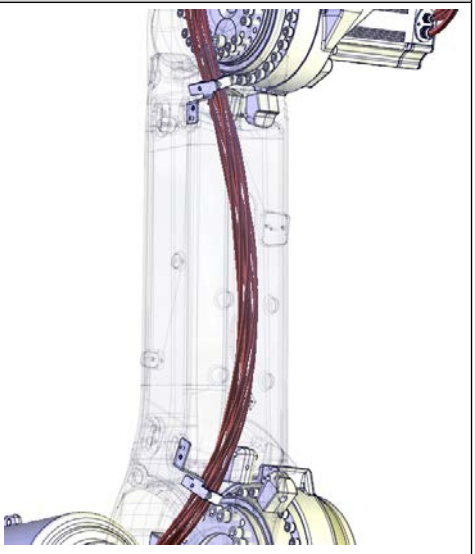
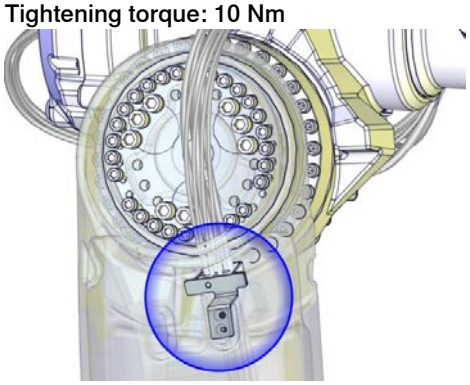
4.4.3 Refitting the cable harness

Continued

	Action	Note
4	Before fitting the remaining axis-3 lower arm cable bracket inside the lower arm, check that it will stay twisted a little between the metal clamps, after fitting, as shown in the figure. Do not change the position of the brackets!	 xx1300000595
5	Refit the axis-3 lower arm metal clamp located on the inside of the lower arm. **Note** The screws are reached from the outside of the lower arm.	Tightening torque: 10 Nm  xx1300000558

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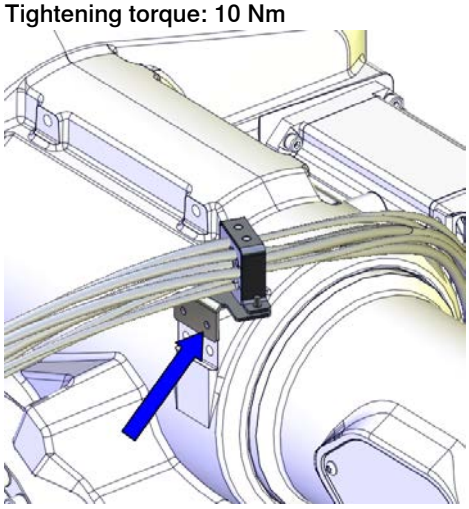
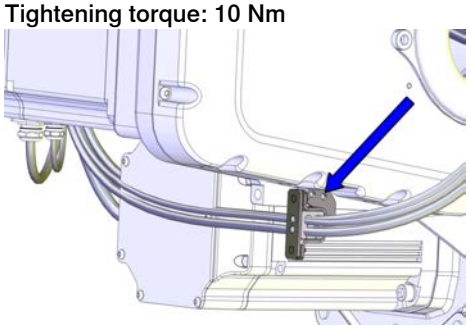
Refitting the cable harness - upper arm and wrist

These procedures describes how to refit the cable harness in upper arm and wrist.

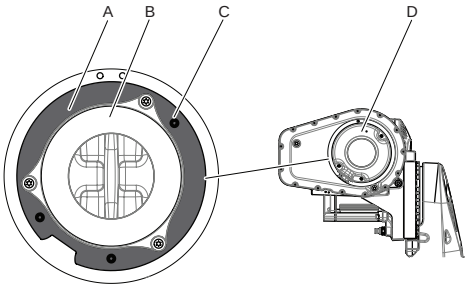
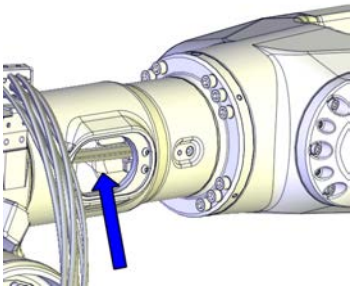
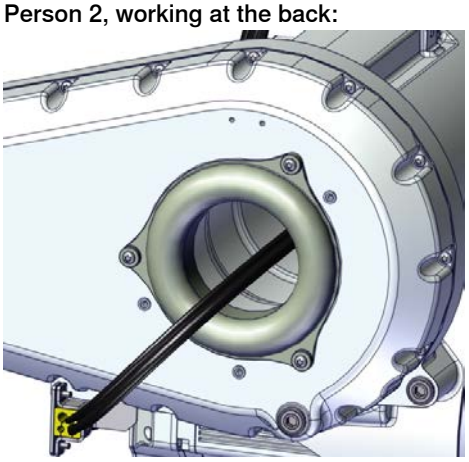
Refitting the cable harness - upper arm

	Action	Note
1	Refit the metal clamp on top of the arm house.	Tightening torque: 10 Nm  xx1300000541
2	Refit the arm house metal clamp.	Tightening torque: 10 Nm  xx1300000543
3	Arrange the cables between the cable clamps in the upper arm.	
4	**Tip** Use tape and tie the axis-5 and axis-6 connectors and carrier into a bundle (if not already done). This is done to facilitate the procedure and to avoid damaging the parts during the procedure. This will also make it easier to run the cable harness through the inside of the robot.	 xx1300000668

Continues on next page

4.4.3 Refitting the cable harness

Continued

	Action	Note
5	Make sure that the gasket underneath the cover is correctly fitted. Replace if damaged. The gasket is covered with adhesive on the side facing the upper arm cover. The three washers are pressed into the holes in the gasket. Make sure all three washers are fitted.	 xx1400000382 A Gasket B Cable guide C Washer D Cover
6	Run the cable harness through the cable guide and then into and through the upper arm tube. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side hole of the arm tube and take a hold of the cable harness. • Person 2: Take a hold on the cable harness at the back of the robot. • Together: Use caution and move the cable harness into the arm tube.	Person 1, working at the side hole:  xx1300000745 Person 2, working at the back:  xx1700001569

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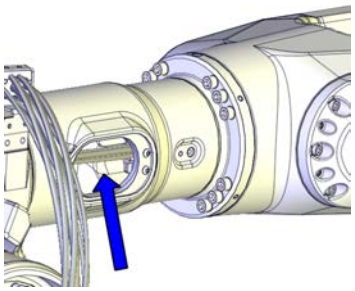
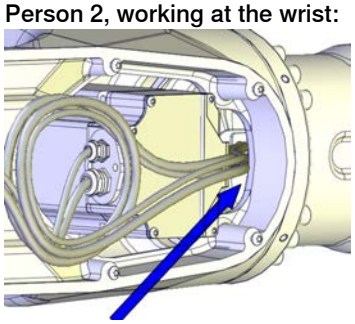
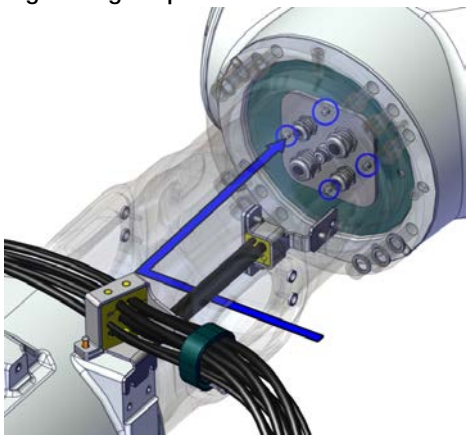
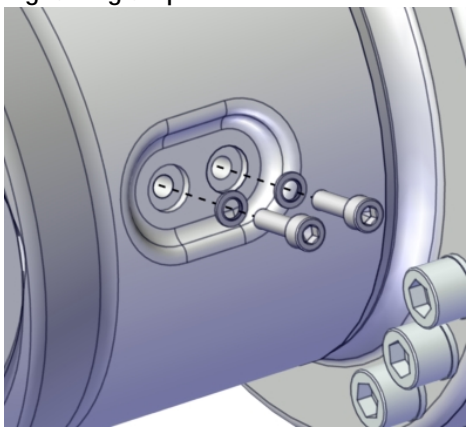
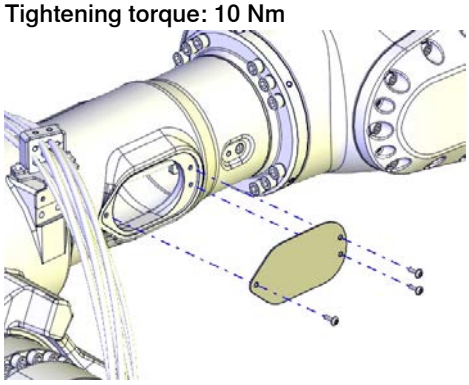
	Action	Note
7	Use caution and push the cable harness into the wrist. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side cover hole and take a hold of the cable harness. • Person 2: Take a hold of the cable harness from inside the wrist. • Together: Move the cable harness past the axis-5 motor and into the wrist.	Person 1, working at the side hole:  xx1300000745 Person 2, working at the wrist:  xx1300000746
8	Refit the four nuts to the cable plate between the wrist and the upper arm tube, by reaching into the upper arm tube through the arm tube side hole.	Tightening torque: 10 Nm  xx1700001567

Continues on next page

4.4.3 Refitting the cable harness

Continued

	Action	Note
9	Refit the metal clamp axis-4, inside the arm tube. **Note** Always use new sealing washers.	New washers are included in the spare part kit. Tightening torque: 10 Nm  xx1700001809
10	Refit the side cover. **Note** • Make sure the gasket is fitted correctly on the side cover • Use attachment screws made of stainless steel to fit the side cover.	Tightening torque: 10 Nm  xx1300000557

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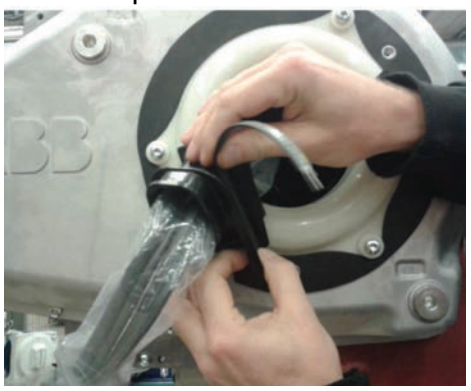
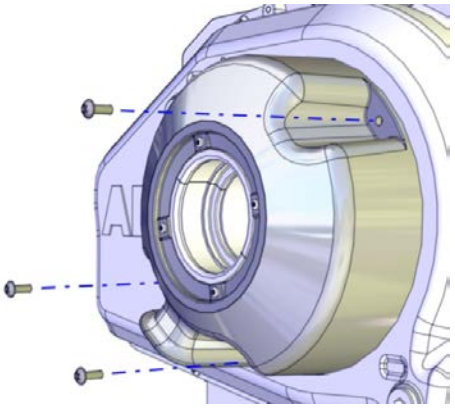
	Action	Note
11	Fit the cover insert around the new cabling and secure it with a weatherstrip.	Cover insert: 3HAC048520-001.  xx1700001803 Weatherstrip: 3HAC053986-001.  xx1700001804
12	Refit the cover with the tube guiding ring fitted. **Note** • Make sure the gasket is fitted correctly • Use attachment screws made of stainless steel to fit the cover.	 xx1200000045

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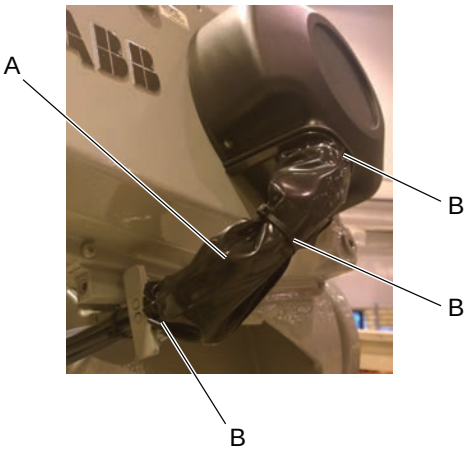
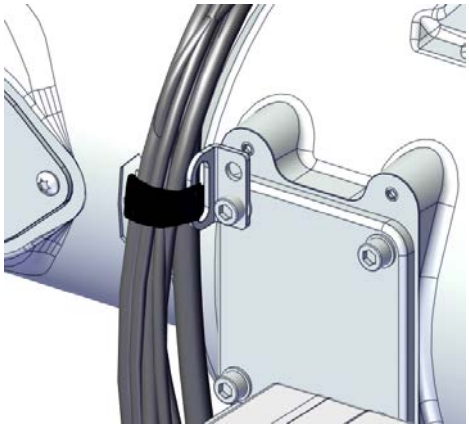
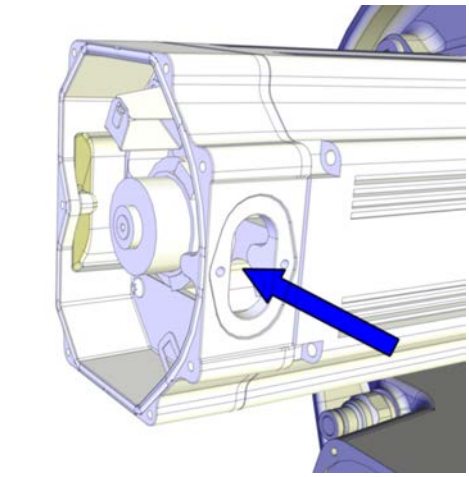
4.4.3 Refitting the cable harness
Continued

	Action	Note
13	Refit the cable protection by closing the zipper and securing with cable ties.	Cable protection, PU rubber: 3HAC055411-001.  xx1700001802 A Cable protection B Cable ties
14	Secure the cable harness to the cable fixing bracket with the velcro strap.	 xx1700001810

Connecting the axis-3 and axis-4 motor cables

	Action	Note
1	Push the motor cables through the cable gland opening.	 xx1300000738

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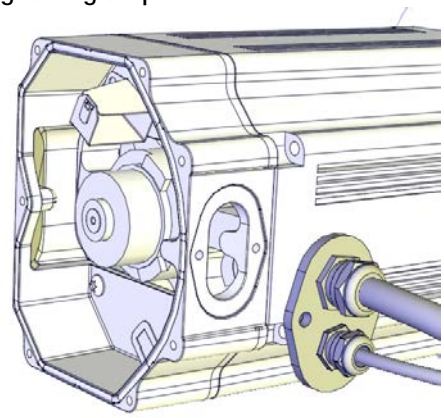
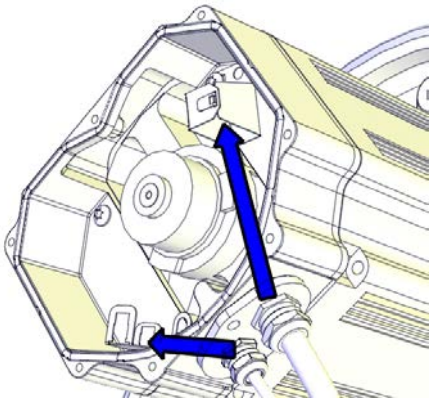
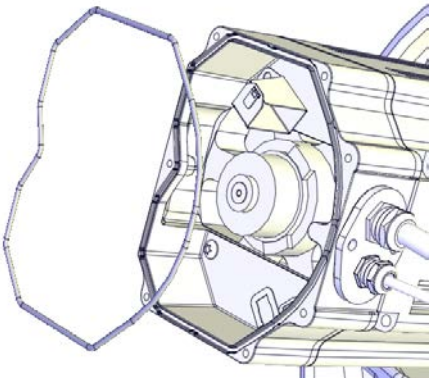
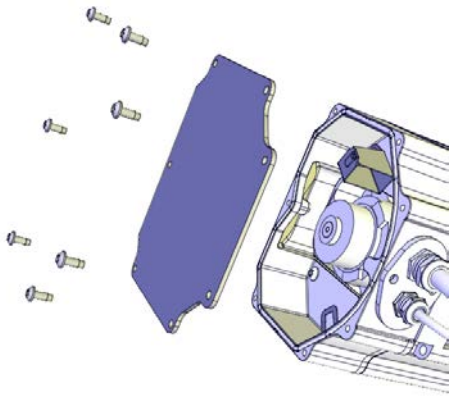
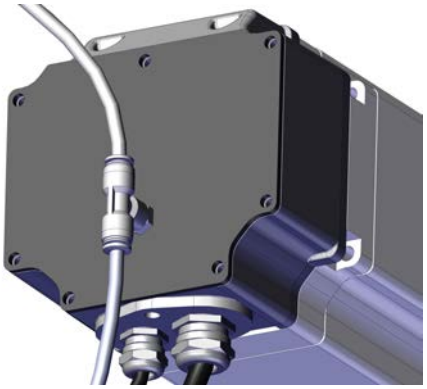
	Action	Note
2	Refit the cable gland cover. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001067
3	Connect the motor cables. Connect in accordance with the markings on the connectors.	 xx1200001066
4	Inspect the o-ring. **Note** Replace if damaged.	O-ring, axis-1: 3HAC067762-001 O-ring, axis-2: 3HAC067762-001 O-ring, axis-3: 3HAC067762-001 O-ring, axis-4: 3HAC067744-001  xx1200001070
5	Wipe clean o-ring and o-ring groove.	

Continues on next page

4.4.3 Refitting the cable harness

Continued

	Action	Note
6	Refit the o-ring. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	
7	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
8	Refit the motor cover with it's attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Attachment screws: M5x12 Stainless steel A2-70 (7 pcs) (9ADA619-44) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001135
9	Make sure that the covers are tightly sealed.	
10	Connect air hose to air fitting on motor. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000568

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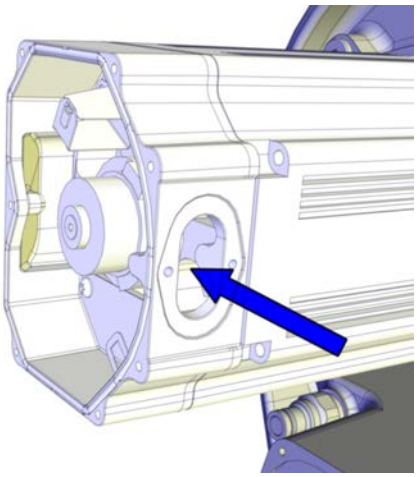
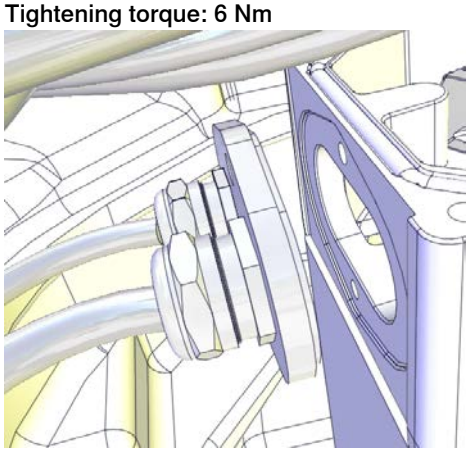
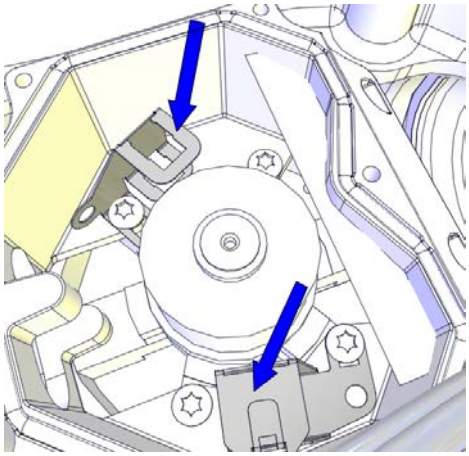
Connecting the axis-5 motor cables

	Action	Note
1	Push the motor cables in through the cable gland opening.	 xx1300000738
2	Refit the cable gland cover by performing the following steps: • Slide the cable gland cover onto the inner screw. • Refit and tighten the outer screw. • Tighten the inner screw. Make sure that the gasket is not damaged. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001016
3	Connect the connectors. Connect in accordance with the markings on the connectors.	 xx1200001015

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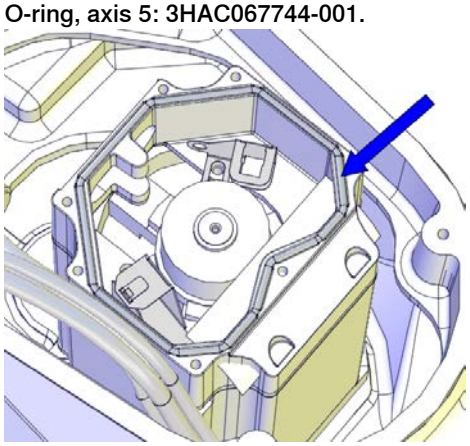
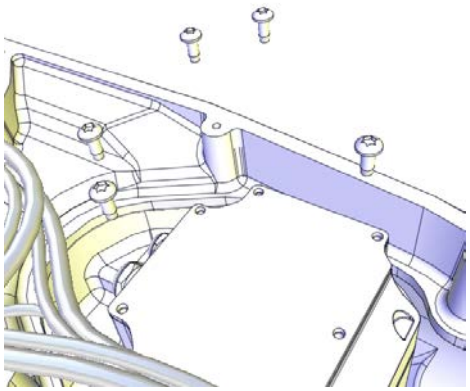
4.4.3 Refitting the cable harness

Continued

	Action	Note
4	Make sure the o-ring on the motor is undamaged. Replace if damaged.	O-ring, axis 5: 3HAC067744-001.  xx1200001021
5	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
6	Refit the motor cover with its attachment screws. **Note** Do not refit the screws that will hold the heat protection plate at this point. **Note** Do not reuse the self-threading attachment screws, it will damage the threads. Replace with standard attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Screws: M5x12. Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001013

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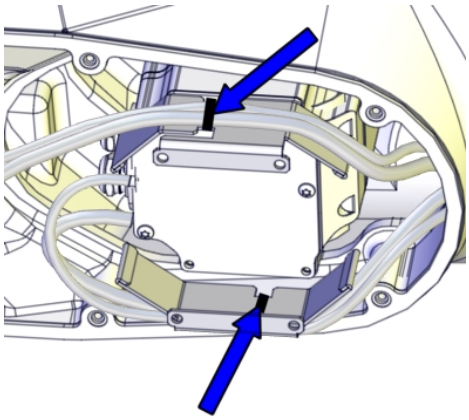
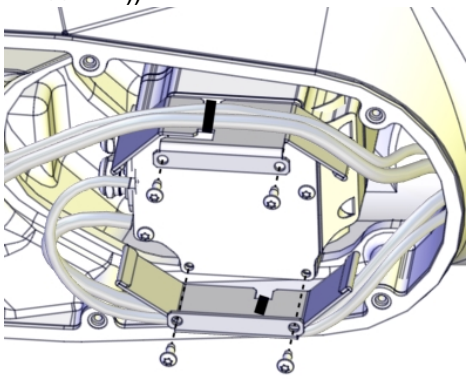
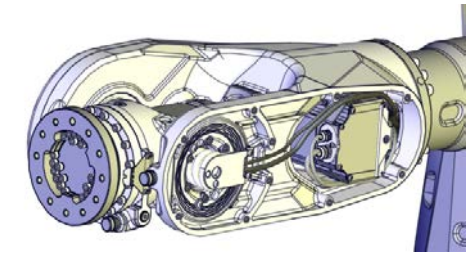
	Action	Note
7	Secure the cable harness with cable straps to the heat protection plate.	 xx1500001029
8	Fit the heat protection plate with the screws.	Screws: M5x12. Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1500001030

Connecting the axis-6 motor cables

	Action	Note
1	Make sure that the cable harness is placed in a way that it will not be damaged when the cover is fitted.	 xx1600002061

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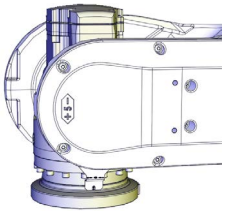
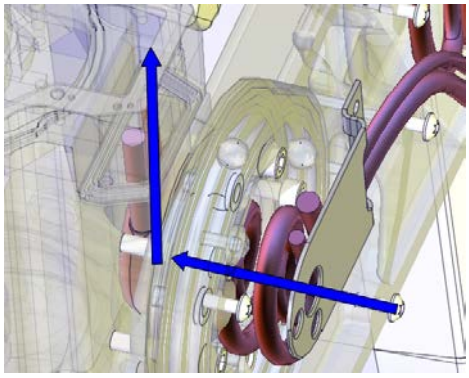
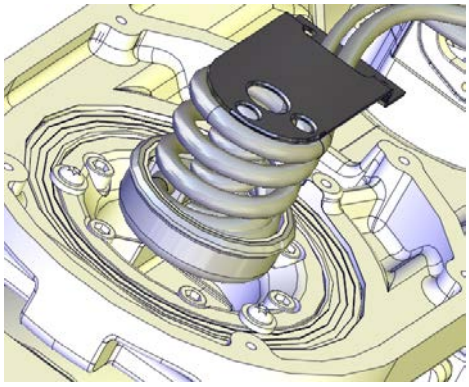
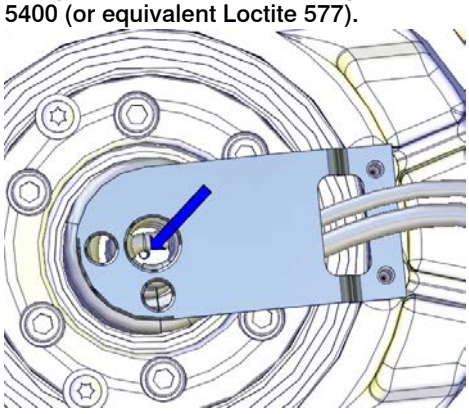
4.4.3 Refitting the cable harness

Continued

	Action	Note
2	**Note** Axis 5 must be in position +90° (or as close as possible) for a correct installation of the cable harness in the wrist. If not, connect the 24 VDC power supply, release the brakes and move axis 5 manually to +90°.	 xx1200001081
3	Push the cable harness into the wrist recess and up into the axis-6 motor.	 xx1300000667
4	Push the carrier carefully into position.	 xx1300001113
5	Secure the carrier with the M4 screw. Use flange sealant. **Note** The screw is located at the bottom of the carrier. **Tip** The attachment screw securing the carrier may be difficult to fit. Make sure the carrier is level and completely pressed against the bottom.	Tightening torque: 4 Nm Flange sealant for conical fittings: Loctite 5400 (or equivalent Loctite 577).  xx1300000485

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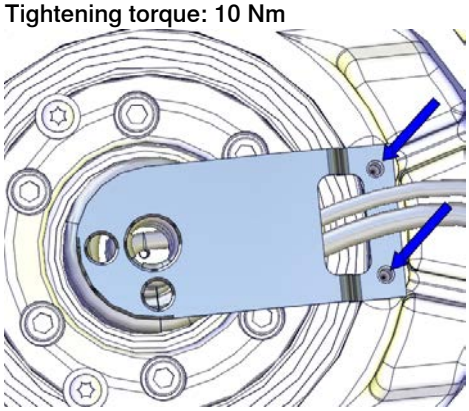
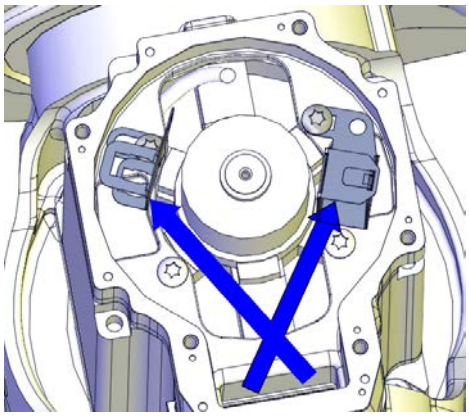
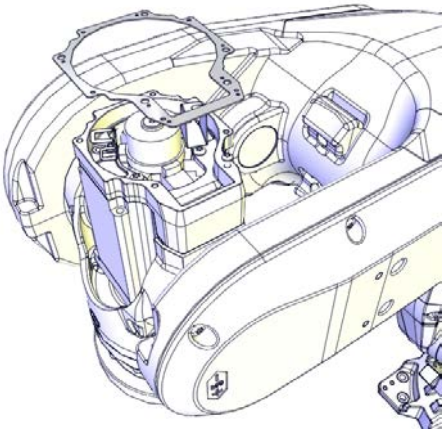
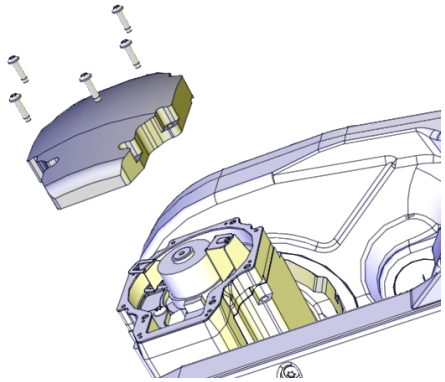
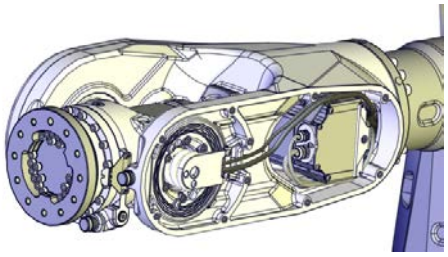
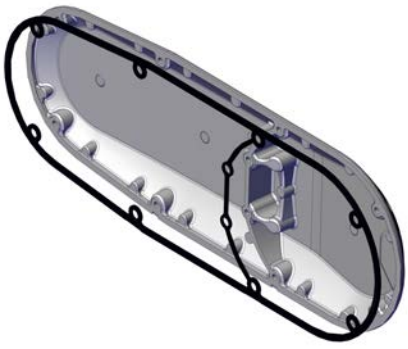
	Action	Note
6	Secure the cable bracket with its attachment screws.	Tightening torque: 10 Nm  xx1300000484
7	Reconnect the connectors to the axis-6 motor. **Note** Place the resolver cable under the motor cable.	 xx1300000488
8	Make sure the gasket is undamaged. Replace if damaged.	Gasket, 3HAC033489-002  xx1200001095
9	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	

Continues on next page

4.4.3 Refitting the cable harness
Continued

	Action	Note
10	Refit the motor cover.	Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001080

Concluding procedure

	Action	Note
1	Make sure that the cable harness is placed in a way that it will not be damaged when the wrist cover is fitted.	 xx1600002061
2	• Make sure that the gasket is undamaged on the cover. Replace gasket if damaged. • Clean the gasket from dirt and old grease residues. • Lubricate with grease between gasket and cover.	 xx2100000526 Grease: 3HAC042536-001 (Shell Gadus S2)

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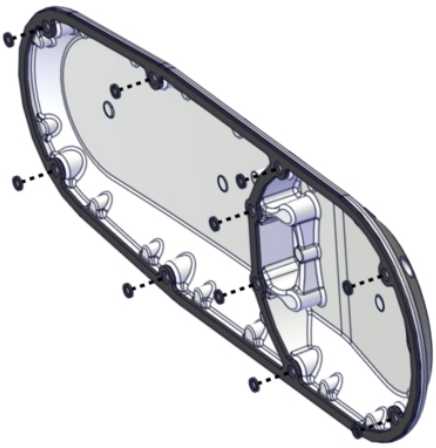
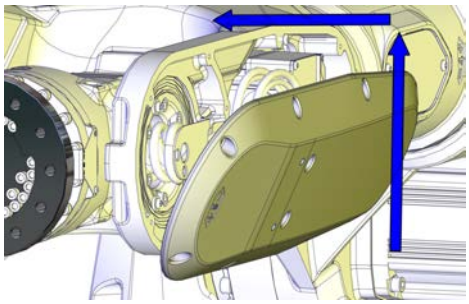
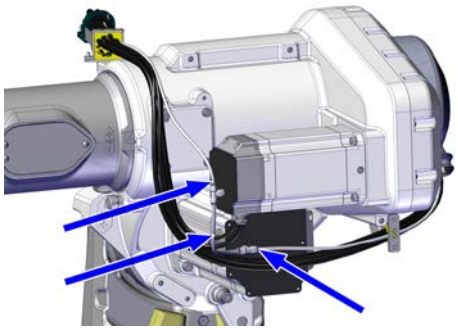
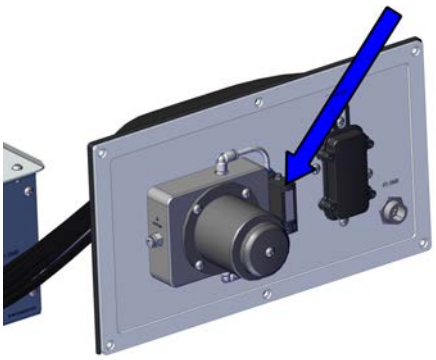
	Action	Note
3	Put washers in the holes of the gasket.	 xx1900002085
4	Refit the wrist cover. In order not to damage the cable harness when the wrist cover is refitted, use this method: 1 Hold the cover slightly tilted below the wrist. 2 Put the cable harness inside the cover. 3 Lift the cover, still tilted. 4 Move the upper part of the cover into position. 5 Secure the cover with its attachment screws.	 xx1300000772 Tightening torque: 10 Nm. Torx pan head screw: 9ADA619-56 (M6x16 Stainless steel A2-70)
5	Cut and fit the air hose for the air fittings on axis-3 and axis-4 motors. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000587
6	Turn on the air pressure supply to the overpressure system.	

Continues on next page

4.4.3 Refitting the cable harness

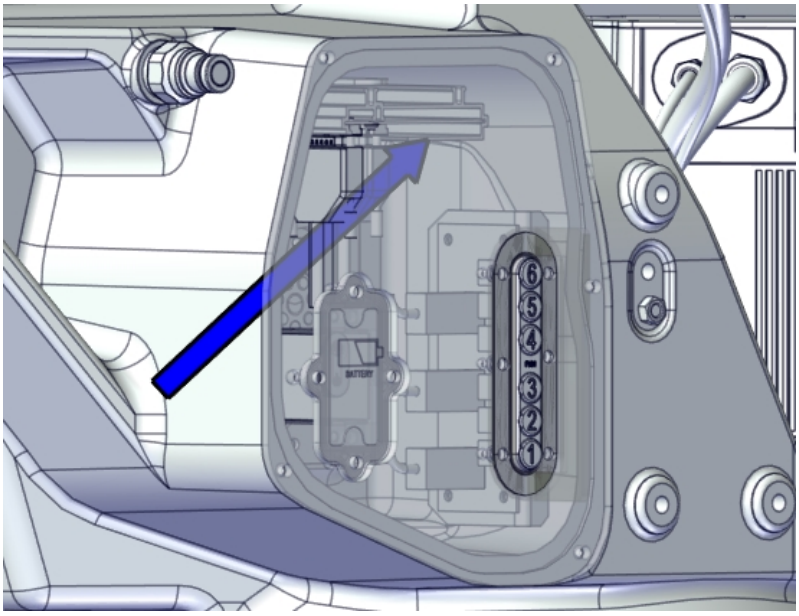
Continued

	Action	Note
7	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same or lower when compared to the initial value. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*. **Note** Wait for approximately 30 minutes until all cavities are fully pressurized and the flow sensor data is showing a stable value.	 xx1700001593
8	Make an overall inspection of the installed cable harness.	See *Inspecting the cable harness on page 132*.
9	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.
10	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.4.4 Replacing the SMB

Location of SMB unit

The SMB (serial measurement board) unit is located inside the SMB/BU recess, as shown in the figure.



xx1700001812

Spare part

Equipment, etc.	Article number	Note
SMB unit (DSQC633C)	See *Product manual, spare parts - IRB 6790*	
Battery pack	See *Product manual, spare parts - IRB 6790*	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
SMB cover	M6x16 Stainless steel A2-70 (5 pcs) 9ADA619-56		5 pcs

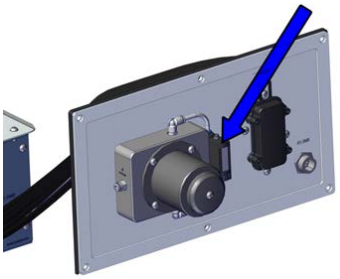
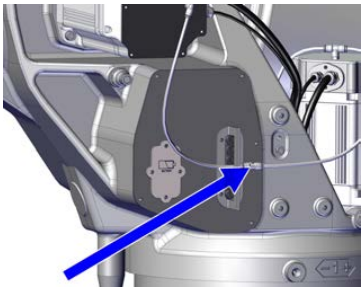
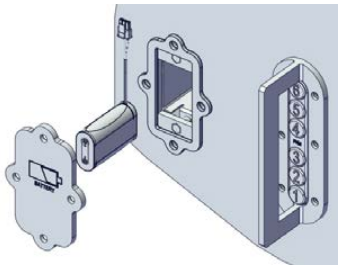
Continues on next page

4.4.4 Replacing the SMB
Continued

Removing the SMB unit

Use these procedures to disconnect and remove the SMB unit.

Preparations before disconnecting the SMB unit

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	
3	Check the leak flow value on the flow sensor (if not already checked and noted). Note the value to be able to compare it when repair is completed.	 xx1700001593
4	**CAUTION** Turn off the air pressure supply.	
5	Disconnect air hose from air fitting on SMB cover.	 xx2100000591
6	Open the small cover on the SMB cover, disconnect the battery cable and remove the battery.	 xx1700001806

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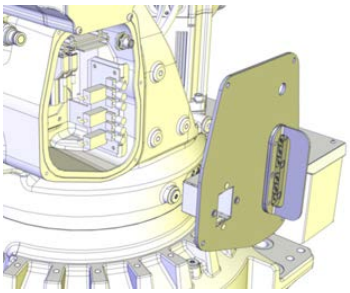
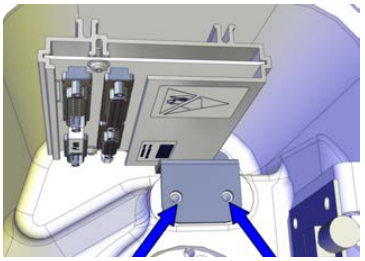
	Action	Note
7	Remove the SMB cover. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	 xx1300000669

Disconnecting and removing the SMB unit

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	
3	Remove the screws and washers that secure the SMB unit bracket.	 xx1300000730

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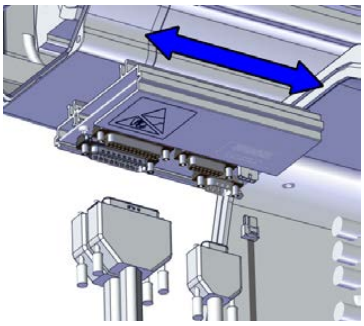
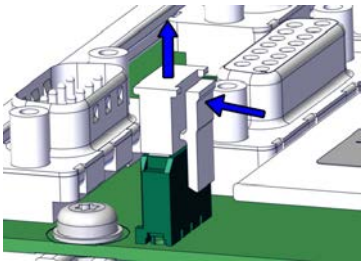
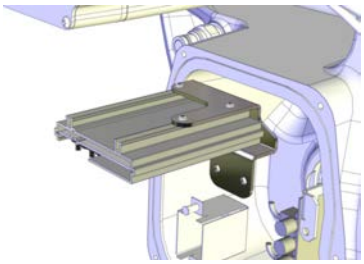
4.4.4 Replacing the SMB
Continued

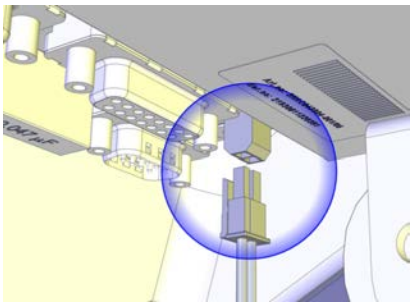
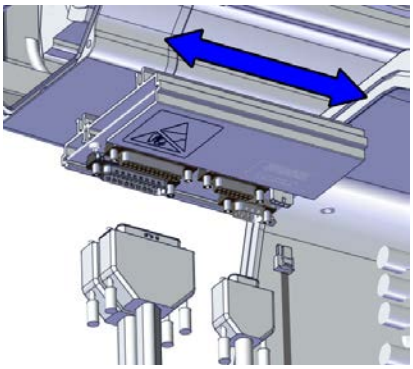
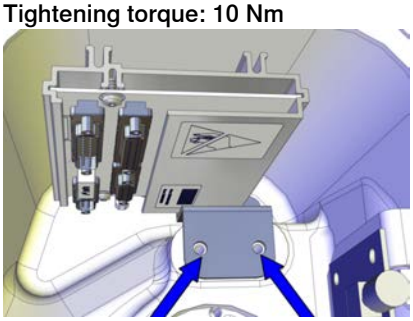
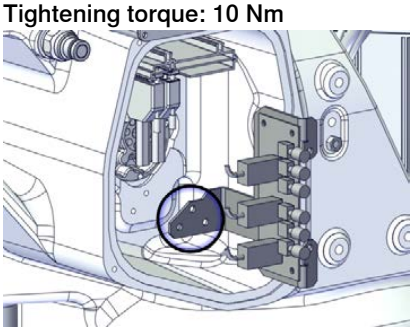
	Action	Note
4	Pull out the SMB unit a little and disconnect the connectors from the SMB board: • R1.SMB1-3, R1.SMB4-6 and R2.SMB • Battery cable connector R2.G. Disconnect the battery cable by pressing down the upper lip of the R2.G connector to release the lock while pulling the connector upwards.	 xx1300000728  xx1700000993
5	Pull out the SMB unit and put it in an ESD bag.	 xx1300000731

Refitting the SMB unit

Refitting the SMB unit

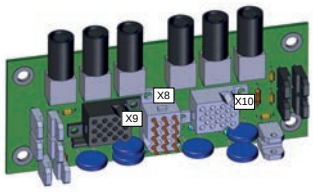
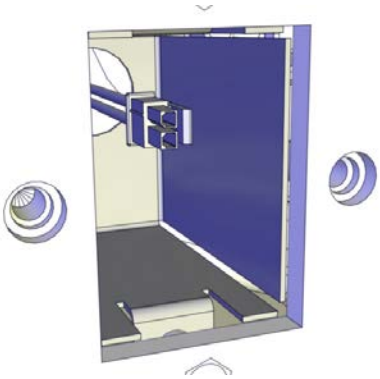
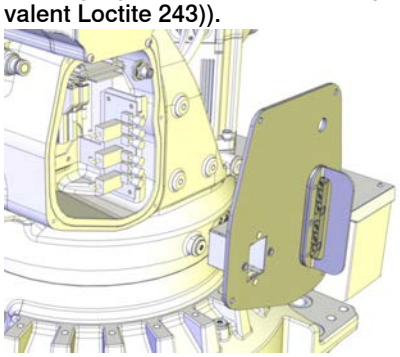
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	

Continues on next page

	Action	Note
3	Connect the battery cable to the SMB unit. Make sure the lock snaps into place during refitting.	 xx1300000729
4	Connect all connectors to the SMB board: • R1.SMB1-3, R1.SMB4-6 and R2.SMB	 xx1300000728
5	Push the SMB unit carefully into position and fit the bracket that secures the SMB unit.	Tightening torque: 10 Nm  xx1300000730
6	If removed, refit the bracket with the brake release unit fitted.	Tightening torque: 10 Nm  xx1700002154

Continues on next page

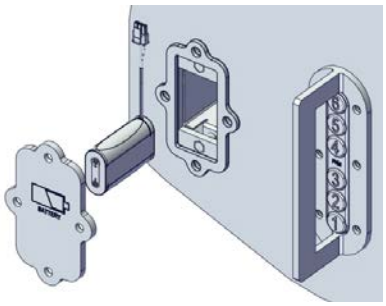
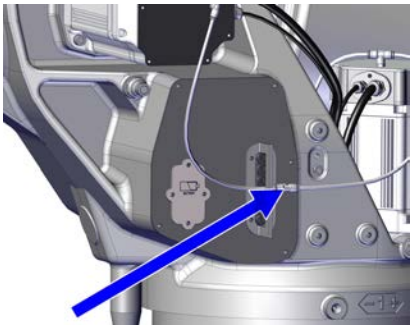
4.4.4 Replacing the SMB
Continued

	Action	Note
7	If disconnected, reconnect the connectors X8, X9 and X10 to the brake release board. Be careful not to damage the sockets or pins. Make sure the connector and its locking arms are snapped down properly.	 xx1700000978
8	Pull out the battery cable through the recess for the battery.	 xx1300000834
9	Check the sealing on the SMB cover. Replace sealing if damaged.	Gasket SMB-cover: 3HAC044074-002.
10	Secure the SMB cover with the attachment screws. If cabling is used for 7th axis (option), refit the connector R2.FB7 to the SMB cover and tighten with 6 Nm.	Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1300000669

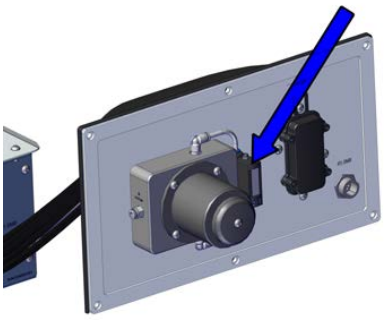
Refitting the SMB battery

	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	
2	Reconnect the battery cable.	

Continues on next page

	Action	Note
3	Place the battery in the recess.	 xx1700001806
4	Refit the battery cover with its attachment screws.	Tightening torque: 10 Nm
5	Connect air hose to air fitting on SMB cover. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000591

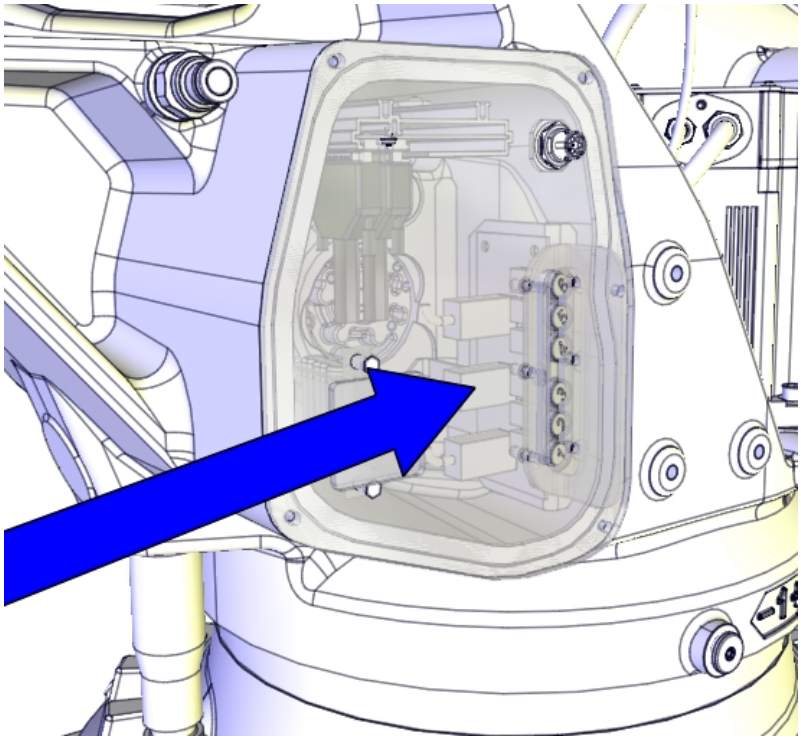
Concluding procedures

	Action	Note
1	Turn on the air pressure supply to the overpressure system.	
2	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
3	Update the revolution counters.	See *Updating revolution counters on IRC5 robots on page 644*.
4	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.4.5 Replacing the brake release unit

Location of brake release unit

The brake release unit (BU) is located inside SMB/BU recess, as shown in the figure.



xx1300000741

Spare part

Equipment, etc.	Article number	Note
Brake release unit	See *Product manual, spare parts - IRB 6790*	
Battery pack	See *Product manual, spare parts - IRB 6790*	

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Continues on next page

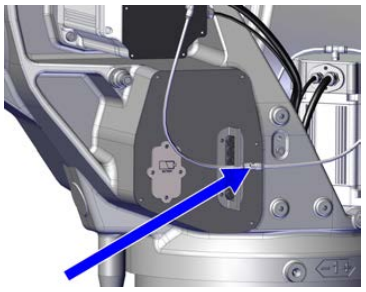
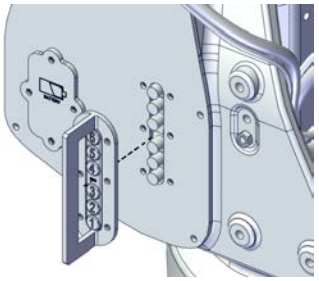
Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Push button cover	M6x16 Stainless steel A2-70 (10 pcs) 9ADA619-56		6 pcs

Removing the brake release unit

Preparations before removing the brake release unit

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	
3	Disconnect air hose from air fitting on SMB cover.	 xx2100000591
4	Remove the push button guard from the SMB cover. The push button guard must be removed to ensure a correct refitting of the brake release unit.	 xx1700001813

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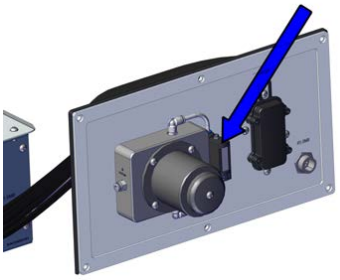
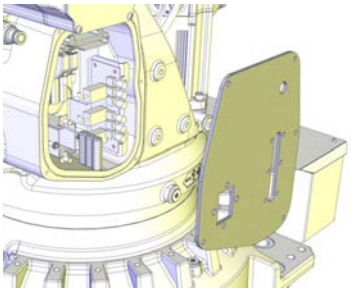
4.4.5 Replacing the brake release unit

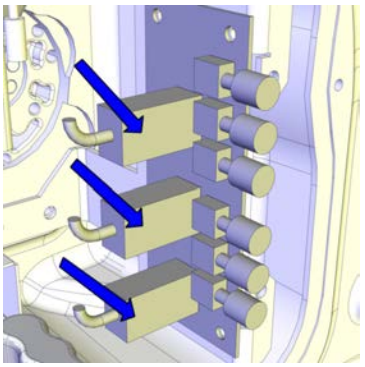
Continued

	Action	Note
5	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593
6	**CAUTION** Turn off the air pressure supply.	
7	Remove the SMB cover.	 xx1300000742
8	The battery can stay connected, to avoid the need of synchronizing the robot. **CAUTION** If the battery stays connected, put (or hold) the SMB cover in a safe position. The battery cable connectors can otherwise be damaged.	

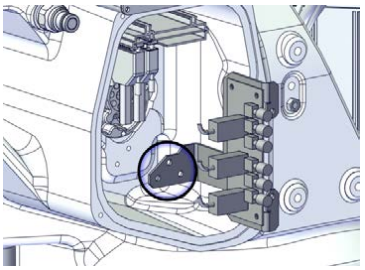
Disconnecting the brake release unit

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	
3	Take a picture or make notes of how the robot cabling is positioned in regard to the brake release board.	

Continues on next page

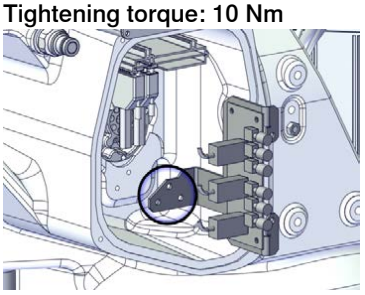
	Action	Note
4	Remove the connectors X8, X9 and X10 from the brake release board.	 xx1300000670

Removing the brake release unit

	Action	Note
1	Unscrew the attachment screws that secure the brake release unit bracket.	 xx1700002154
2	Remove the bracket with the brake release unit fitted.	
3	Remove the brake release unit from the bracket.	

Refitting the brake release unit

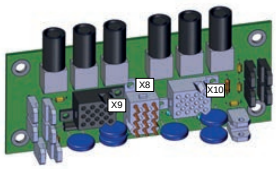
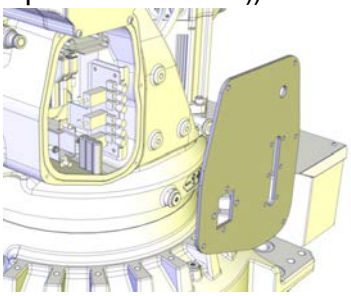
Use this procedure to refit the brake release unit.

	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 51*	
2	Fasten the brake release unit to the bracket.	Maximum tightening torque: 5 Nm.
3	Refit the bracket with the brake release unit fitted. Make sure the unit is placed as straight as possible on the bracket! The push buttons can otherwise get jammed when the SMB cover is refitted.	Tightening torque: 10 Nm  xx1700002154

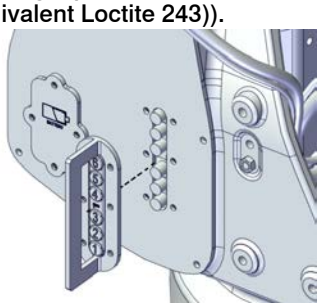
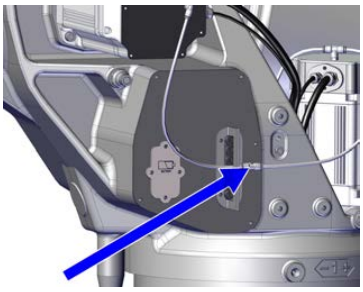
Continues on next page

4.4.5 Replacing the brake release unit

Continued

	Action	Note
4	Reconnect the connectors X8, X9 and X10 to the brake release unit. Be careful not to damage the sockets or pins. Make sure the connector and its locking arms are snapped down properly.	 xx1700000978
5	Verify that the robot cabling is positioned correctly, according to previously taken picture/notes. **WARNING** Screened cables must not get in contact with the brake release board after installation. Eliminate all risks of contact between screened cables and the brake release board.	
6	Check the sealing on the SMB cover. Replace complete cover if sealing is damaged.	SMB cover: 3HAC070534-002.
7	Refit the SMB cover with its attachment screws. **Note** Do not refit the push button guard at this point!	Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1300000742
8	**WARNING** Before continuing any service work, follow the safety procedure in section *The brake release buttons may be jammed after service work on page 192*!	

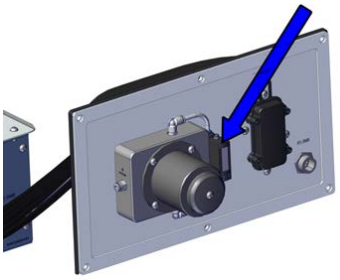
Continues on next page

	Action	Note
9	Apply flange sealant with activator on the push button guard.	Activator (Loctite 7091). Flange sealant (Loctite 574 (or equivalent)).  xx2100000958
10	Refit the push button guard to the SMB cover.	Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1700001813
11	Connect air hose to air fitting on SMB cover. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000591
12	Press the push buttons 1 to 6, one at a time, to make sure that the buttons are moving freely and do not stay in any locked position.	
13	Reconnect the battery, if it has been disconnected.	
14	Turn on the air pressure supply to the overpressure system.	

Continues on next page

4.4.5 Replacing the brake release unit

Continued

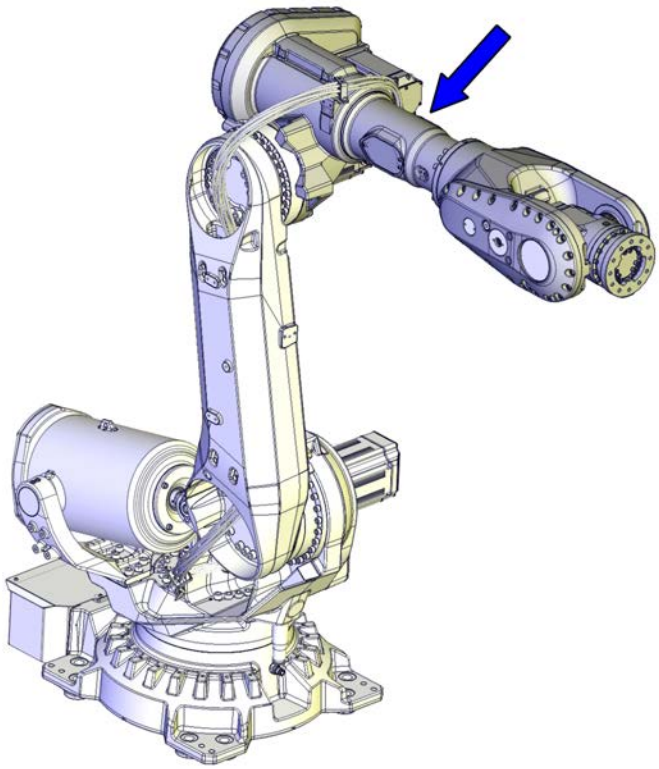
	Action	Note
15	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
16	Update the revolution counters if the battery has been disconnected.	See *Updating revolution counters on IRC5 robots on page 644*.
17	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.5 Upper and lower arms

4.5.1 Replacing the upper arm

Location of the upper arm

The upper arm is located as shown in the figure. These sections describe how to replace the complete upper arm, which includes the wrist unit.



xx1300000483

Spare part

Spare part	Spare part number	Note
Upper arm	See *Product manual, spare parts - IRB 6790*	

Consumables

Parts needed to be replaced after removal.

Equipment, etc.	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.

Continues on next page

4.5.1 Replacing the upper arm
Continued

Equipment, etc.	Article number	Note
O-ring	3HAC067762-001	D=169.5x3 Used on axis-3 motor cover.
	3HAC067744-001	D=119x3 Used on axis-4 motor cover.
	3HAC067744-001	D=119x3 Used on axis-5 motor cover.
Gasket	3HAC033489-002	Used on axis-6 motor cover.
Flange sealant	-	Loctite 574 (or equivalent)
Flange sealant for conical fittings	-	Loctite 5400 (or equivalent Loctite 577)
Activator	3HAC074342-001	Loctite 7091
Sealant (grey)	3HAC026759-001	Sikaflex 521FC

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Upper arm	M16x50 stainless steel 3HAC060786-041	17x25x3 coated stainless steel HV200 (3HAC060866-005)	9 pcs
	M12x40 stainless steel 3HAC060786-031	13x19x2 coated stainless steel 3HAC060866-004	27 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Lifting eye	3HAC16131-1	M12
Lifting eye	3HAC16131-1	M12
Fender washer	-	Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.
Pallet		Used for putting down removed parts from robot.
Guide pin, M12x150	3HAC13056-2	Always use guide pins in pairs.
Guide pin, M12x200	3HAC13056-3	Always use guide pins in pairs.
Guide pin, M16x150	3HAC13120-2	Always use guide pins in pairs.
Guide pin, M16x200	3HAC13120-3	Always use guide pins in pairs.
24 VDC power supply	-	Used to release the motor brakes.

Continues on next page

Equipment, etc.	Article number	Note
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 651*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the upper arm

Use these procedures to remove the upper arm.

Note

There is an alternative method to remove the upper arm if only the axis-3 gearbox shall be replaced. This alternative method describes how to remove the upper arm with the robot cable harness still partly fitted. See *Replacing the axis-3 gearbox on page 599*.

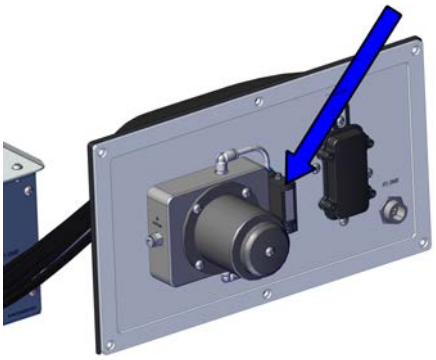
Preparations before removing the upper arm

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

Continues on next page

4.5.1 Replacing the upper arm

Continued

	Action	Note
2	Jog the robot to a position where it is best to remove tools and other equipment fitted to wrist and upper arm.	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
4	Remove tools and other equipment fitted to wrist and upper arm.	
5	Prepare an area where to put the upper arm, after removal. On pallets, as a suggestion.	
6	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593
7	**CAUTION** Turn off the air pressure supply.	

Position of the robot in the continued process

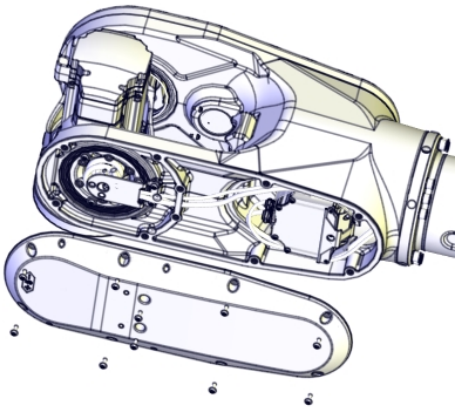
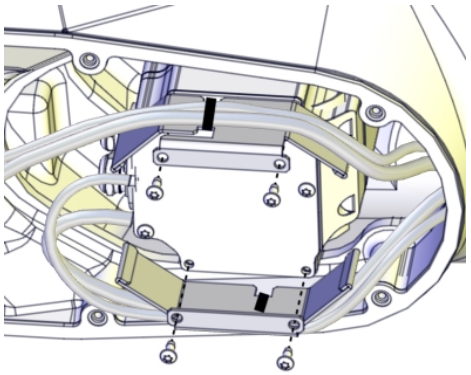
	Action	Note
1	Jog the robot into position: • Axis 1: No significance (as long as the robot is secured to the foundation) • Axis 2: -60° • Axis 3: +60° • Axis 4: +90° • Axis 5: +90° • Axis 6: No significance	

Continues on next page

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

Retrieving access to the wrist cabling

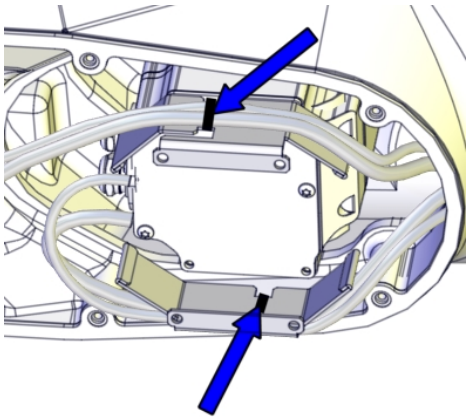
Use this procedure to remove the wrist cover to retrieve access to the axis-5 and axis-6 motor cables.

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Remove the wrist cover.	 xx1300002247
3	Remove the heat protection plates from the motor with the cabling still attached to the plate.	 xx1500001030

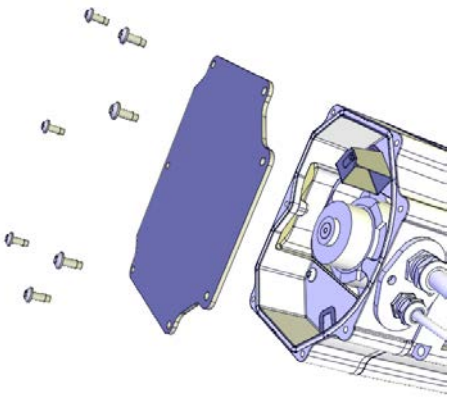
Continues on next page

4.5.1 Replacing the upper arm

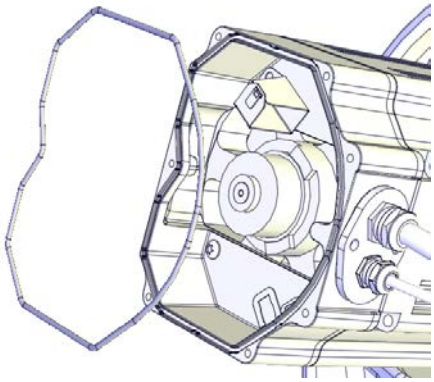
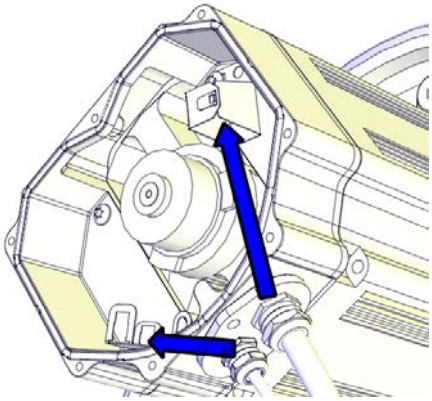
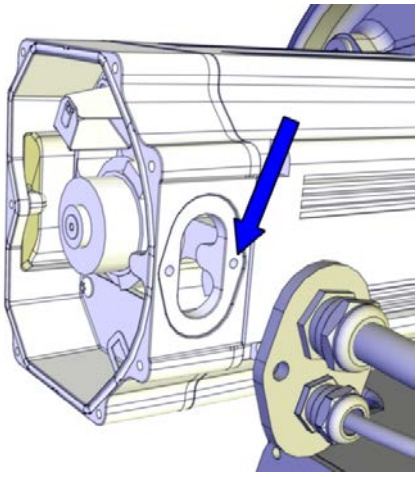
Continued

	Action	Note
4	Cut the cable ties that hold the cable harness to the plate. **Note** Keep the heat protection plate until refitting. **Tip** If removing the plate only for replacing the motor, the cabling does not need to be loosened from the plate.	 xx1500001029

Disconnecting the axis-5 motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Unscrew the attachment screws and washers and remove the motor cover.	 xx1200001135

Continues on next page

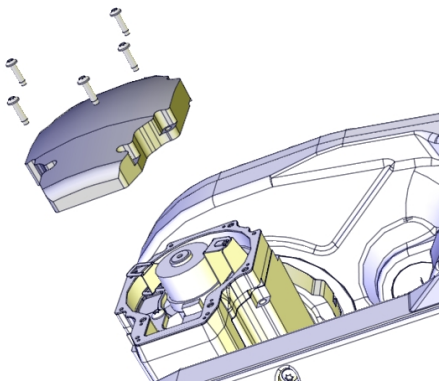
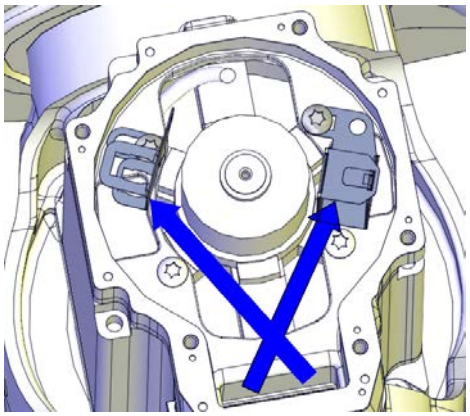
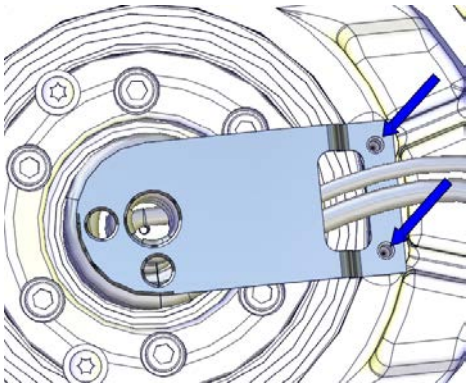
	Action	Note
3	Make sure the o-ring is present.	 xx1200001070
4	Disconnect the motor cables.	 xx1200001066
5	Remove the cable gland cover by performing the following steps: 1 Open the inner screw a little (the one the arrow is pointing at). No need to remove this screw from the motor. 2 Remove the outer screw. 3 Slide the cable gland cover away from the inner screw. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable exit hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1300000656
6	Use caution and pull out the motor cables.	

Continues on next page

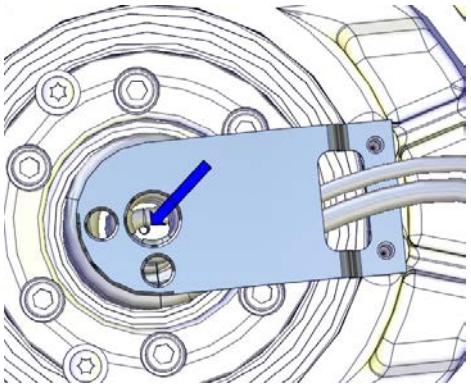
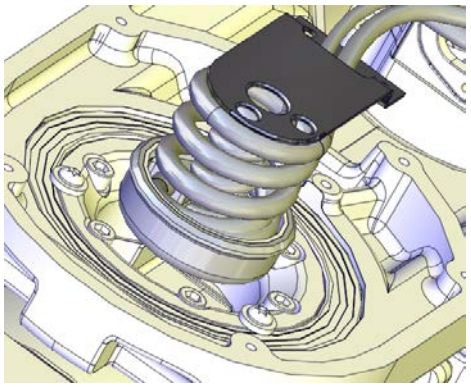
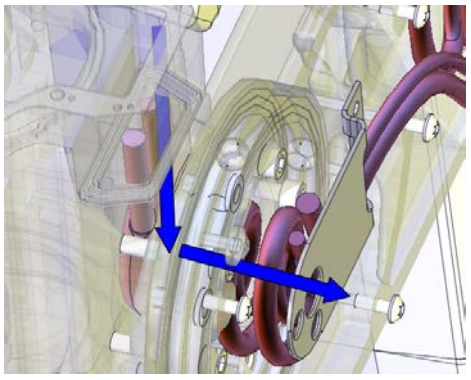
4.5.1 Replacing the upper arm

Continued

Disconnecting the axis-6 motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Unscrew the attachment screws and remove the motor cover.	 xx1200001080
3	Disconnect the motor cables.	 xx1300000488
4	Unscrew the attachment screws that hold the cable bracket.	 xx1300000484

Continues on next page

	Action	Note
5	Unscrew the M4 screw that holds the carrier. **Note** The screw is located at the bottom of the carrier. **Note** The parts are sealed with flange sealant Loctite 5400 (or equivalent Loctite 577). Remove the part carefully.	 xx1300000485
6	Pull out the carrier from its position.	 xx1300001113
7	Pull out the axis-6 motor cables by holding the cables with one hand at the motor and the other at the carrier.	 xx1300000666

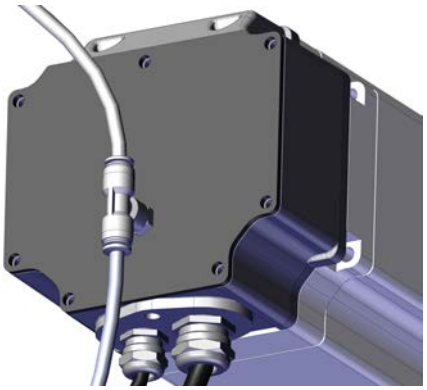
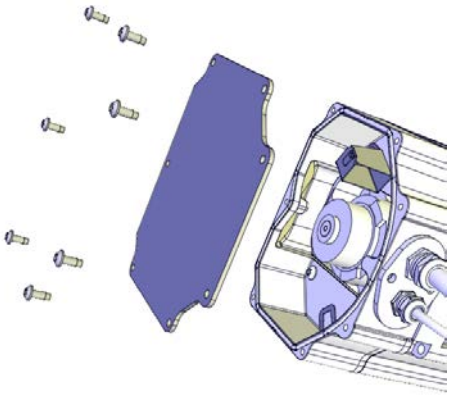
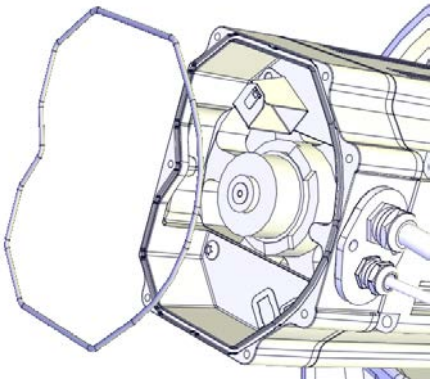
Disconnecting the axis-3 and axis-4 motor cables

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

Continues on next page

4.5.1 Replacing the upper arm

Continued

	Action	Note
2	Disconnect air hose from air fitting on motor cover.	 xx2100000568
3	Unscrew the attachment screws and washers and remove the motor cover. **Note** Axis 3 and 4 motors only: Be careful not to damage the air hose or air nipple.	 xx1200001135
4	Make sure the o-ring is present.	 xx1200001070

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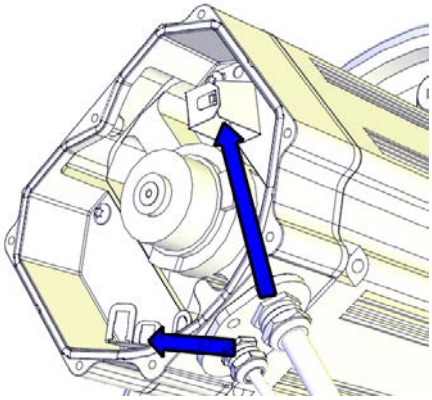
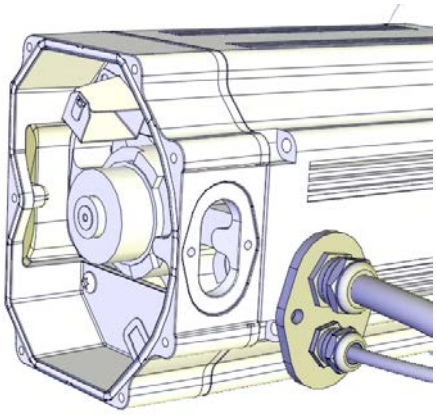
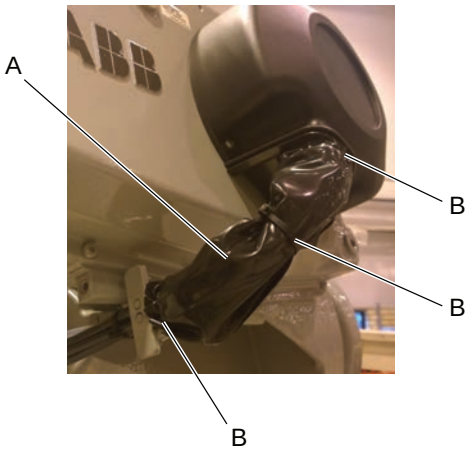
	Action	Note
5	Disconnect the motor cables.	 xx1200001066
6	Remove the cable gland cover. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable gland hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1200001067
7	Use caution and pull out the motor cables.	

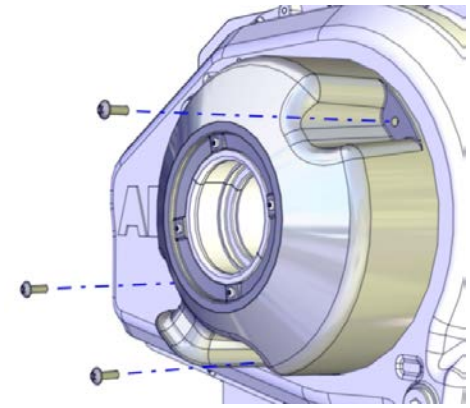
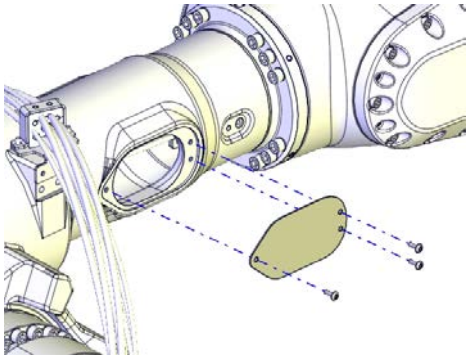
Removing the cable harness - wrist and upper arm

	Action	Note
1	Remove the cable protection by cutting the cable ties and opening the zipper.	 xx1700001802 A Cable protection B Cable ties

Continues on next page

4.5.1 Replacing the upper arm

Continued

	Action	Note
2	Remove the cover. **Note** Use caution not to damage the gasket, not to loose the washers on the cover sealing or not to loose the inserts fitted on the cover.	 xx1200000045
3	If the cabling is to be replaced by a new cable harness, remove the cover insert to use it on the new cabling.	 xx1700001803
4	**Tip** Use tape and tie the axis-5 and axis-6 connectors and carrier into a bundle (if not already done). This is done to facilitate the removal and to avoid damaging the parts. This will also make it easier to run the cable harness through the inside of the upper arm.	 xx1300000668
5	Remove the side cover on the arm tube.	 xx1300000557

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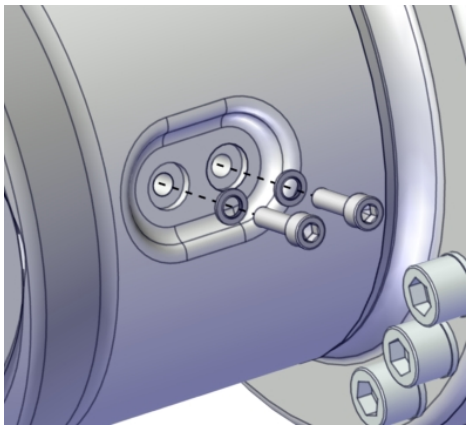
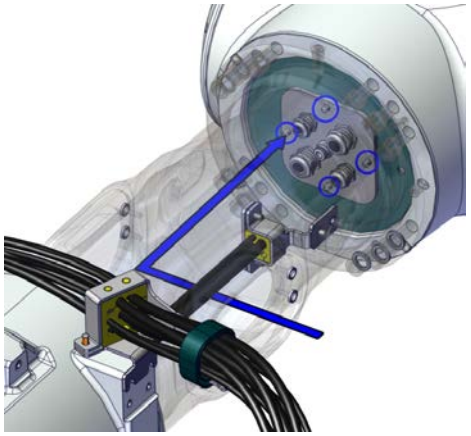
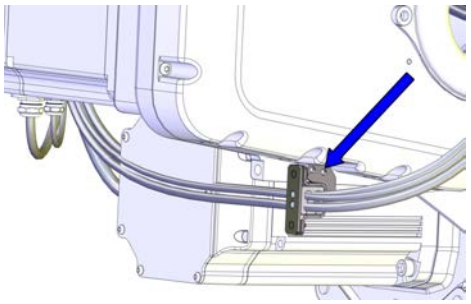
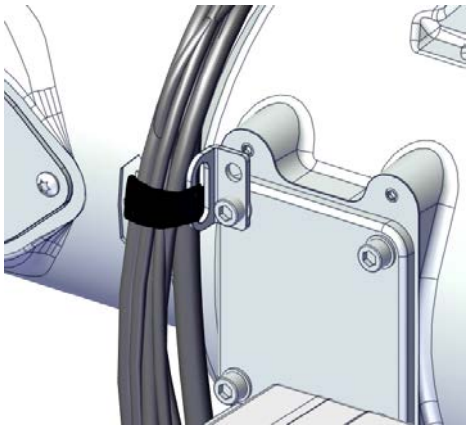
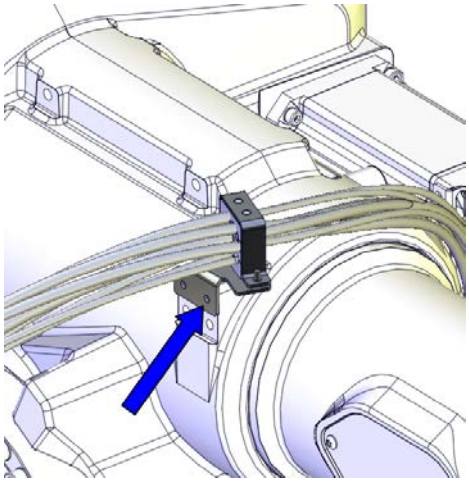
	Action	Note
6	Unscrew the screws and remove the sealing washers, holding the metal clamp inside the arm tube.	 xx1700001809
7	Remove the four nuts at the cable plate between the wrist and the upper arm tube, by reaching into the upper arm tube through the arm tube side hole.	 xx1700001567
8	Remove the arm house metal clamp.	 xx1300000543

Continues on next page

4.5.1 Replacing the upper arm

Continued

	Action	Note
9	Open the velcro strap at the cable fixing bracket.	 xx1700001810 Cable fixing bracket.
10	Remove the metal clamp on top of the arm house.	 xx1300000541

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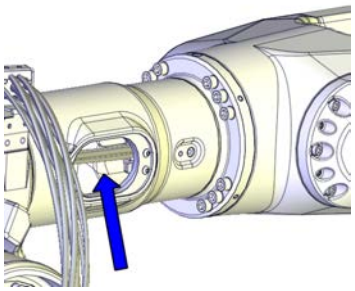
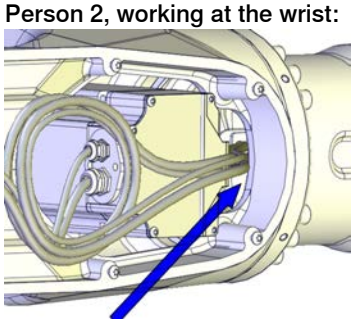
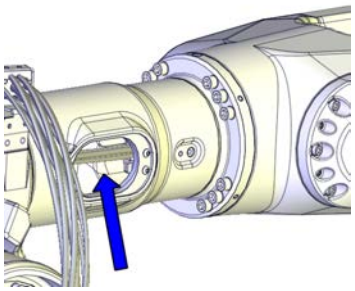
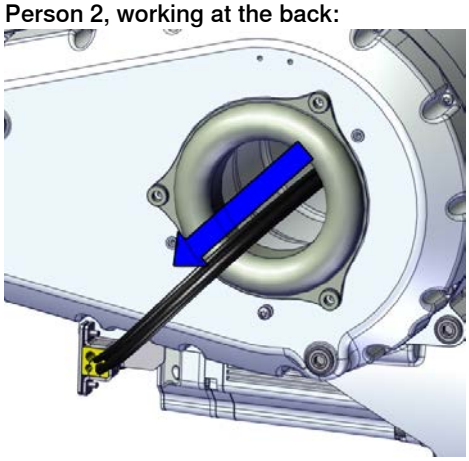
	Action	Note
11	Remove the cable harness out from the wrist. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side hole and take a hold of the cable harness. • Person 2: Take a hold on the cable harness inside the wrist. • Together: Move the cable harness past the axis-5 motor and into the arm tube.	Person 1, working at the side hole:  xx1300000745 Person 2, working at the wrist:  xx1300000746
12	Remove the cable harness out of the arm tube, at the back of the upper arm. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side hole and take a hold of the cable harness. • Person 2: Take a hold on the cable harness at the back of the robot. • Together: Move the cable harness out of the arm tube.	Person 1, working at side hole:  xx1300000745 Person 2, working at the back:  xx1700001568

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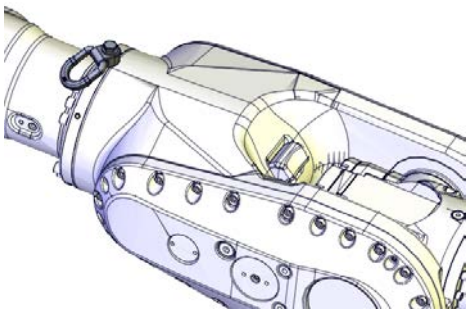
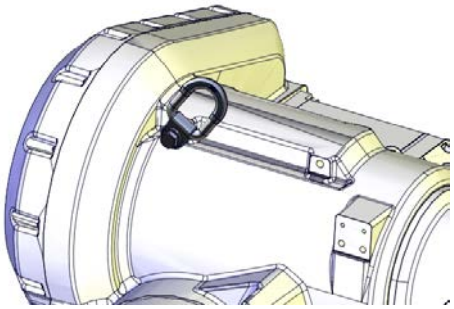
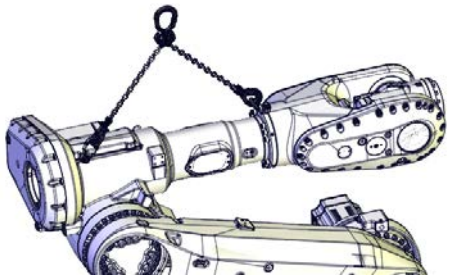
4.5.1 Replacing the upper arm

Continued

Attaching the lifting accessories

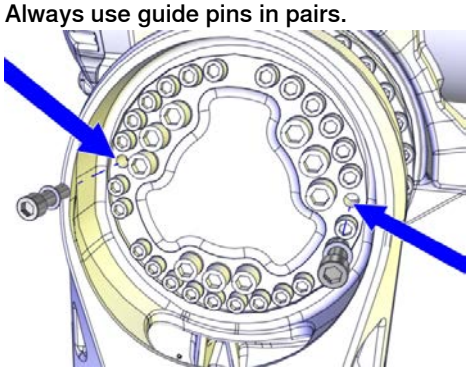
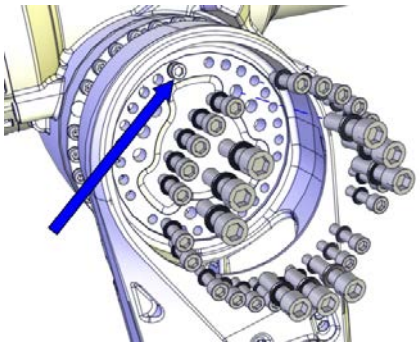
Use this procedure to attach the lifting accessories to the upper arm.

	Action	Note
1	**CAUTION** The weight of the complete upper arm (including the wrist) is 360 kg All lifting accessories used must be sized accordingly.	
2	Fit a lifting eye to the wrist. **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1  xx1200001133
3	Fit a lifting eye in the arm house, with a fender washer underneath.  xx1400002196 **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1 Fender washer: Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.  xx1200001134
4	Attach the upper arm lifting accessory (chain) to an overhead crane (or similar) and then to the lifting eye in the arm house and in the wrist.	Lifting accessory (chain): 3HAC15556-1  xx1200001308
5	Raise the lifting accessories to take the weight of the upper arm.	

Continues on next page

	Action	Note
6	In case of necessary adjustments, use the shortening loops on the lifting accessory (chain) to find the level position.	 xx1400002197

Preparations before removing the upper arm

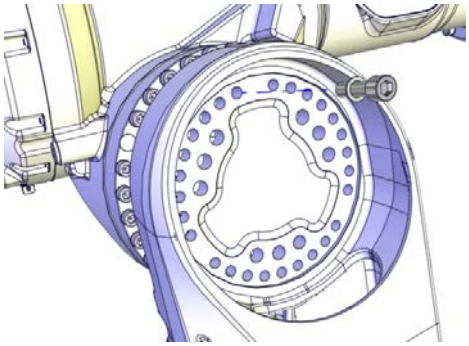
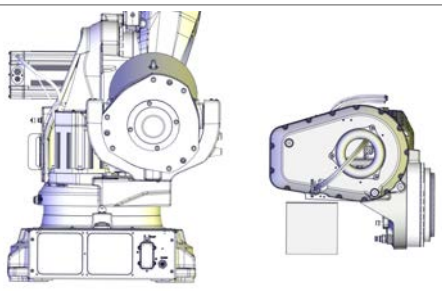
	Action	Note
1	Remove two attachment screws (M12) in opposite holes and replace them with guide pins. **Note** Make sure that it is the screws that hold the lower arm to the axis-3 gearbox that are removed! **Tip** Lubricate the guide pins with some grease to make the upper arm slide better.	Guide pin, M12x150: 3HAC13056-2 Guide pin, M12x200: 3HAC13056-3 Always use guide pins in pairs.  xx1300000659
2	Leave one of the remaining attachment screws fitted, remove the other screws.	 xx1300000747

Continues on next page

4.5.1 Replacing the upper arm

Continued

Removing the upper arm

	Action	Note
1	**Note** Make sure the lift is done completely leveled! In case of necessary adjustments, use the shortening loops on the lifting accessory (chain), and make sure to place the chain the right way through the loops.	 xx1400002197
2	Remove the remaining attachment screw and let the upper arm slide out from the lower arm with support from the guide pins.	 xx1300001610
3	Lift the upper arm and place it on the prepared area. **CAUTION** *Only valid when the upper arm is removed due to replacement of the axis-3 gearbox:* If the cable harness is still fitted or partly fitted, use caution when lifting the upper arm over to the other side of the robot, in order not to cause any damage to the cable harness.	
4	*This step is only valid when the upper arm is removed due to replacement of the axis-3 gearbox:* Place pieces of wood (or similar) under arm house and wrist. Lower the upper arm, and let the upper arm rest as shown in the figure. This is done in order to keep the axis-3 gearbox in a vertical position and to get the best position to replace the axis-3 gearbox, if applicable.	 xx1300000553

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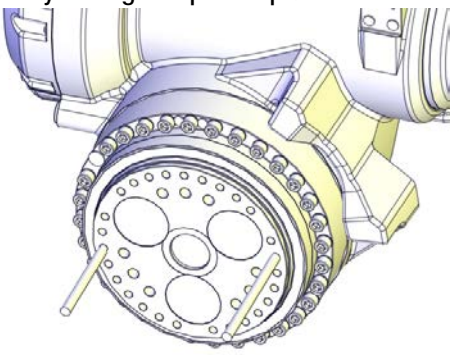
Refitting the upper arm

Use these procedures to refit the upper arm.

Preparations before refitting the upper arm

	Action	Note
1	Wipe clean all contact surfaces.	
2	Fit two guide pins in opposite M12 holes in the axis-3 gearbox. **Tip** Lubricate the guide pins with some grease to make the upper arm slide better.	Guide pin, M12x150: 3HAC13056-2 Guide pin, M12x200: 3HAC13056-3 Always use guide pins in pairs.  xx1700000058

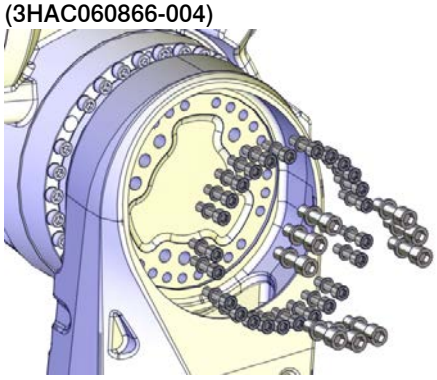
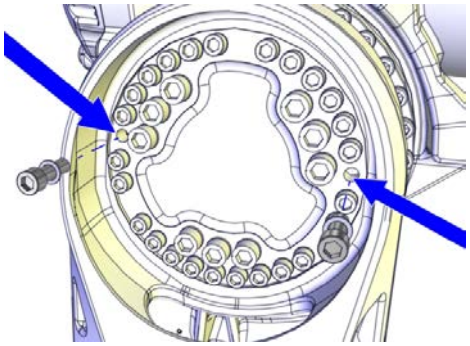
Securing the upper arm

	Action	Note
1	**CAUTION** The weight of the complete upper arm (including the wrist) is 360 kg All lifting accessories used must be sized accordingly.	
2	Attach the lifting accessories, if not already fitted.	See *Attaching lifting accessories to the upper arm on page 202*.
3	Lift the upper arm and put it on the guide pins.	
4	If the axis-3 motor is installed to the upper arm: In order to release the brakes, connect the 24 VDC power supply. Connect to R2.MP3-connector: • + = pin 2 • - = pin 5 Use the rotation tool and rotate the axis-3 motor to find the correct position for the guide pins in the lower arm.	24 VDC power supply Rotation tool
5	If the axis-3 motor is not installed to the upper arm: Use the pinion to rotate the axis-3 gearbox to find the correct position for the guide pins in the lower arm.	Pinion: 3HAC067546-001

Continues on next page

4.5.1 Replacing the upper arm

Continued

	Action	Note
6	Insert all nine M16 screws and 25 of the 27 M12 screws.	Screws: M16x50 stainless steel (3HAC060786-041) (9 pcs) M12x40 stainless steel (3HAC060786-031) (25 of 27 pcs) Washers: 17x25x3 coated stainless steel (HV200 (3HAC060866-005)) 13x19x2 coated stainless steel (3HAC060866-004)  xx1400000359
7	Remove the guide pins and fit the two remaining M12 screws.	 xx1300000659
8	Secure the upper arm by tightening the attachment screws.	Tightening torque depends on screw dimension. Tightening torque, M16: 300 Nm Tightening torque, M12: 120 Nm

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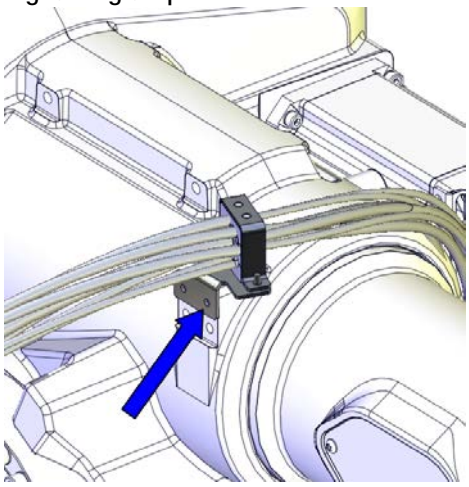
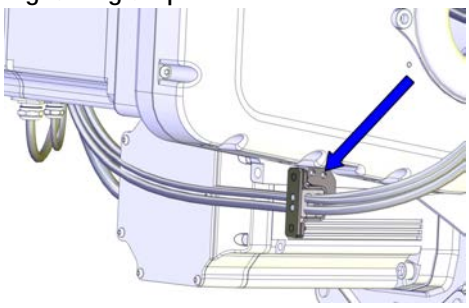
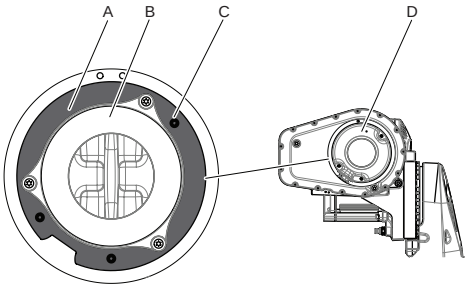
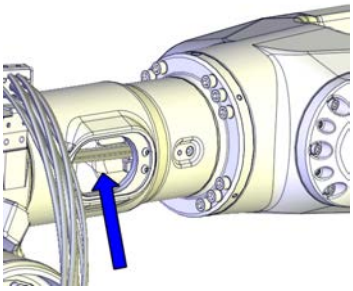
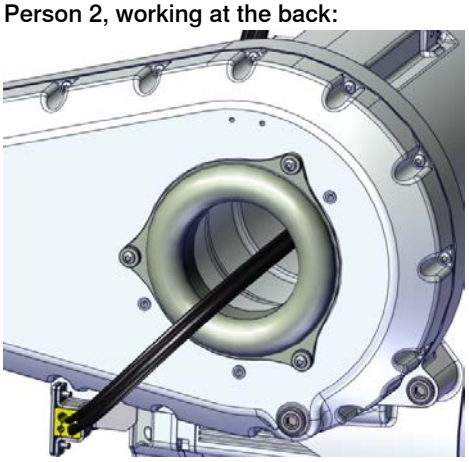
Refitting the cable harness - upper arm

	Action	Note
1	Refit the metal clamp on top of the arm house.	Tightening torque: 10 Nm  xx1300000541
2	Refit the arm house metal clamp.	Tightening torque: 10 Nm  xx1300000543
3	Arrange the cables between the cable clamps in the upper arm.	
4	**Tip** Use tape and tie the axis-5 and axis-6 connectors and carrier into a bundle (if not already done). This is done to facilitate the procedure and to avoid damaging the parts during the procedure. This will also make it easier to run the cable harness through the inside of the robot.	 xx1300000668

Continues on next page

4.5.1 Replacing the upper arm

Continued

	Action	Note
5	Make sure that the gasket underneath the cover is correctly fitted. Replace if damaged. The gasket is covered with adhesive on the side facing the upper arm cover. The three washers are pressed into the holes in the gasket. Make sure all three washers are fitted.	 xx1400000382 A Gasket B Cable guide C Washer D Cover
6	Run the cable harness through the cable guide and then into and through the upper arm tube. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side hole of the arm tube and take a hold of the cable harness. • Person 2: Take a hold on the cable harness at the back of the robot. • Together: Use caution and move the cable harness into the arm tube.	Person 1, working at the side hole:  xx1300000745 Person 2, working at the back:  xx1700001569

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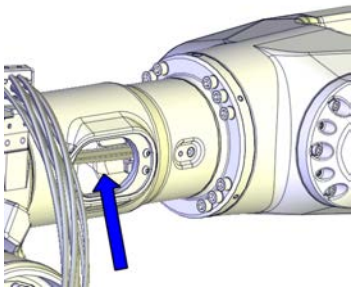
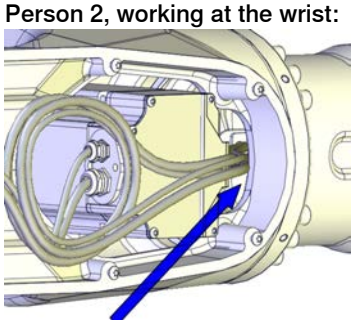
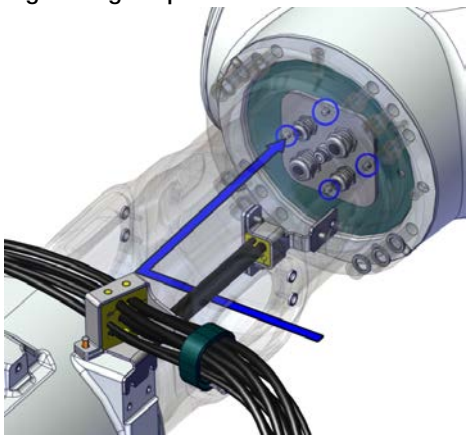
	Action	Note
7	Use caution and push the cable harness into the wrist. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side cover hole and take a hold of the cable harness. • Person 2: Take a hold of the cable harness from inside the wrist. • Together: Move the cable harness past the axis-5 motor and into the wrist.	Person 1, working at the side hole:  xx1300000745 Person 2, working at the wrist:  xx1300000746
8	Refit the four nuts to the cable plate between the wrist and the upper arm tube, by reaching into the upper arm tube through the arm tube side hole.	Tightening torque: 10 Nm  xx1700001567

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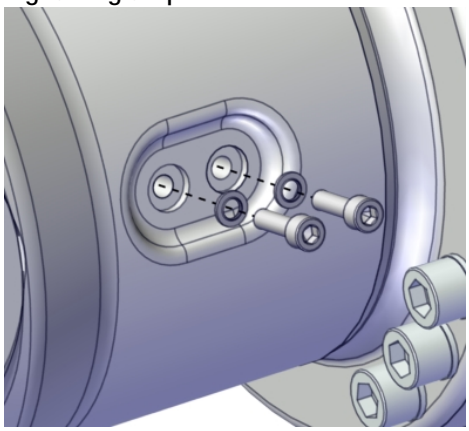
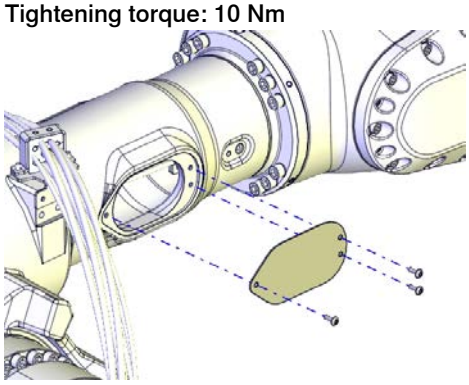
4.5.1 Replacing the upper arm

Continued

	Action	Note
9	Refit the metal clamp axis-4, inside the arm tube. **Note** Always use new sealing washers.	New washers are included in the spare part kit. Tightening torque: 10 Nm  xx1700001809
10	Refit the side cover. **Note** • Make sure the gasket is fitted correctly on the side cover • Use attachment screws made of stainless steel to fit the side cover.	Tightening torque: 10 Nm  xx1300000557

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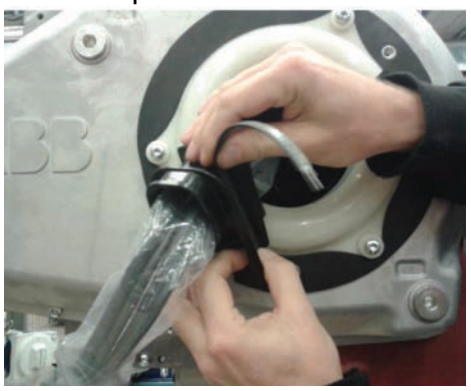
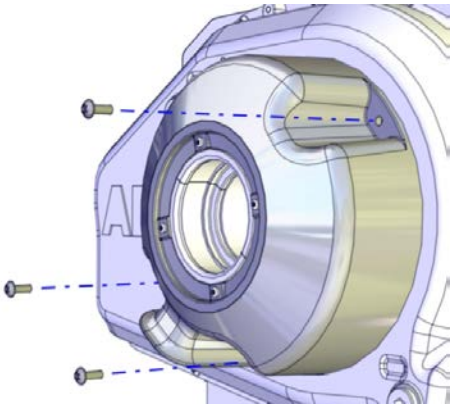
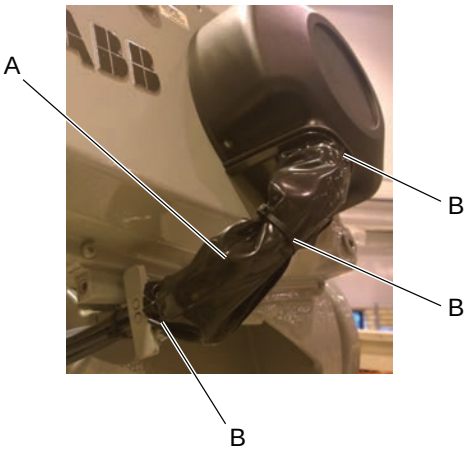
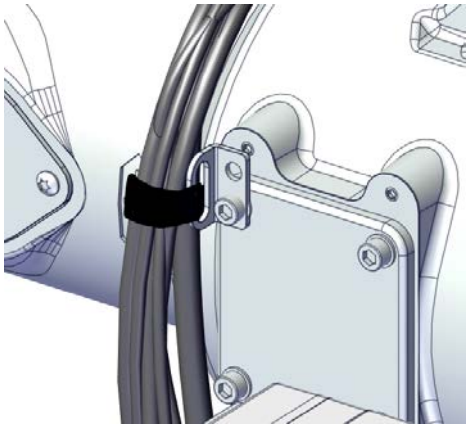
	Action	Note
11	Fit the cover insert around the new cabling and secure it with a weatherstrip.	Cover insert: 3HAC048520-001.  xx1700001803 Weatherstrip: 3HAC053986-001.  xx1700001804
12	Refit the cover with the tube guiding ring fitted. **Note** • Make sure the gasket is fitted correctly • Use attachment screws made of stainless steel to fit the cover.	 xx1200000045

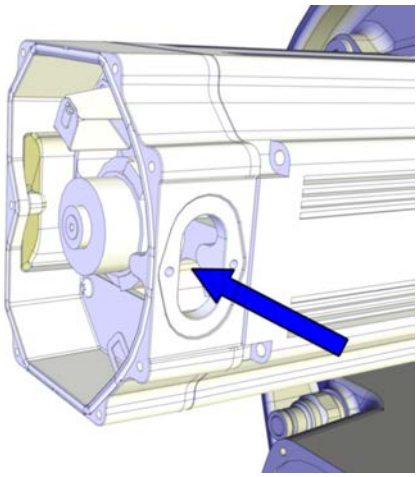
Continues on next page

4.5.1 Replacing the upper arm

Continued

	Action	Note
13	Refit the cable protection by closing the zipper and securing with cable ties.	Cable protection, PU rubber: 3HAC055411-001.  xx1700001802 **A** Cable protection **B** Cable ties
14	Secure the cable harness to the cable fixing bracket with the velcro strap.	 xx1700001810

Connecting the axis-3 and axis-4 motor cables

	Action	Note
1	Push the motor cables through the cable gland opening.	 xx1300000738

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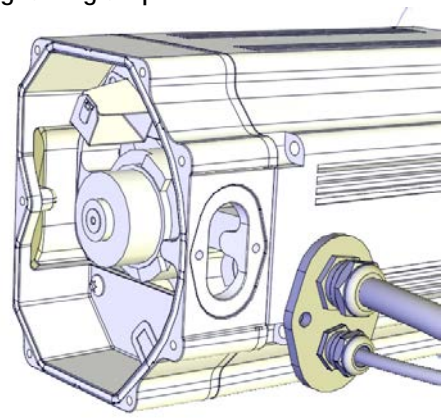
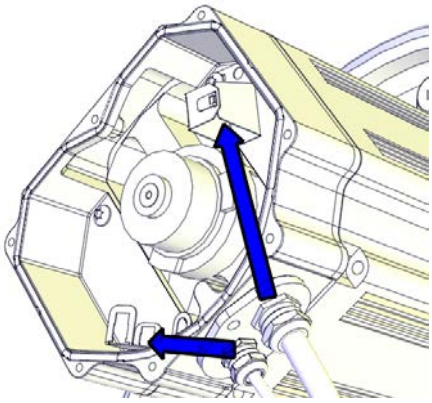
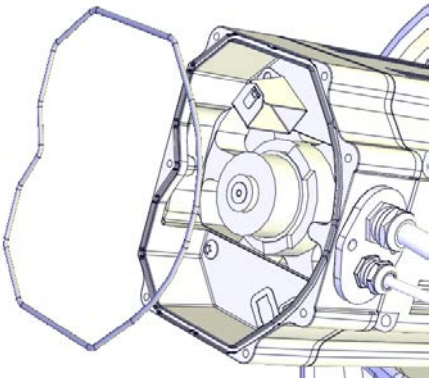
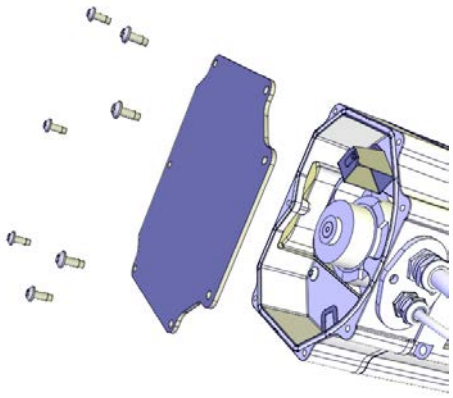
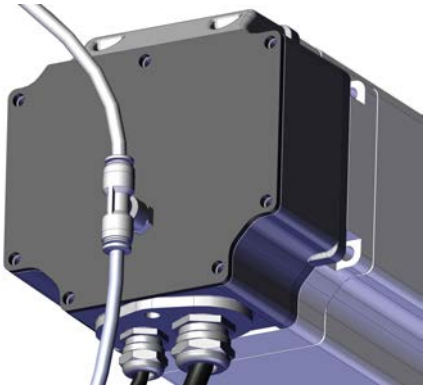
	Action	Note
2	Refit the cable gland cover. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001067
3	Connect the motor cables. Connect in accordance with the markings on the connectors.	 xx1200001066
4	Inspect the o-ring. **Note** Replace if damaged.	O-ring, axis-1: 3HAC067762-001 O-ring, axis-2: 3HAC067762-001 O-ring, axis-3: 3HAC067762-001 O-ring, axis-4: 3HAC067744-001  xx1200001070
5	Wipe clean o-ring and o-ring groove.	

Continues on next page

4.5.1 Replacing the upper arm

Continued

	Action	Note
6	Refit the o-ring. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	
7	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
8	Refit the motor cover with it's attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Attachment screws: M5x12 Stainless steel A2-70 (7 pcs) (9ADA619-44) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001135
9	Make sure that the covers are tightly sealed.	
10	Connect air hose to air fitting on motor. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000568

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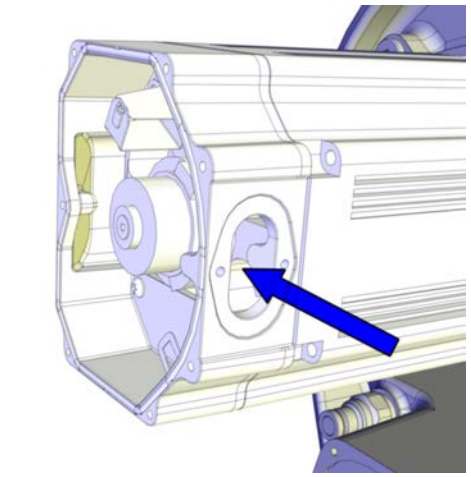
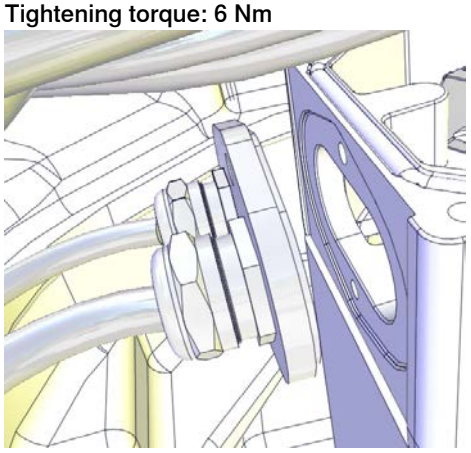
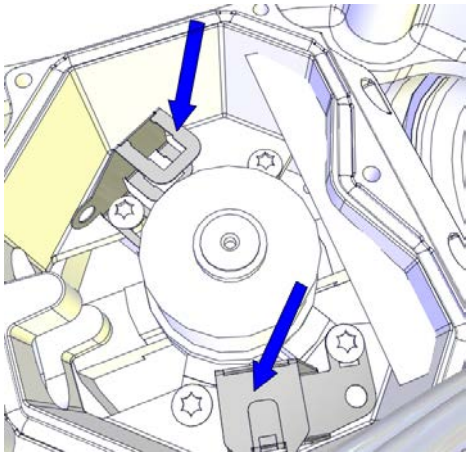
Connecting the axis-5 motor cables

	Action	Note
1	Push the motor cables in through the cable gland opening.	 xx1300000738
2	Refit the cable gland cover by performing the following steps: • Slide the cable gland cover onto the inner screw. • Refit and tighten the outer screw. • Tighten the inner screw. Make sure that the gasket is not damaged. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001016
3	Connect the connectors. Connect in accordance with the markings on the connectors.	 xx1200001015

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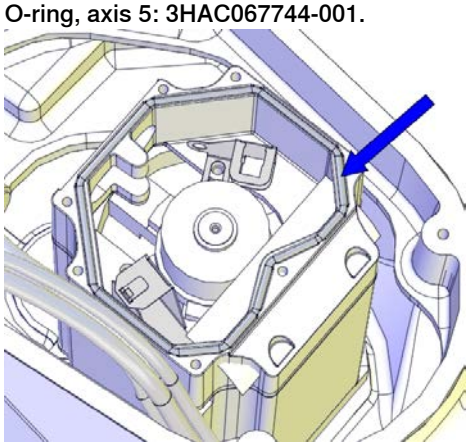
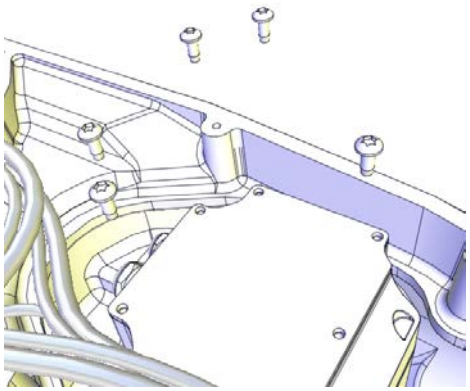
4.5.1 Replacing the upper arm

Continued

	Action	Note
4	Make sure the o-ring on the motor is undamaged. Replace if damaged.	O-ring, axis 5: 3HAC067744-001.  xx1200001021
5	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
6	Refit the motor cover with its attachment screws. **Note** Do not refit the screws that will hold the heat protection plate at this point. **Note** Do not reuse the self-threading attachment screws, it will damage the threads. Replace with standard attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Screws: M5x12. Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001013

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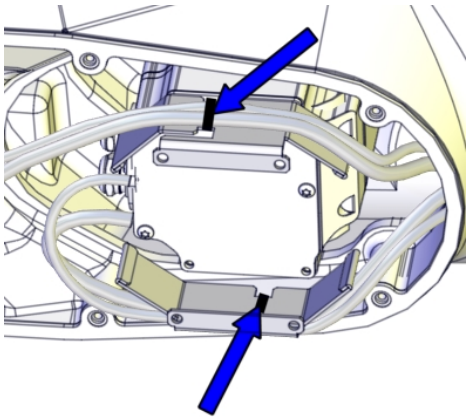
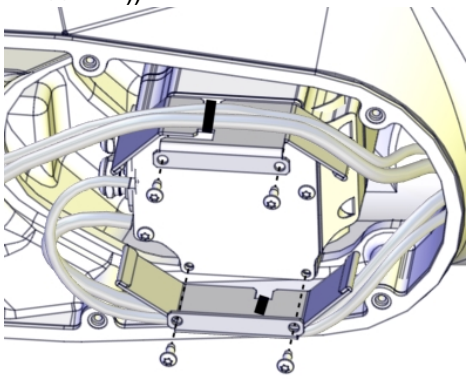
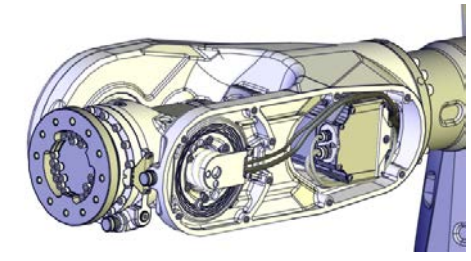
	Action	Note
7	Secure the cable harness with cable straps to the heat protection plate.	 xx1500001029
8	Fit the heat protection plate with the screws.	Screws: M5x12. Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1500001030

Connecting the axis-6 motor cables

	Action	Note
1	Make sure that the cable harness is placed in a way that it will not be damaged when the cover is fitted.	 xx1600002061

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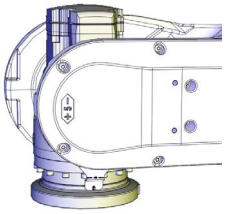
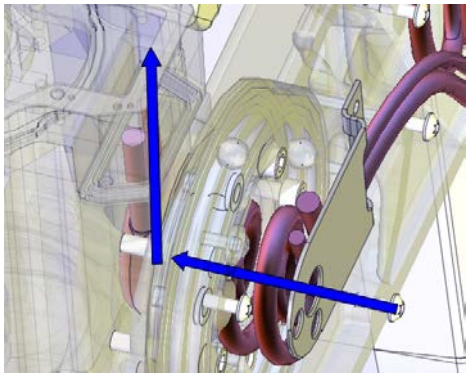
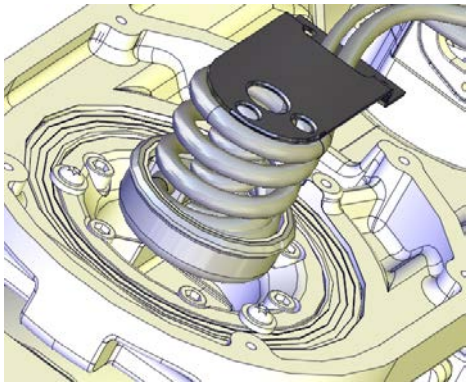
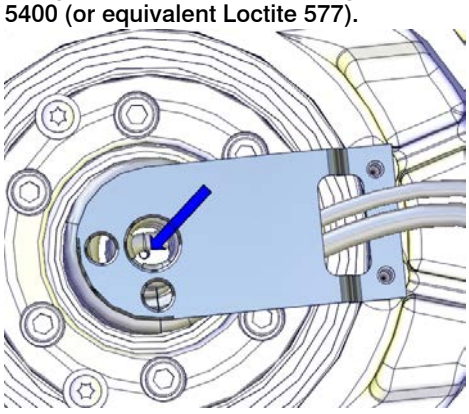
4.5.1 Replacing the upper arm

Continued

	Action	Note
2	**Note** Axis 5 must be in position +90° (or as close as possible) for a correct installation of the cable harness in the wrist. If not, connect the 24 VDC power supply, release the brakes and move axis 5 manually to +90°.	 xx1200001081
3	Push the cable harness into the wrist recess and up into the axis-6 motor.	 xx1300000667
4	Push the carrier carefully into position.	 xx1300001113
5	Secure the carrier with the M4 screw. Use flange sealant. **Note** The screw is located at the bottom of the carrier. **Tip** The attachment screw securing the carrier may be difficult to fit. Make sure the carrier is level and completely pressed against the bottom.	Tightening torque: 4 Nm Flange sealant for conical fittings: Loctite 5400 (or equivalent Loctite 577).  xx1300000485

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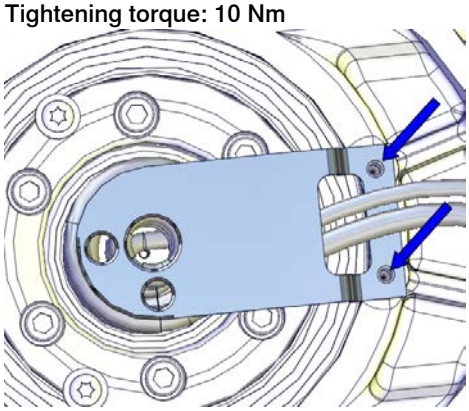
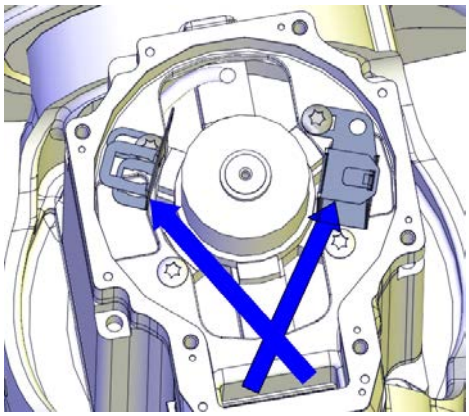
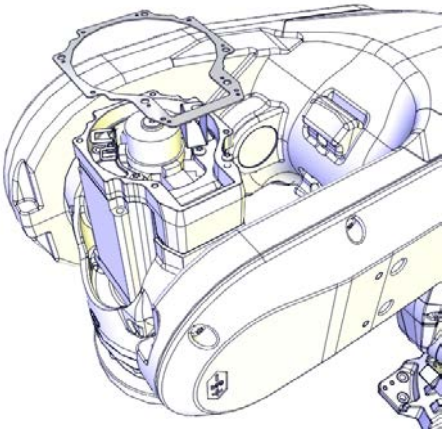
	Action	Note
6	Secure the cable bracket with its attachment screws.	Tightening torque: 10 Nm  xx1300000484
7	Reconnect the connectors to the axis-6 motor. **Note** Place the resolver cable under the motor cable.	 xx1300000488
8	Make sure the gasket is undamaged. Replace if damaged.	Gasket, 3HAC033489-002  xx1200001095
9	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	

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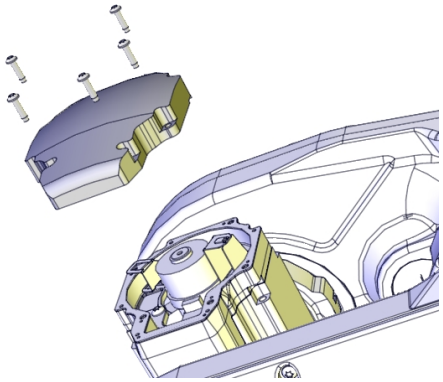
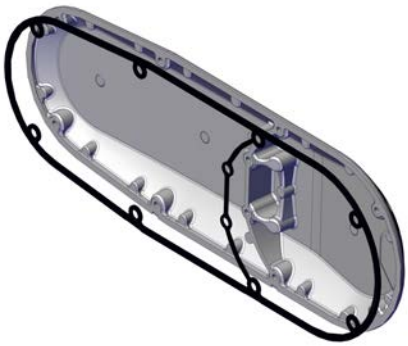
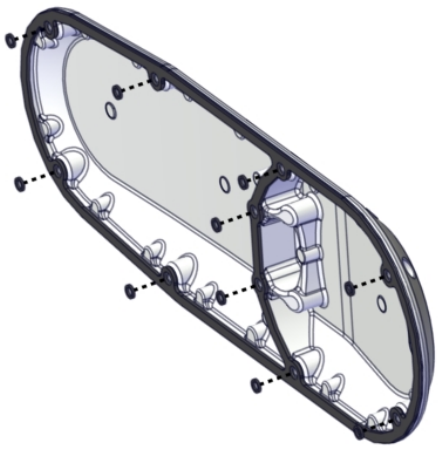
4.5.1 Replacing the upper arm
Continued

	Action	Note
10	Refit the motor cover.	Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001080

Refitting the wrist cover

	Action	Note
1	• Make sure that the gasket is undamaged on the cover. Replace gasket if damaged. • Clean the gasket from dirt and old grease residues. • Lubricate with grease between gasket and cover.	 xx2100000526 Grease: 3HAC042536-001 (Shell Gadus S2)
2	Put washers in the holes of the gasket.	 xx1900002085

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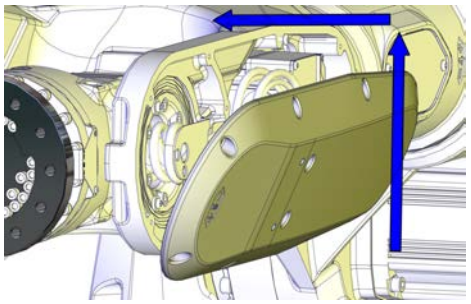
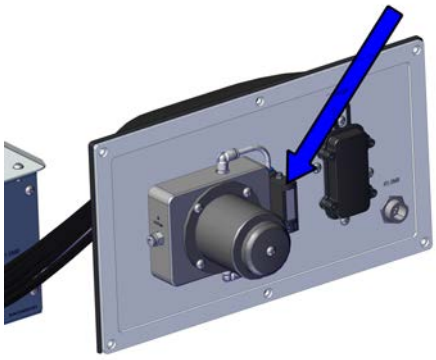
	Action	Note
3	Refit the wrist cover. In order not to damage the cable harness when the wrist cover is refitted, use this method: 1 Hold the cover angled. See figure! 2 Catch any part of the cable harness hanging down. 3 Lift the cover, still held in an angle. 4 Move the upper part of the cover into position. 5 Secure the cover with its attachment screws.	 xx1300000772 Tightening torque: 10 Nm. Torx pan head screw: 9ADA619-56 (M6x16 Stainless steel A2-70)
4	Remove the lifting accessories. Refit stop screws in the lifting accessory attachment holes.	

Concluding procedure

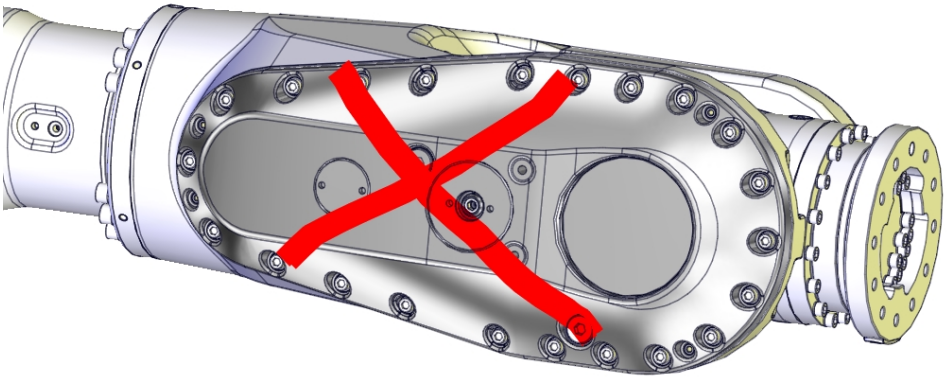
	Action	Note
1	Turn on the air pressure supply to the overpressure system.	
2	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
3	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.
4	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.5.2 Replacing the wrist

Strictly forbidden to open the cover on the axis-5 gearbox

Note

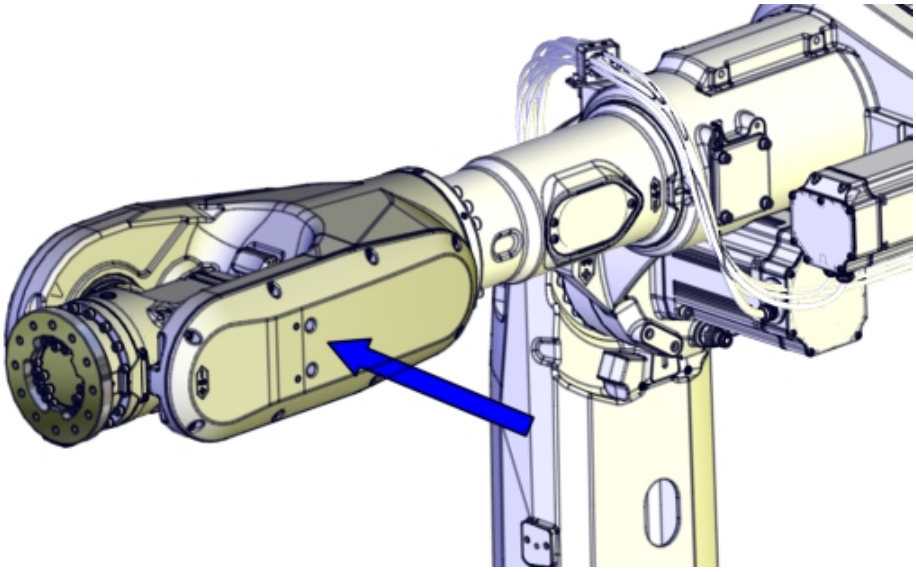
Do not, under any circumstances, open the cover on the axis-5 gearbox! It is strictly forbidden to do any repair work on the axis-5 gearbox.



xx1300002248

Location of the wrist

The wrist is located as shown in the figure.



xx1300000597

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Spare part

Spare part	Spare part number	Note
Wrist	See *Product manual, spare parts - IRB 6790*	

Consumables

Equipment, etc.	Article number	Note
Cable tie	-	
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.
O-ring	3HAC067744-001	D=119x3 Used on axis-5 motor cover.
Gasket	3HAC033489-002	Used on axis-6 motor cover.
Activator	3HAC074342-001	Loctite 7091
Flange sealant	-	Loctite 574 (or equivalent)
Flange sealant for conical fittings	-	Loctite 5400 (or equivalent Loctite 577)

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel with a special coating. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Wrist	M12x50 stainless steel 3HAC060786-032	13x19x2 coated stainless steel 3HAC060866-004	12 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Roundsling, 1 m	-	Length: 1 m, lifting capacity: 1,000 kg.
Pallet		Used for putting down removed parts from robot.
Cardboard		Used for protection.
Guide pin, M12x150	3HAC13056-2	Always use guide pins in pairs.
24 VDC power supply	-	Used to release the motor brakes.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Continues on next page

4.5.2 Replacing the wrist
Continued

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 651*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

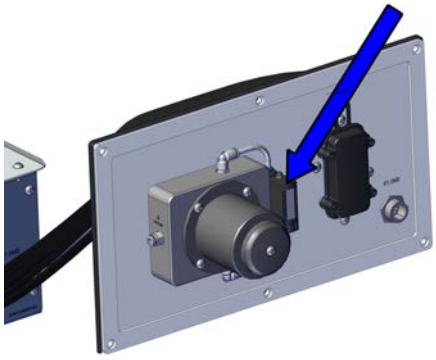
Removing the wrist

These procedures describes how to remove the wrist.

Preparations before removing the wrist

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Remove tools and other equipment fitted to the wrist.	
3	Jog the robot into position: • Axis 1: no significance (as long as the robot is secured to the foundation) • Axis 2: -60° • Axis 3: +60° • Axis 4: +90° • Axis 5: +90° • Axis 6: no significance	

Continues on next page

	Action	Note
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
5	Prepare a pallet with cardboard in front of the robot or where it is possible, to be used for putting down the wrist unit on.	
6	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593
7	**CAUTION** Turn off the air pressure supply.	

Retrieving access to the wrist cabling

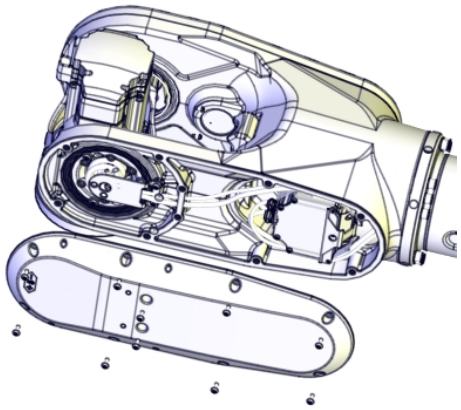
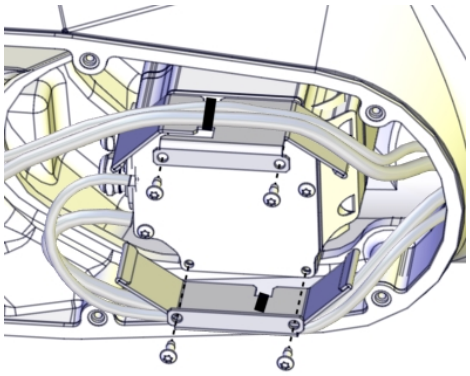
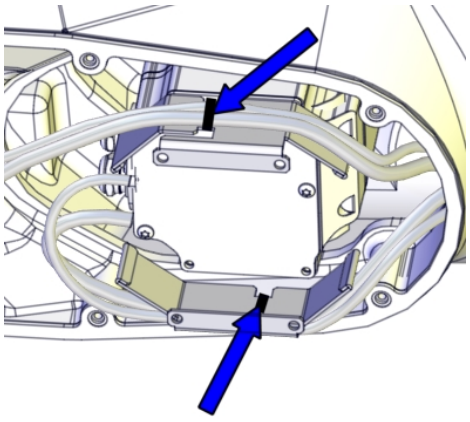
Use this procedure to remove the wrist cover to retrieve access to the axis-5 and axis-6 motor cables.

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

Continues on next page

4.5.2 Replacing the wrist

Continued

	Action	Note
2	Remove the wrist cover.	 xx1300002247
3	Remove the heat protection plates from the motor with the cabling still attached to the plate.	 xx1500001030
4	Cut the cable ties that hold the cable harness to the plate. **Note** Keep the heat protection plate until refitting. **Tip** If removing the plate only for replacing the motor, the cabling does not need to be loosened from the plate.	 xx1500001029

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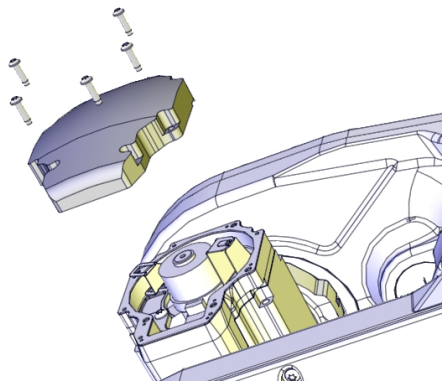
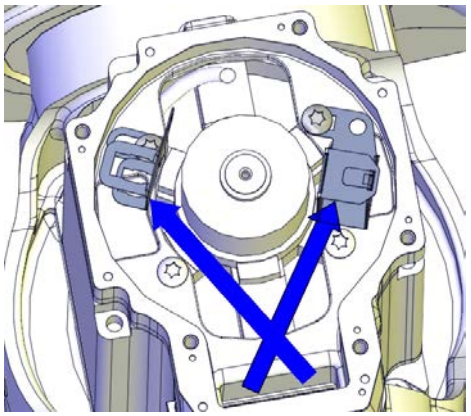
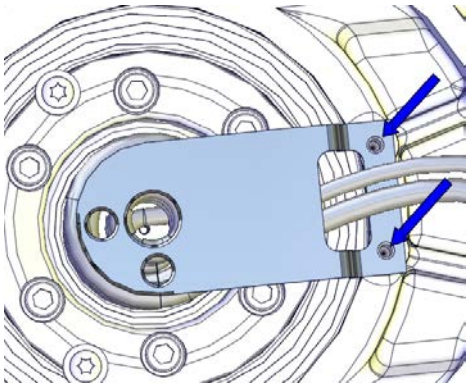
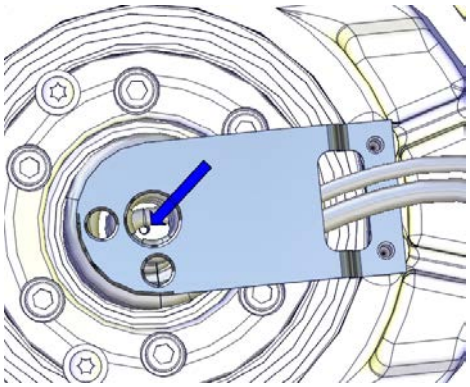
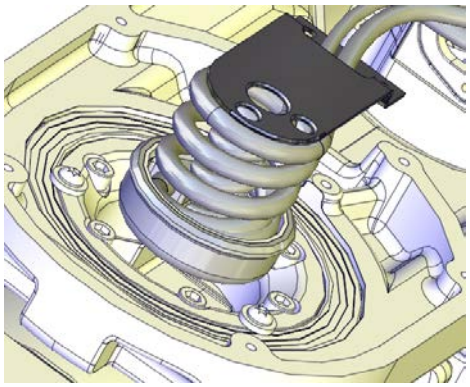
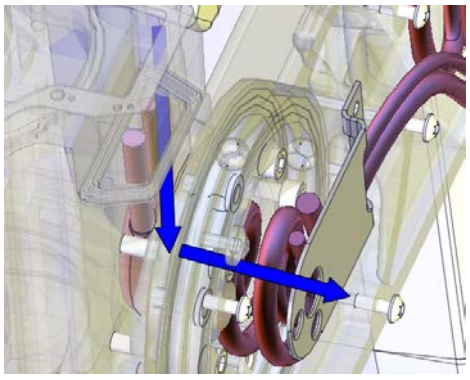
Disconnecting the axis-6 motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Unscrew the attachment screws and remove the motor cover.	 xx1200001080
3	Disconnect the motor cables.	 xx1300000488
4	Unscrew the attachment screws that hold the cable bracket.	 xx1300000484

Continues on next page

4.5.2 Replacing the wrist

Continued

	Action	Note
5	Unscrew the M4 screw that holds the carrier. **Note** The screw is located at the bottom of the carrier. **Note** The parts are sealed with flange sealant Loctite 5400 (or equivalent Loctite 577). Remove the part carefully.	 xx1300000485
6	Pull out the carrier from its position.	 xx1300001113
7	Pull out the axis-6 motor cables by holding the cables with one hand at the motor and the other at the carrier.	 xx1300000666

Disconnecting the axis-5 motor cables

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

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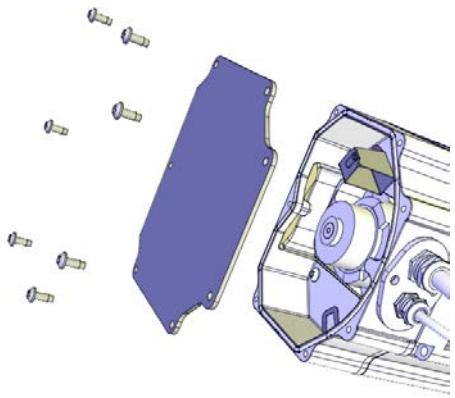
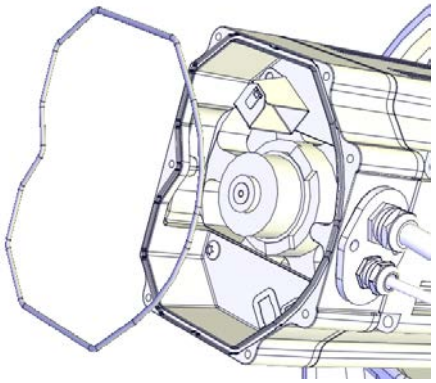
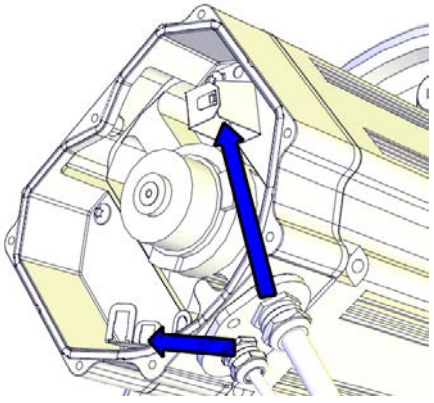
	Action	Note
2	Unscrew the attachment screws and washers and remove the motor cover.	 xx1200001135
3	Make sure the o-ring is present.	 xx1200001070
4	Disconnect the motor cables.	 xx1200001066

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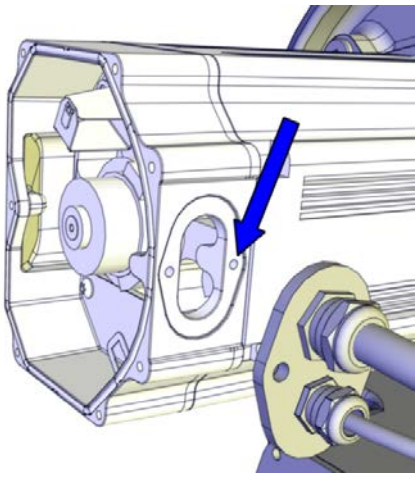
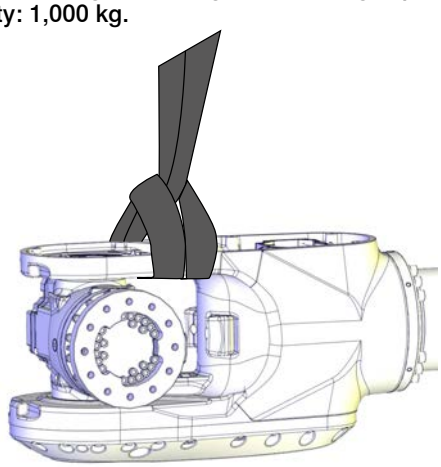
4.5.2 Replacing the wrist

Continued

	Action	Note
5	Remove the cable gland cover by performing the following steps: 1 Open the inner screw a little (the one the arrow is pointing at). No need to remove this screw from the motor. 2 Remove the outer screw. 3 Slide the cable gland cover away from the inner screw. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable exit hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1300000656
6	Use caution and pull out the motor cables.	

Attaching the lifting accessories to the wrist

	Action	Note
1	**CAUTION** The weight of the complete wrist is 125 kg All lifting accessories used must be sized accordingly.	
2	Attach a roundsling to the wrist as shown in the figure. **CAUTION** It is very important that the roundsling is placed as shown in the figure, to keep the wrist balanced when it is removed. Placed at a different position, there is a risk of sudden change in the balance, which can cause damage or injury. Do not attach the roundsling around the axis-5 gearbox!	Roundsling, 1 m: Length: 1 m, lifting capacity: 1,000 kg.  xx1300000673
3	**Note** Make sure the roundsling is stretched, so it can carry the weight of the wrist.	

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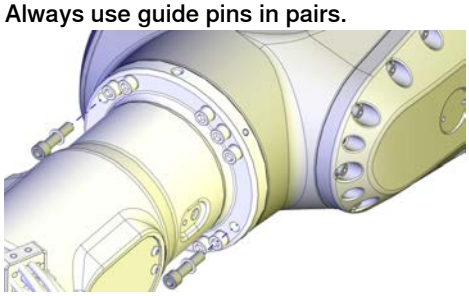
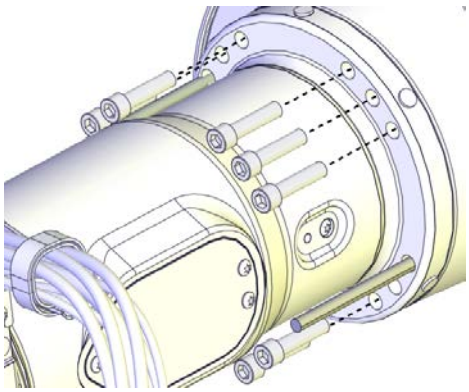
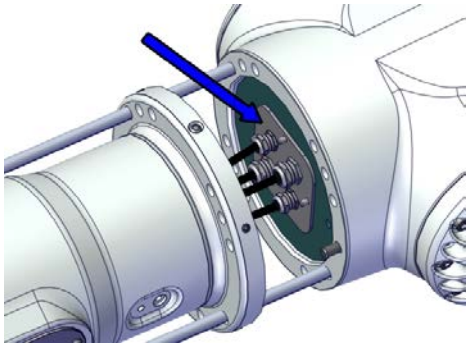
Removing the wrist

	Action	Note
1	Remove two attachment screws in opposite holes and replace them with guide pins. **Tip** Lubricate the guide pins with some grease to make the wrist slide better.	Guide pin, M12x150: 3HAC13056-2 Always use guide pins in pairs.  xx1300000748
2	Remove the remaining attachment screws.	 xx1300000749
3	Pull out the wrist a bit, onto the guide pins. Loosen the cable plate from the wrist by removing the four nuts. This is done to be able to remove the cable harness from the wrist in a safe way. **CAUTION** Make sure that the cabling does not get damaged.	 xx1700001594 A Tubeshaft plate

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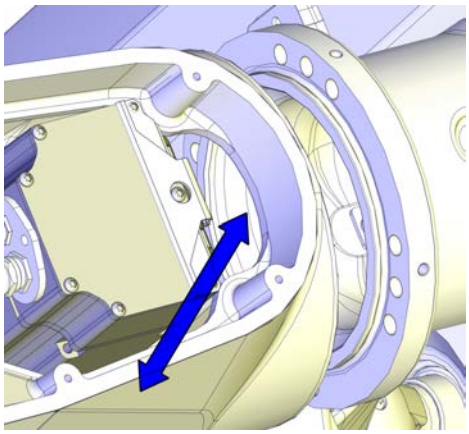
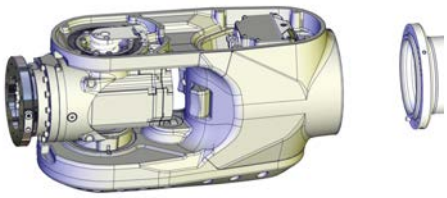
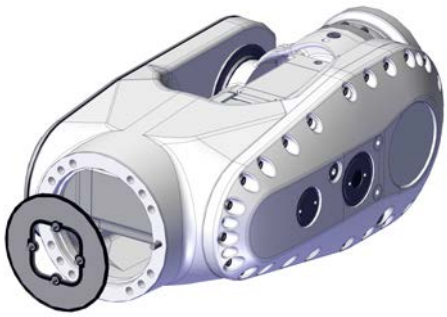
4.5.2 Replacing the wrist
Continued

	Action	Note
4	Use caution and pull out the cabling from the wrist unit.	 xx1300000769
5	Slide the wrist off the guide pins and put it on a pallet or similar.	 xx1300000770
6	Loosen the tubeshaft plate from the wrist to fit it to the new wrist spare part.	 xx1700002156

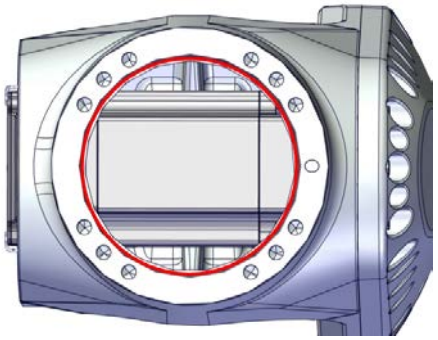
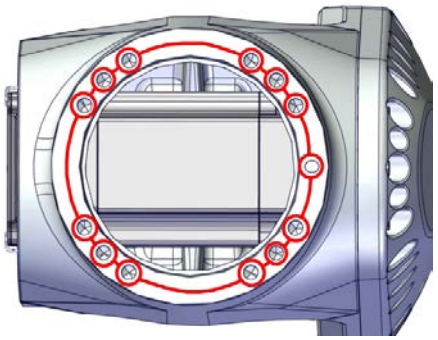
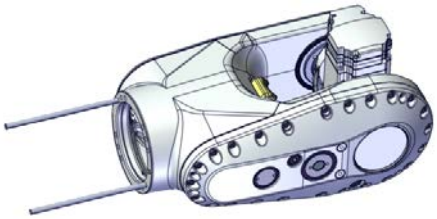
Refitting the wrist

These procedures describes how to refit the wrist.

Preparations before refitting the wrist

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

Continues on next page

	Action	Note
2	Remove old residues of flange sealant and remove all contamination from all contact surfaces.	
3	Seal the contact surfaces of the wrist. 1 First apply an activator to the contact surfaces. 2 Then apply new flange sealant to the corresponding contact surfaces. **Note** The activator must be used to harden the flange sealant.	Activator: 3HAC074342-001 (Loctite 7091). Flange sealant: - (Loctite 574 (or equivalent)). Contact surface against the tubeshaft flange:  xx1700001876 Contact surface against the upper arm tube:  xx1700001877
4	Fit two guide pins in opposite holes in the wrist. **Tip** Lubricate the guide pins with some grease to make the wrist slide better.	Guide pin, M12x150: 3HAC13056-2 Always use guide pins in pairs.  xx1700001595

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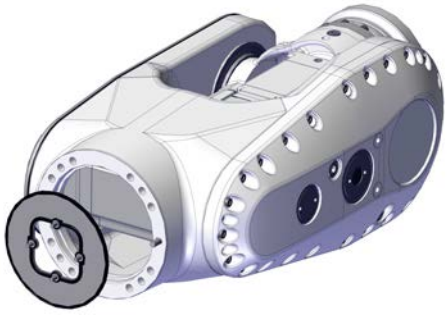
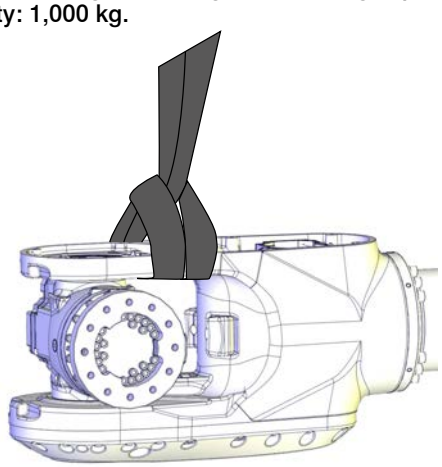
4.5.2 Replacing the wrist

Continued

	Action	Note
5	Fit the tubeshaft plate to the wrist.	 xx1700002156
6	If axis-5 is not already in position +90°, connect the 24 VDC power supply, release the brakes and move the axis manually into that position. Connect to R2.MP5-connector: • + = pin 2 • - = pin 5	24 VDC power supply

Attaching the lifting accessories to the wrist

	Action	Note
1	**CAUTION** The weight of the complete wrist is 125 kg All lifting accessories used must be sized accordingly.	
2	Attach a roundsling to the wrist as shown in the figure. **CAUTION** It is very important that the roundsling is placed as shown in the figure, to keep the wrist balanced when it is removed. Placed at a different position, there is a risk of sudden change in the balance, which can cause damage or injury. Do not attach the roundsling around the axis-5 gearbox!	Roundsling, 1 m: Length: 1 m, lifting capacity: 1,000 kg.  xx1300000673
3	**Note** Make sure the roundsling is stretched, so it can carry the weight of the wrist.	

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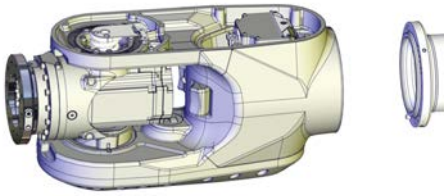
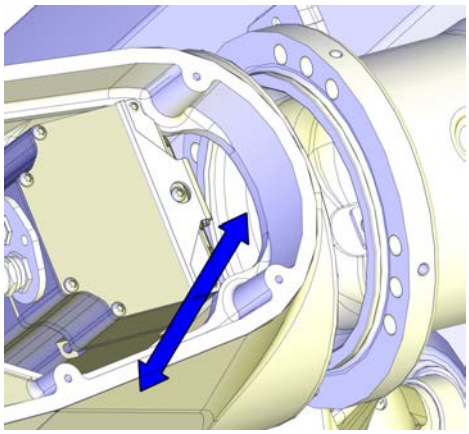
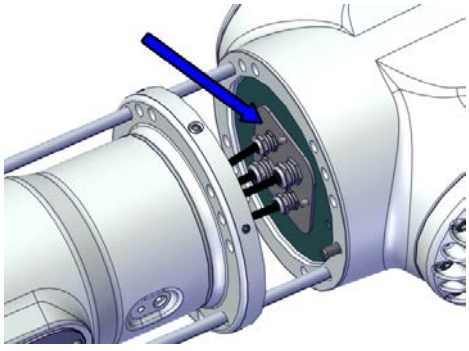
Refitting the wrist

	Action	Note
1	Lift the wrist and insert the guide pins into the holes of the arm tube. **Tip** Leave a small opening between wrist and arm tube. This will make it easier to run the cable harness back into the wrist.	 xx1300000770
2	Run the cabling into the wrist unit. Be careful not to damage any part of the cable harness.	 xx1300000769
3	Mount the four sealing plate nuts on the tube shaft.	Tightening torque: 10 Nm. Nut: M6 Steel 8-A2F (9ADA298-4)
4	Slide the wrist into fitting position. Make sure that the tubeshaft plate is placed properly in the groove in the wrist.	 xx1700001594

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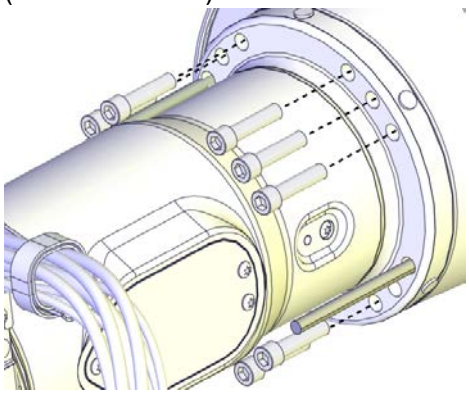
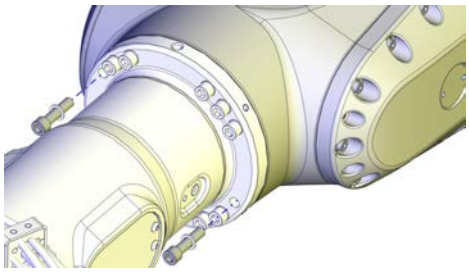
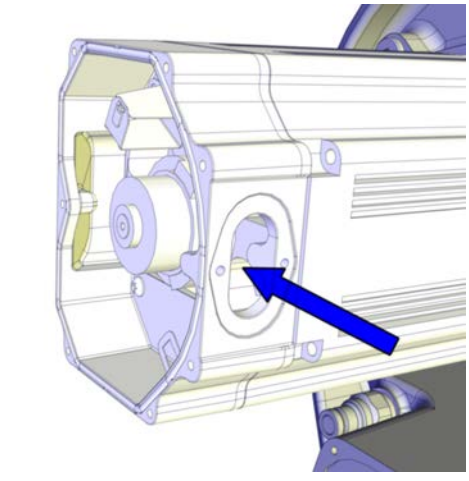
4.5.2 Replacing the wrist

Continued

	Action	Note
5	Fit 10 of the 12 attachment screws and washers.	Screws: M12x50 stainless steel (3HAC060786-032). Washers: 13x19x2 coated stainless steel (3HAC060866-004)  xx1300000749
6	Remove the guide pins and replace them with the remaining attachment screws and washers.	 xx1300000748
7	Tighten the attachment screws.	Tightening torque: 120 Nm.

Connecting the axis-5 motor cables

	Action	Note
1	Push the motor cables in through the cable gland opening.	 xx1300000738

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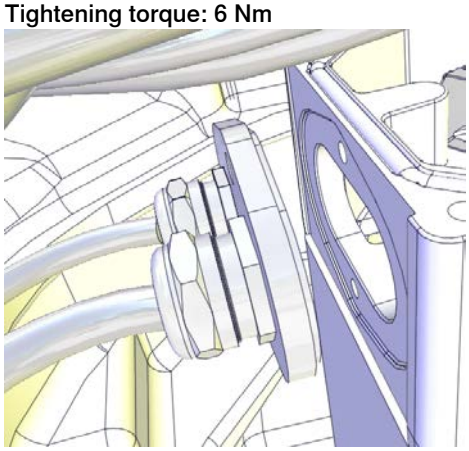
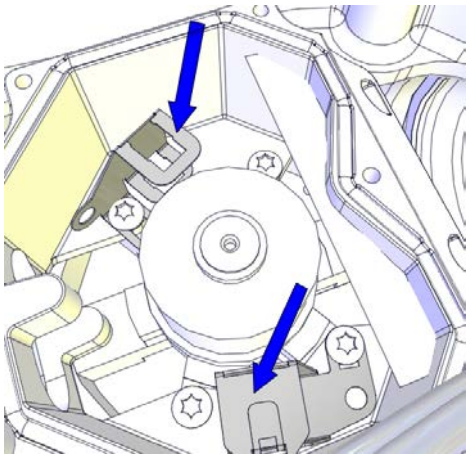
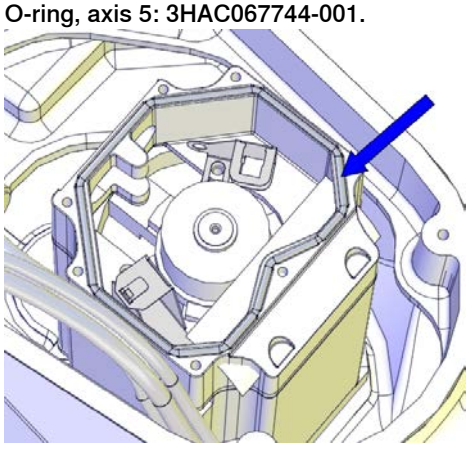
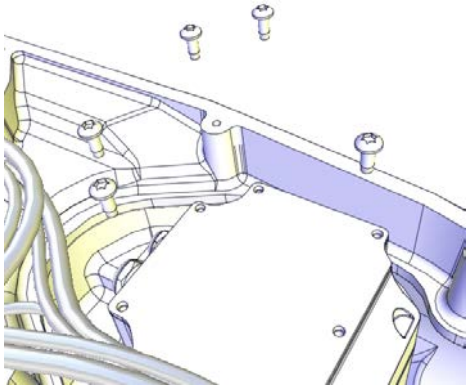
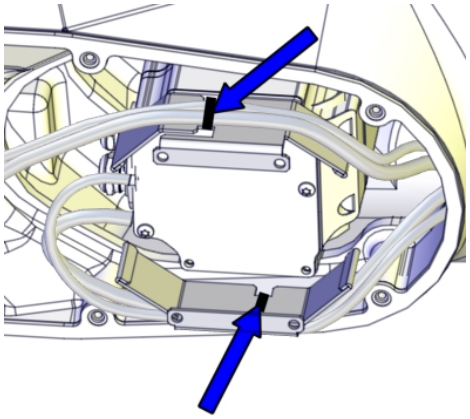
	Action	Note
2	Refit the cable gland cover by performing the following steps: • Slide the cable gland cover onto the inner screw. • Refit and tighten the outer screw. • Tighten the inner screw. Make sure that the gasket is not damaged. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001016
3	Connect the connectors. Connect in accordance with the markings on the connectors.	 xx1200001015
4	Make sure the o-ring on the motor is undamaged. Replace if damaged.	O-ring, axis 5: 3HAC067744-001.  xx1200001021
5	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	

Continues on next page

4.5.2 Replacing the wrist

Continued

	Action	Note
6	Refit the motor cover with its attachment screws. **Note** Do not refit the screws that will hold the heat protection plate at this point. **Note** Do not reuse the self-threading attachment screws, it will damage the threads. Replace with standard attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Screws: M5x12. Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001013
7	Secure the cable harness with cable straps to the heat protection plate.	 xx1500001029

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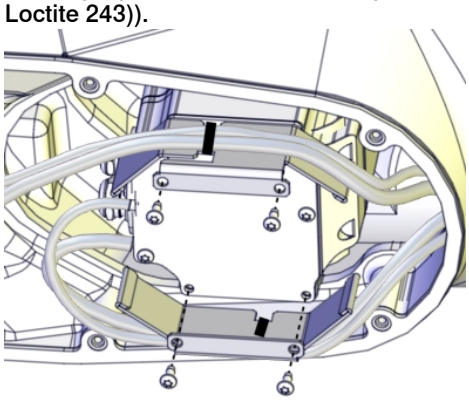
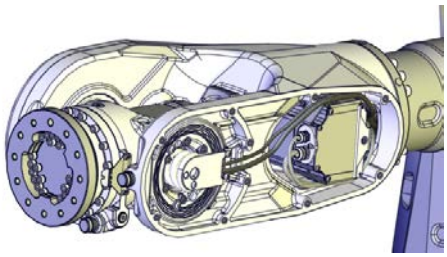
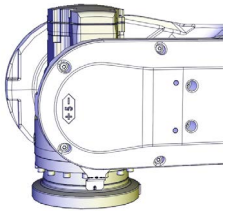
	Action	Note
8	Fit the heat protection plate with the screws.	Screws: M5x12. Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1500001030

Connecting the axis-6 motor cables

	Action	Note
1	Make sure that the cable harness is placed in a way that it will not be damaged when the cover is fitted.	 xx1600002061
2	**Note** Axis 5 must be in position +90° (or as close as possible) for a correct installation of the cable harness in the wrist. If not, connect the 24 VDC power supply, release the brakes and move axis 5 manually to +90°.	 xx1200001081

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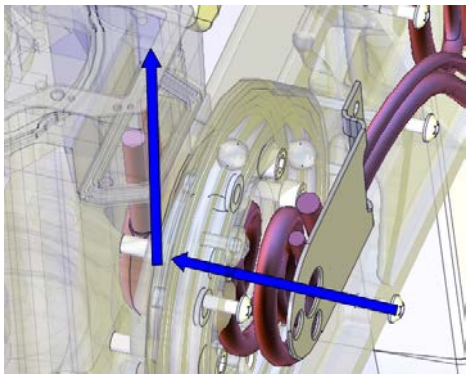
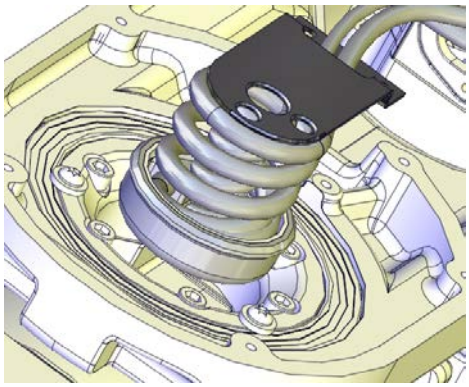
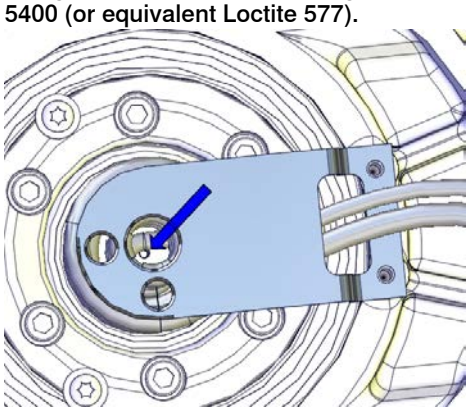
4.5.2 Replacing the wrist

Continued

	Action	Note
3	Push the cable harness into the wrist recess and up into the axis-6 motor.	 xx1300000667
4	Push the carrier carefully into position.	 xx1300001113
5	Secure the carrier with the M4 screw. Use flange sealant. **Note** The screw is located at the bottom of the carrier. **Tip** The attachment screw securing the carrier may be difficult to fit. Make sure the carrier is level and completely pressed against the bottom.	Tightening torque: 4 Nm Flange sealant for conical fittings: Loctite 5400 (or equivalent Loctite 577).  xx1300000485

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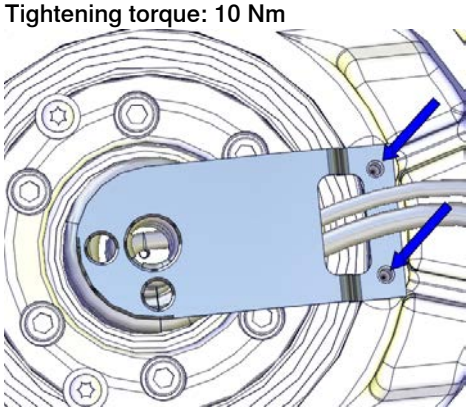
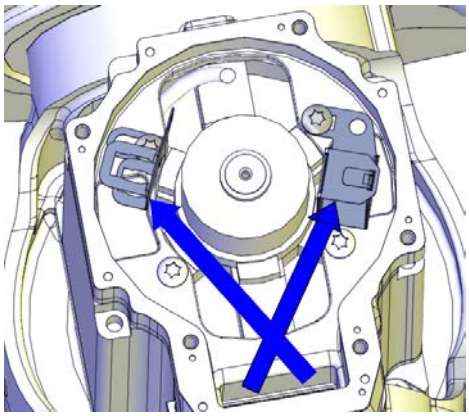
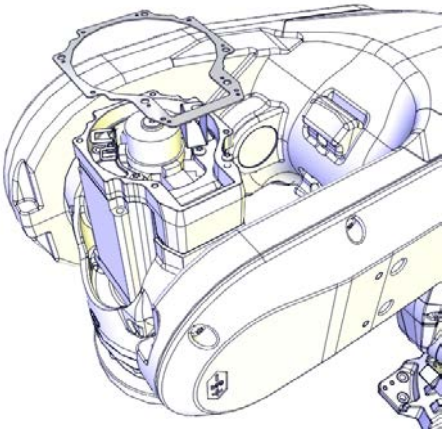
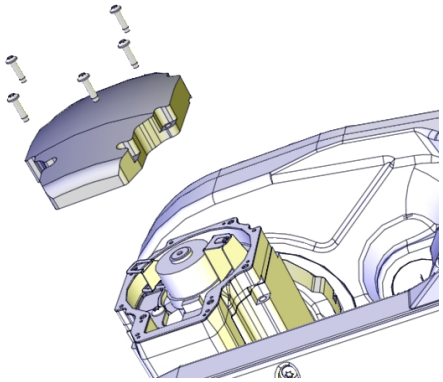
	Action	Note
6	Secure the cable bracket with its attachment screws.	Tightening torque: 10 Nm  xx1300000484
7	Reconnect the connectors to the axis-6 motor. **Note** Place the resolver cable under the motor cable.	 xx1300000488
8	Make sure the gasket is undamaged. Replace if damaged.	Gasket, 3HAC033489-002  xx1200001095
9	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	

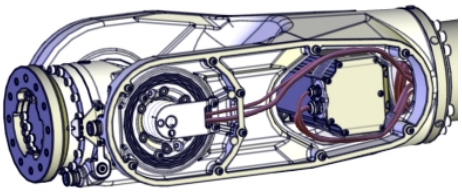
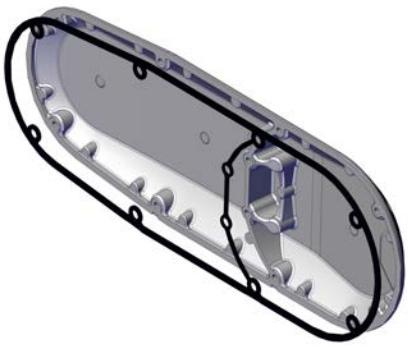
Continues on next page

4.5.2 Replacing the wrist

Continued

	Action	Note
10	Refit the motor cover.	Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001080

Concluding procedure

	Action	Note
1	Make sure that the cable harness is placed in a way so it will not be damaged when the wrist cover is fitted.	 xx1500001672
2	• Make sure that the gasket is undamaged on the cover. Replace gasket if damaged. • Clean the gasket from dirt and old grease residues. • Lubricate the gasket with grease.	 xx2100000526 Grease: 3HAC042536-001 (Shell Gadus S2)

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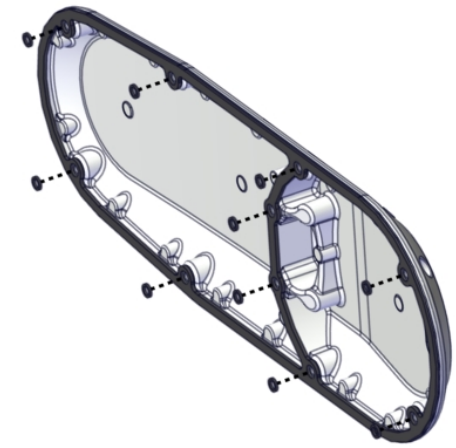
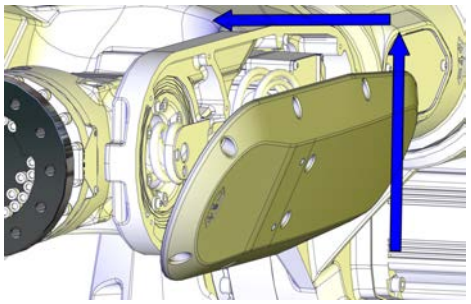
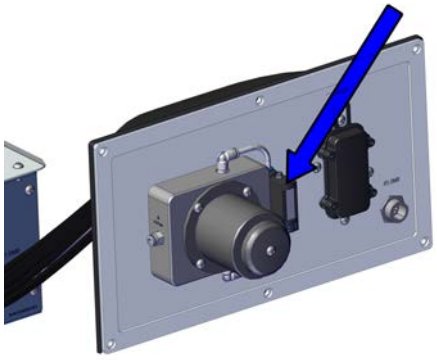
	Action	Note
3	Put washers in the holes of the gasket.	 xx1900002085
4	Refit the wrist cover. Use this method not to damage the cable harness: 1 Hold the cover tilted. See figure! 2 Catch any part of the cable harness hanging down. 3 Lift the cover, still held tilted. 4 Move the upper part of the cover into position. 5 Secure the cover with its attachment screws.	 xx1300000772 Tightening torque: 10 Nm. Torx pan head screw: 9ADA619-56 (M6x16 Stainless steel A2-70)
5	Turn on the air pressure supply to the overpressure system.	
6	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
7	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.

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4.5.2 Replacing the wrist

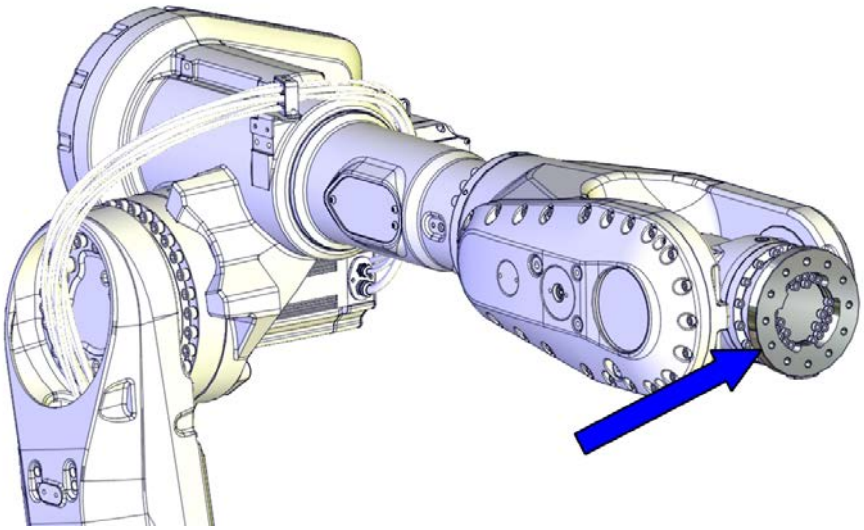
Continued

	Action	Note
8	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.5.3 Replacing the turning disc

Location of the turning disc

The turning disc is located in the front of the wrist housing as shown in the figure.



xx1300000491

Spare part

Spare part	Spare part number	Note
Turning disc	See *Product manual, spare parts - IRB 6790*	
Turcon Roto VL seal	3HAC060656-002	The seal is damaged when the turning disc is removed and must be replaced.
Guiding ring	3HAC062111-001	Located on the axis-6 gear-box. Replace if damaged.

Consumables

Equipment, etc.	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Turning disc	M8x25 stainless steel 3HAC060786-010 Screws are not reusable after removal. Replace them with new screws.	8.4x13x1.6 stainless steel 3HAC060866-001	24 pcs

Continues on next page

4.5.3 Replacing the turning disc
Continued

Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

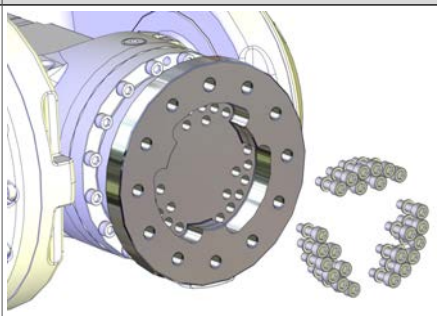
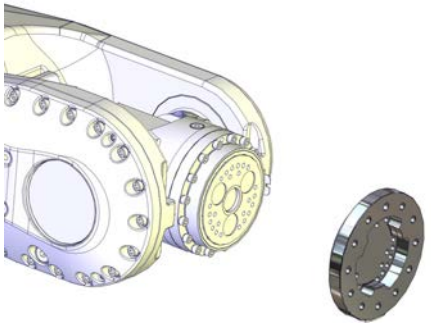
Removing the turning disc

Use these procedures to remove the turning disc.

Preparations before removing the turning disc

	Action	Note
1	Run the robot to a position most comfortable for the removal of the turning disc.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	Remove any equipment fitted to the turning disc.	

Removing the turning disc

	Action	Note
1	Remove the screws and washers, that secure the turning disc.	 xx1300000492
2	Remove the turning disc.	 xx1300000493

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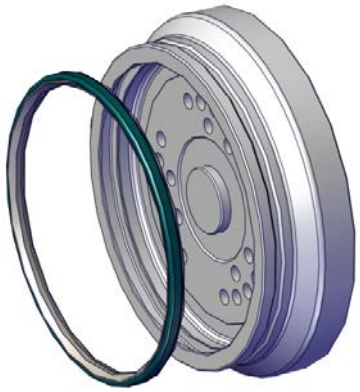
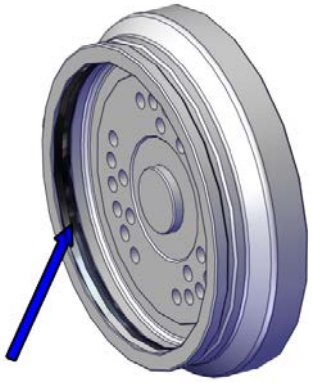
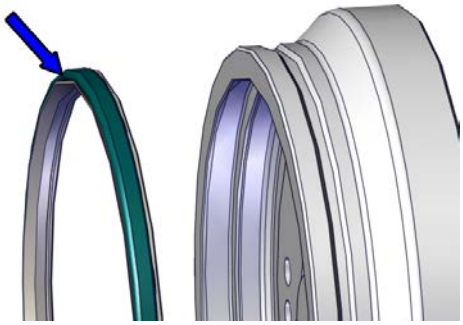
	Action	Note
3	Remove the seal from the turning disc. **Note** Replace the seal if damaged.	 xx1700001592

Refitting the turning disc

Use this procedure to refit the turning disc.

Refitting the turning disc

	Action	Note
1	Lubricate the new seal with grease and fit it to the turning disc. Face the sealing side outwards from the turning disc when orienting the seal, as shown in the figure.	Turcon Roto VL seal: 3HAC060656-002 Grease: 3HAC042536-001 (Shell Gadus S2).  xx1700001878  xx1700002033

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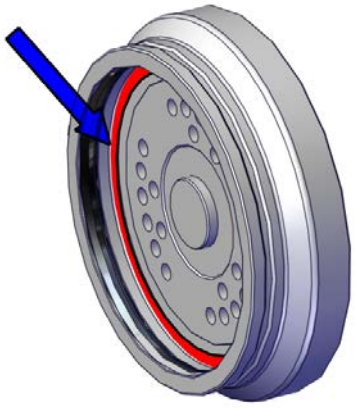
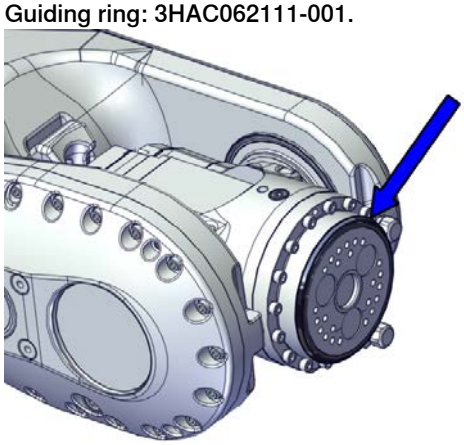
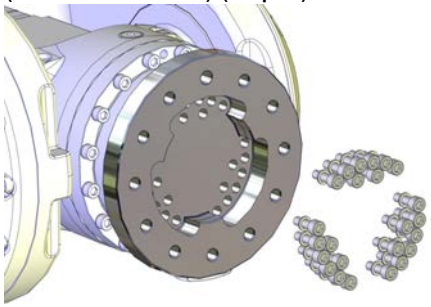
4.5.3 Replacing the turning disc

Continued

	Action	Note
2	Apply grease all the way around the inner corner of the turning disc. **Note** No grease is allowed on the screw flange.	Grease: 3HAC042536-001 (Shell Gadus S2).  xx1700002094
3	Ensure that the guiding ring is positioned on the gearbox.	Guiding ring: 3HAC062111-001.  xx1700001602
4	Wipe clean the contact surfaces.	
5	Secure the turning disc with new attachment screws and washers. **CAUTION** The attachment screws can not be reused. **Tip** Use three M8x35 screws first to pull in the turning disc against the gearbox, if needed. Then remove the screws and secure the turning disc with the specified attachment screws.	Tightening torque: 25 Nm + 45° ±10°. Attachment screws: M8x25 stainless steel, 3HAC060786-010 (24 pcs) Washers: 8.4x13x1.6 stainless steel (3HAC060866-001) (24 pcs)  xx1300000492

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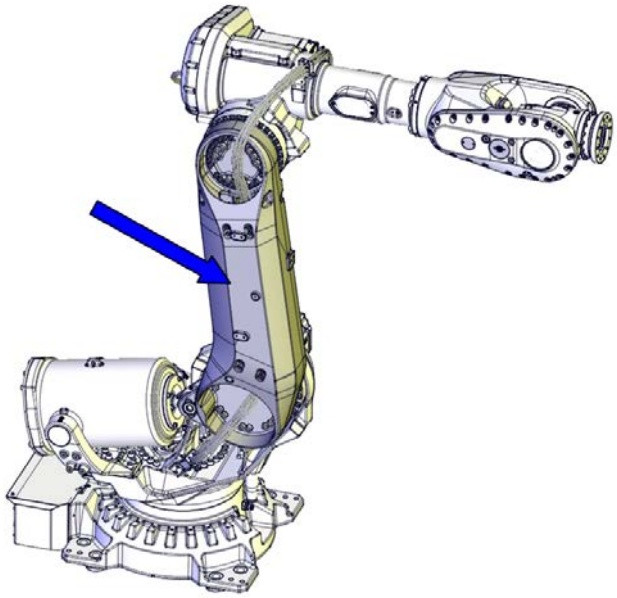
Concluding procedure

	Action	Note
1	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.5.4 Replacing the lower arm

Location of the lower arm

The lower arm is located as shown in the figure.



xx1300000786

Summary of the replacement procedure

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

1. Unload the balancing device.
2. Remove the shaft in the balancing device front link ear
3. Remove the cabling from the upper and lower arm.
4. Remove the upper arm.
5. Replace the lower arm.

Spare part

Spare part	Spare part number	Note
Lower arm	See *Product manual, spare parts - IRB 6790*	

Consumables

Equipment	Article number	Note
Grease	3HAA1001-294	Tribol GR 100-0 PD, 50 ml For lubrication of the front bearing of the balancing device.

Continues on next page

Equipment	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.
O-ring	3HAC067762-001	D=169.5x3 Used on axis-3 motor cover.
	3HAC067744-001	D=119x3 Used on axis-4 motor cover.
	3HAC067744-001	D=119x3 Used on axis-5 motor cover.
Gasket	3HAC033489-002	Used on axis-6 motor cover.
Flange sealant	-	Loctite 574 (or equivalent)
Activator	3HAC074342-001	Loctite 7091
Flange sealant for conical fittings	-	Loctite 5400 (or equivalent Loctite 577)

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Lower arm	M16x50 stainless steel 3HAC060786-041	17x25x3 coated stainless steel HV200 (3HAC060866-005)	21 pcs
Upper arm	M16x50 stainless steel 3HAC060786-041	17x25x3 coated stainless steel HV200 (3HAC060866-005)	9 pcs
	M12x40 stainless steel 3HAC060786-031	13x19x2 coated stainless steel 3HAC060866-004	27 pcs
Balancing device cover plate	M10x30 stainless steel (3HAC060786-020)	-	4 pcs

Required tools and equipment

Equipment	Article number	Note
Distance tool	3HAC030662-001	Only used to keep the balancing device in a locked position, after the balancing device springs has been unloaded with the help of the robot itself.  **DANGER** *Never* use this tool to unload or restore a balancing device!
Lifting shackle	-	SA-10-8-NA1
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.

Continues on next page

4.5.4 Replacing the lower arm
Continued

Equipment	Article number	Note
Dismantle and mounting tool	3HAC028920-001	Used for removing and fitting shaft and bearings.
Hydraulic pump 70 MPa	3HAC13086-1	To be used with the hydraulic cylinder.
Hydraulic cylinder	3HAC11731-1	To be used with the press tool.
Lifting eye	3HAC16131-1	M12
Lifting eye	3HAC16131-1	M12
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.
Guide pin, M12x150	3HAC13056-2	Always use guide pins in pairs.
Guide pin, M12x200	3HAC13056-3	Always use guide pins in pairs.
Pallet		Used for putting down removed parts from robot.
Guide pin, M16x150	3HAC13120-2	Always use guide pins in pairs.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
24 VDC power supply	-	Used to release the motor brakes.
Anvil	3HAC047273-001	Included in the tool kit Dismantle and mounting tool (3HAC028920-001).
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 651*.

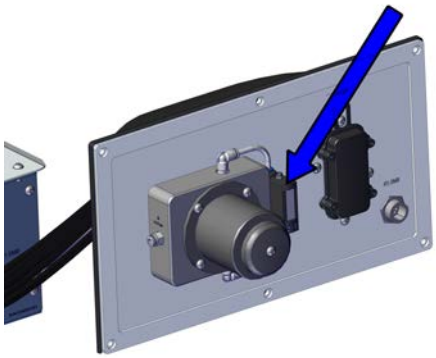
Continues on next page

	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 lower arm

Use these procedures to remove the lower arm.

Preparations before removing the lower arm

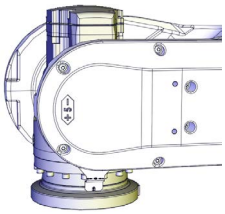
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	Remove all equipment fitted to upper and lower arms.	
4	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593
5	**CAUTION** Turn off the air pressure supply.	

Continues on next page

4.5.4 Replacing the lower arm

Continued

Position of the robot in the continued process

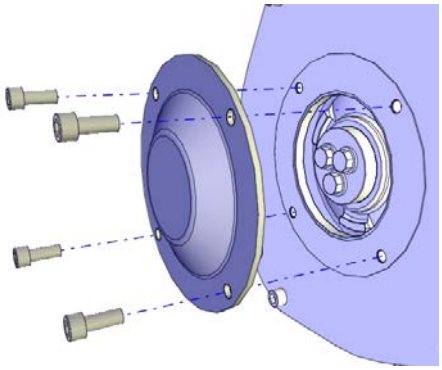
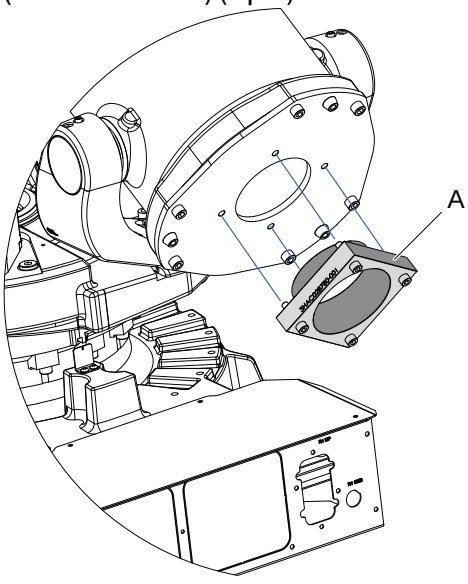
	Action	Note
1	Jog the robot to: • Axis 1: 0° • Axis 2: 0° • Axis 3: 0° • Axis 4: 0° • Axis 5: +90° • Axis 6: 0°	
2	Connect the 24 VDC power supply, release the brakes and move the axis 5 manually into +90°. Connect to R2.MP5-connector: • + = pin 2 • - = pin 5	24 VDC power supply  xx1200001081
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	

Unloading the balancing device springs with the robot and locking position with the Distance tool

Use this procedure to unload the balancing device with the help of the robot, and lock the balancing device springs in a compressed position, using the Distance tool (3HAC030662-001).

	Action	Note
1	**DANGER** Do not use the Distance tool (3HAC030662-001) to unload or restore the pressure of the balancing device springs! This tool is only used to lock the spring unit in a compressed position, after axis-2 has been jogged to -30° or +30°. Fitting and removal of the tool shall only be done with axis-2 in this position! To unload or restore a new balancing device or if the spring unit of the balancing device cannot be compressed by jogging the robot, only use the Hydraulic press tool, balancing device (3HAC074411-001).	
2	Jog axis-2 to: • -30° or +30°	This is done in order to compress the balancing device springs inside the balancing device before fitting the Distance tool.

Continues on next page

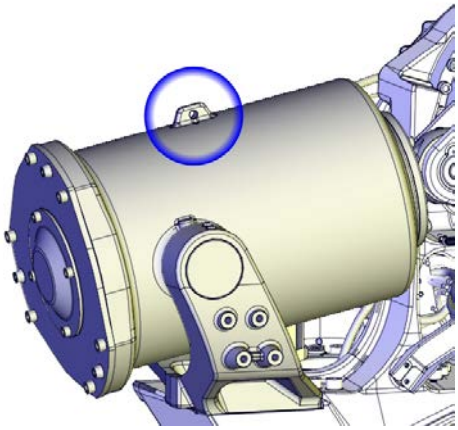
	Action	Note
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Remove the cover plate on the back of the balancing device. **DANGER** DO NOT remove any other screws than the rear cover attachment screws.	 xx1300000554
5	Fit the Distance tool on the back of the balancing device using the four screws. **DANGER** Use caution when tightening the screws. The threads in the cover can be damaged if more tightening torque than 45 Nm is used, risking that the Distance tool is not properly fitted.	Tightening torque: 45 Nm Attachment screws: M10x30 stainless steel (3HAC060786-020) (4 pcs)  xx0800000480 A Distance tool: 3HAC030662-001
6	Turn the power on temporary.	
7	Jog axis-2 to the calibration position. The balancing device is now unloaded.	This is done to compress the balancing device springs, making it possible to remove the front shaft of the balancing device.
8	Let the Distance tool stay fitted during the continued procedure.	

Continues on next page

4.5.4 Replacing the lower arm
Continued

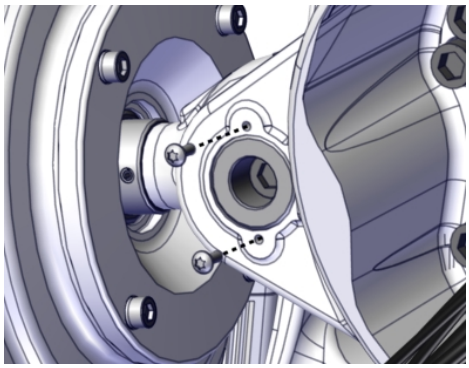
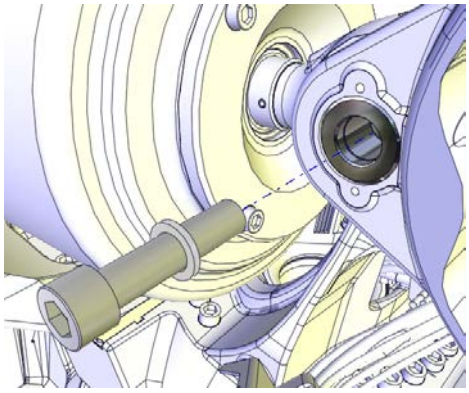
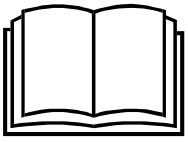
	Action	Note
9	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	

Preparations before removing the shaft in the link ear

	Action	Note
1	Jog axis-2 to the calibration position (if not already in this position).	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	Remove any equipment, if fitted, on or close to the balancing device.	
4	**CAUTION** The weight of the balancing device (excluding cradle) is 140 kg All lifting accessories used must be sized accordingly.	
5	Fit a lifting shackle to the balancing device.	Lifting shackle: SA-10-8-NA1  xx1300000661
6	Fit the lifting accessory (chain) to the shackle and raise to unload the weight.	Lifting accessory (chain): 3HAC15556-1

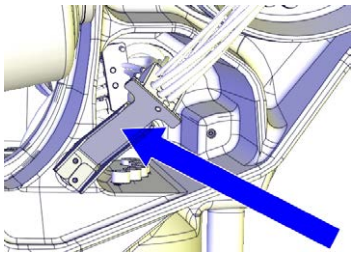
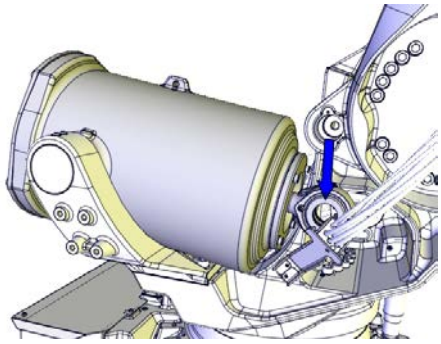
Continues on next page

Removing the shaft in the front (link ear)

	Action	Note
1	Remove the two screws.	 xx1900002146
2	Unscrew the attachment screw and washer.	 xx1200001279 • M16x70, stainless steel
3	Pull the shaft out using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.

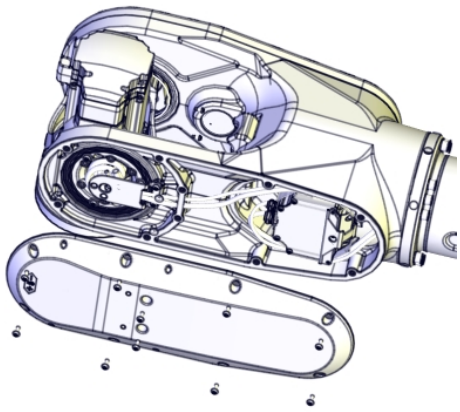
Continues on next page

4.5.4 Replacing the lower arm
Continued

	Action	Note
4	Remove the attachment screws of the cable bracket on the frame and let it hang loose.	 xx1200001283
5	Put down the balancing device and let it rest on the frame.	 xx1200001281

Retrieving access to the wrist cabling

Use this procedure to remove the wrist cover to retrieve access to the axis-5 and axis-6 motor cables.

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Remove the wrist cover.	 xx1300002247

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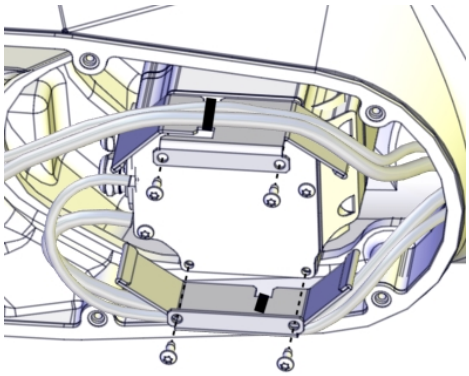
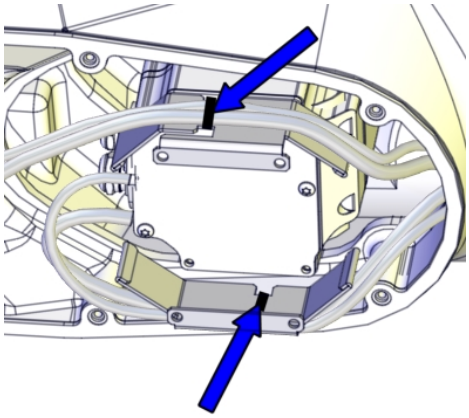
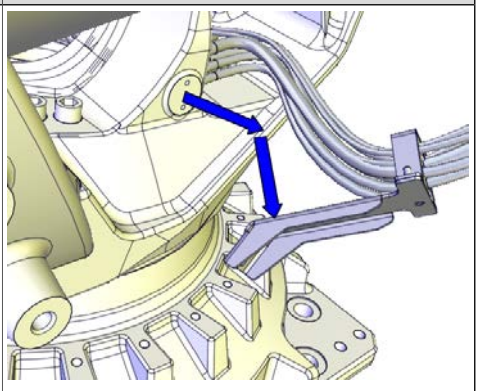
	Action	Note
3	Remove the heat protection plates from the motor with the cabling still attached to the plate.	 xx1500001030
4	Cut the cable ties that hold the cable harness to the plate. **Note** Keep the heat protection plate until refitting. **Tip** If removing the plate only for replacing the motor, the cabling does not need to be loosened from the plate.	 xx1500001029

Removing cable brackets

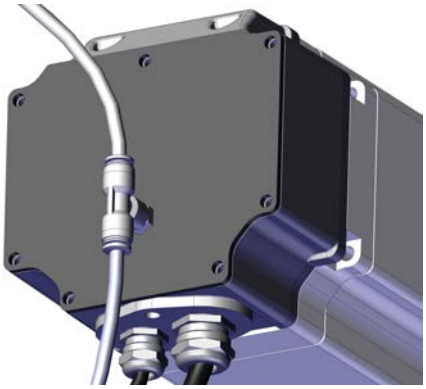
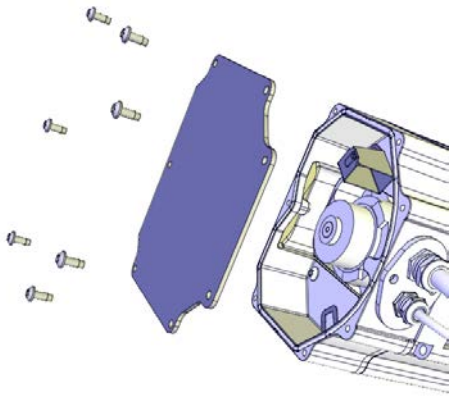
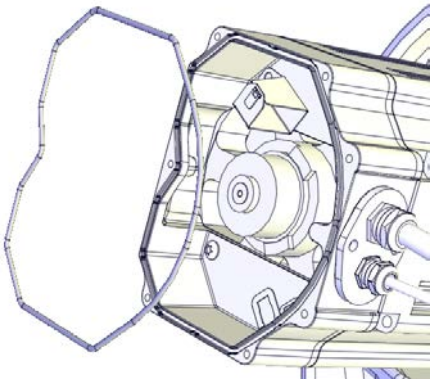
	Action	Note
1	Unscrew the screws that hold the bracket and let it hang free.	 xx1200001184

Continues on next page

4.5.4 Replacing the lower arm

Continued

Disconnecting the axis-3 and axis-4 motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Disconnect air hose from air fitting on motor cover.	 xx2100000568
3	Unscrew the attachment screws and washers and remove the motor cover. **Note** Axis 3 and 4 motors only: Be careful not to damage the air hose or air nipple.	 xx1200001135
4	Make sure the o-ring is present.	 xx1200001070

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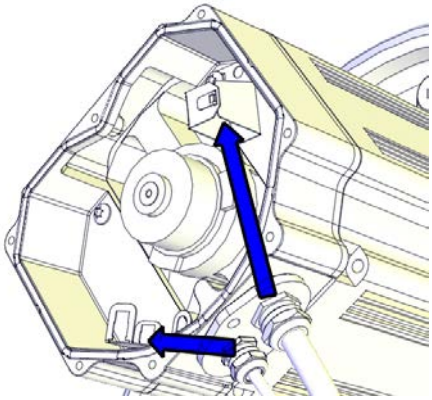
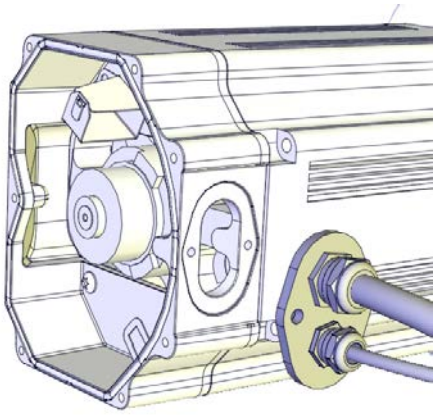
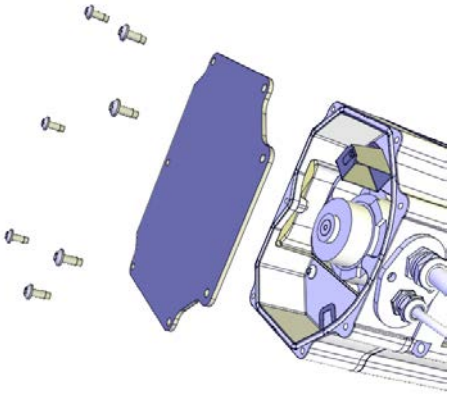
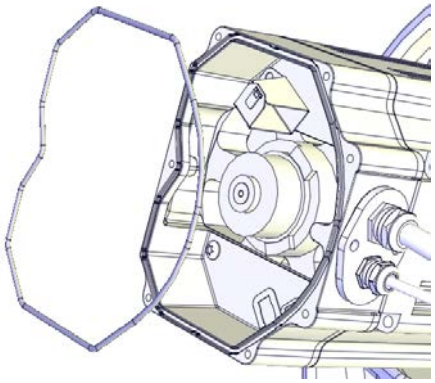
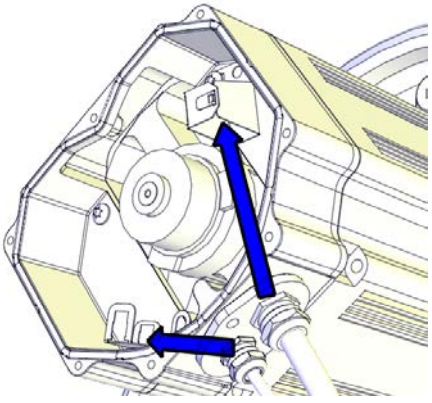
	Action	Note
5	Disconnect the motor cables.	 xx1200001066
6	Remove the cable gland cover. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable gland hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1200001067
7	Use caution and pull out the motor cables.	

Disconnecting the axis-5 motor cables

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

Continues on next page

4.5.4 Replacing the lower arm
Continued

	Action	Note
2	Unscrew the attachment screws and washers and remove the motor cover.	 xx1200001135
3	Make sure the o-ring is present.	 xx1200001070
4	Disconnect the motor cables.	 xx1200001066

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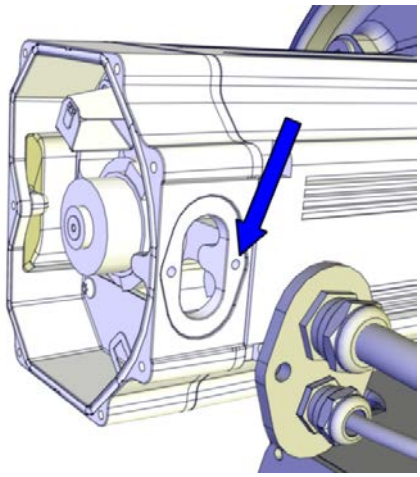
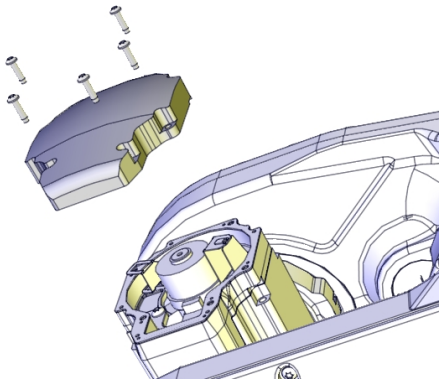
	Action	Note
5	Remove the cable gland cover by performing the following steps: 1 Open the inner screw a little (the one the arrow is pointing at). No need to remove this screw from the motor. 2 Remove the outer screw. 3 Slide the cable gland cover away from the inner screw. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable exit hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1300000656
6	Use caution and pull out the motor cables.	

Disconnecting the axis-6 motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Unscrew the attachment screws and remove the motor cover.	 xx1200001080

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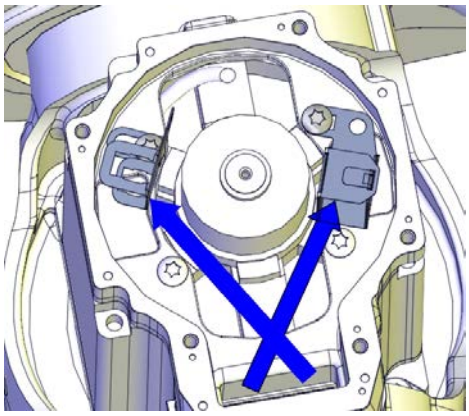
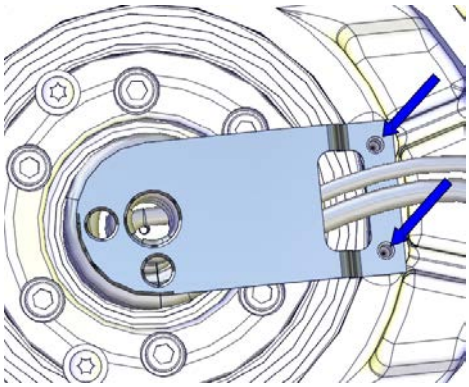
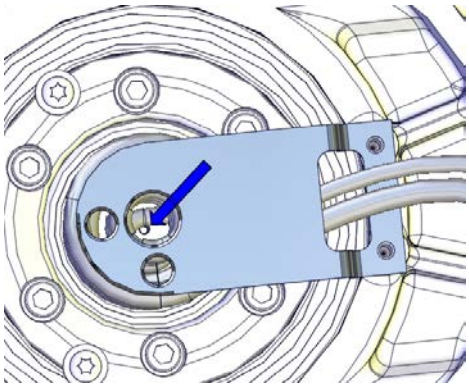
4.5.4 Replacing the lower arm
Continued

	Action	Note
3	Disconnect the motor cables.	 xx1300000488
4	Unscrew the attachment screws that hold the cable bracket.	 xx1300000484
5	Unscrew the M4 screw that holds the carrier. **Note** The screw is located at the bottom of the carrier. **Note** The parts are sealed with flange sealant Loctite 5400 (or equivalent Loctite 577). Remove the part carefully.	 xx1300000485

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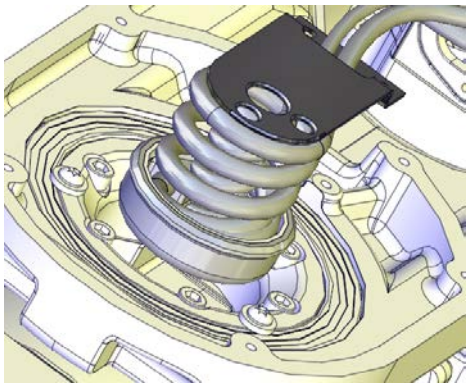
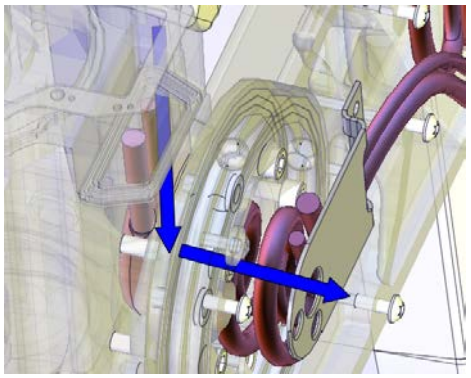
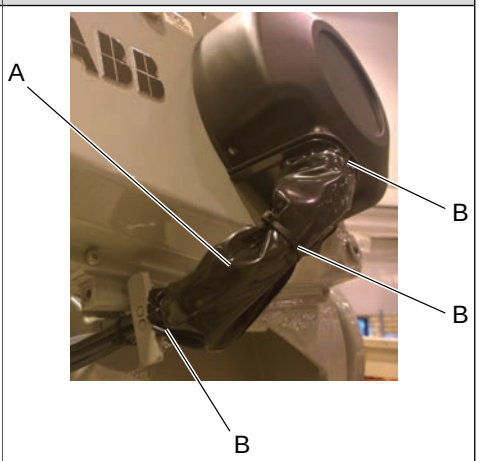
	Action	Note
6	Pull out the carrier from its position.	 xx1300001113
7	Pull out the axis-6 motor cables by holding the cables with one hand at the motor and the other at the carrier.	 xx1300000666

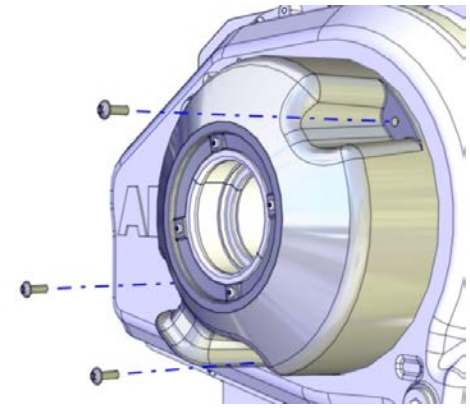
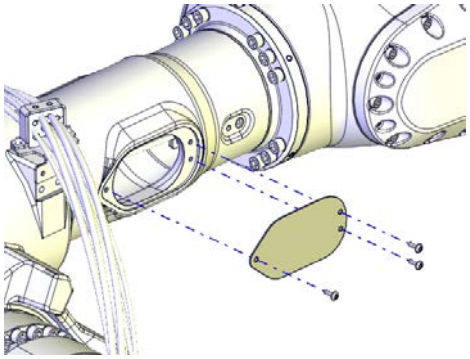
Removing the cable harness - wrist and upper arm

	Action	Note
1	Remove the cable protection by cutting the cable ties and opening the zipper.	 xx1700001802 **A** Cable protection **B** Cable ties

Continues on next page

4.5.4 Replacing the lower arm

Continued

	Action	Note
2	Remove the cover. **Note** Use caution not to damage the gasket, not to loose the washers on the cover sealing or not to loose the inserts fitted on the cover.	 xx1200000045
3	If the cabling is to be replaced by a new cable harness, remove the cover insert to use it on the new cabling.	 xx1700001803
4	**Tip** Use tape and tie the axis-5 and axis-6 connectors and carrier into a bundle (if not already done). This is done to facilitate the removal and to avoid damaging the parts. This will also make it easier to run the cable harness through the inside of the upper arm.	 xx1300000668
5	Remove the side cover on the arm tube.	 xx1300000557

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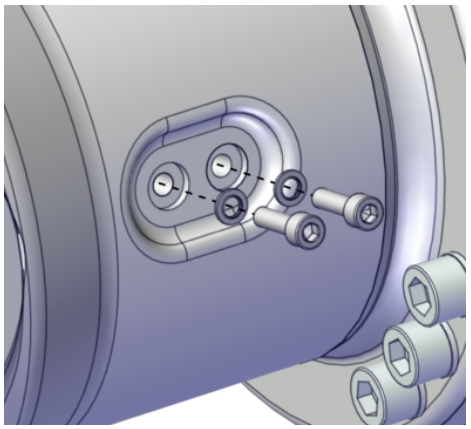
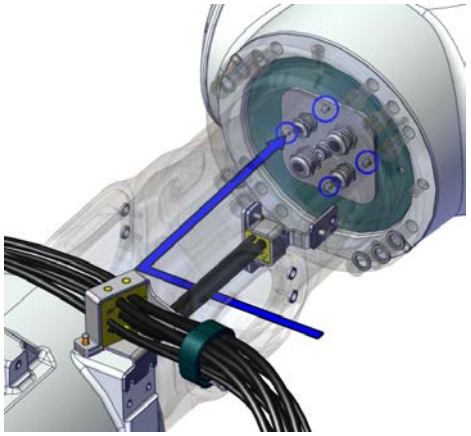
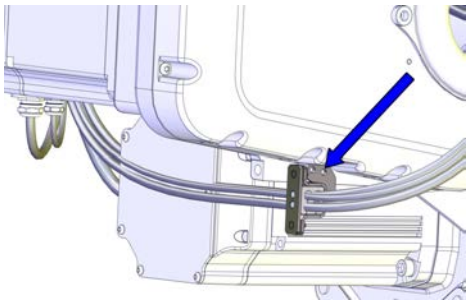
	Action	Note
6	Unscrew the screws and remove the sealing washers, holding the metal clamp inside the arm tube.	 xx1700001809
7	Remove the four nuts at the cable plate between the wrist and the upper arm tube, by reaching into the upper arm tube through the arm tube side hole.	 xx1700001567
8	Remove the arm house metal clamp.	 xx1300000543

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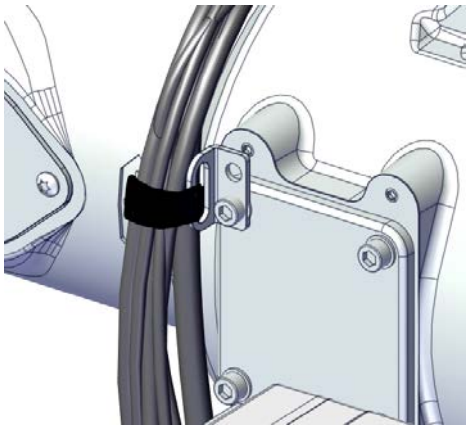
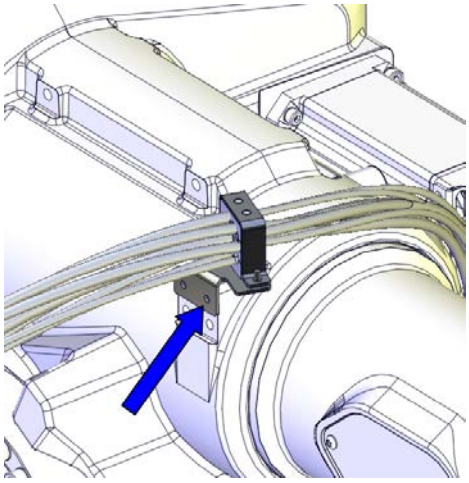
4.5.4 Replacing the lower arm

Continued

	Action	Note
9	Open the velcro strap at the cable fixing bracket.	 xx1700001810 Cable fixing bracket.
10	Remove the metal clamp on top of the arm house.	 xx1300000541

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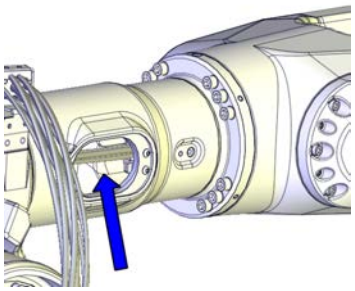
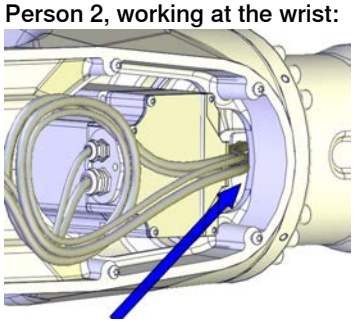
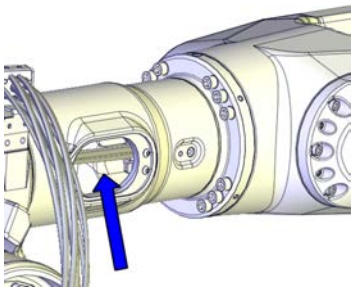
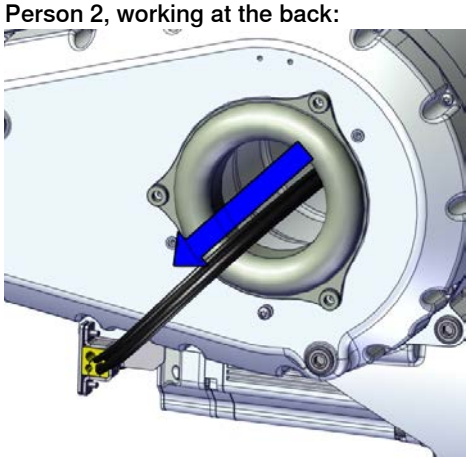
	Action	Note
11	Remove the cable harness out from the wrist. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side hole and take a hold of the cable harness. • Person 2: Take a hold on the cable harness inside the wrist. • Together: Move the cable harness past the axis-5 motor and into the arm tube.	Person 1, working at the side hole:  xx1300000745 Person 2, working at the wrist:  xx1300000746
12	Remove the cable harness out of the arm tube, at the back of the upper arm. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side hole and take a hold of the cable harness. • Person 2: Take a hold on the cable harness at the back of the robot. • Together: Move the cable harness out of the arm tube.	Person 1, working at side hole:  xx1300000745 Person 2, working at the back:  xx1700001568

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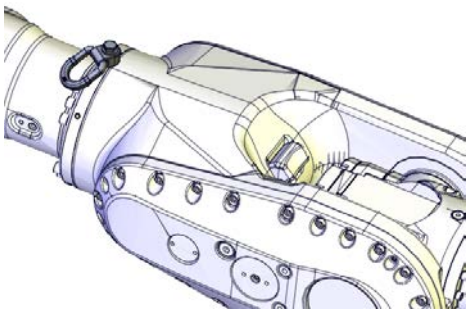
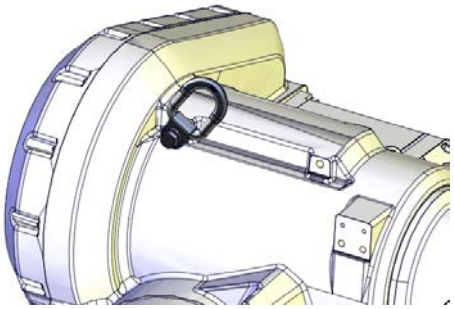
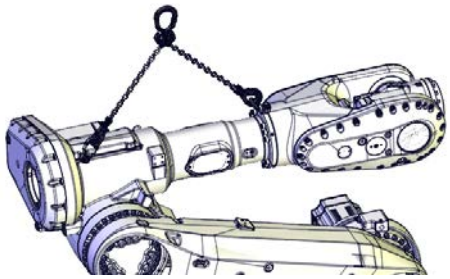
4.5.4 Replacing the lower arm

Continued

Attaching the lifting accessories to the upper arm

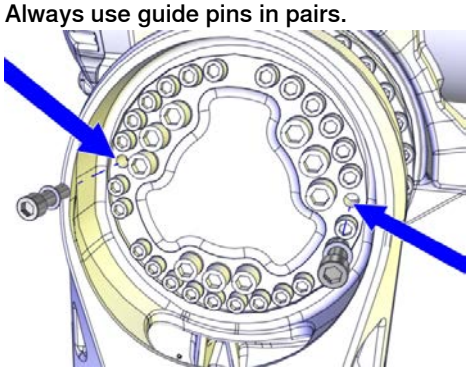
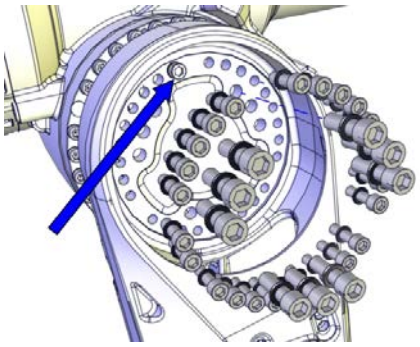
Use this procedure to attach the lifting accessories to the upper arm.

	Action	Note
1	**CAUTION** The weight of the complete upper arm (including the wrist) is 360 kg All lifting accessories used must be sized accordingly.	
2	Fit a lifting eye to the wrist. **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1  xx1200001133
3	Fit a lifting eye in the arm house, with a fender washer underneath.  xx1400002196 **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1 Fender washer: Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.  xx1200001134
4	Attach the upper arm lifting accessory (chain) to an overhead crane (or similar) and then to the lifting eye in the arm house and in the wrist.	Lifting accessory (chain): 3HAC15556-1  xx1200001308
5	Raise the lifting accessories to take the weight of the upper arm.	

Continues on next page

	Action	Note
6	In case of necessary adjustments, use the shortening loops on the lifting accessory (chain) to find the level position.	 xx1400002197

Preparations before removing the upper arm

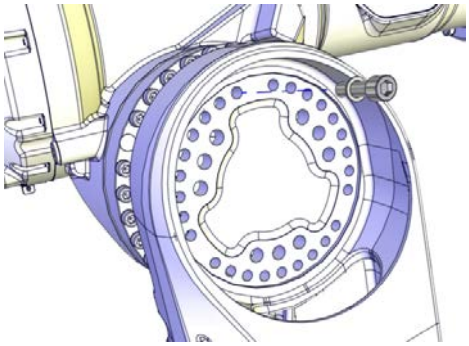
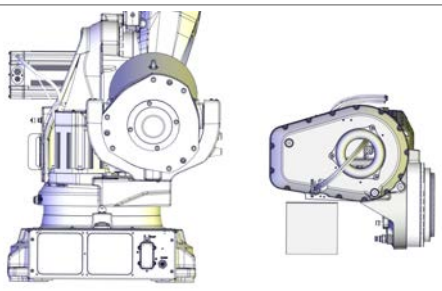
	Action	Note
1	Remove two attachment screws (M12) in opposite holes and replace them with guide pins. **Note** Make sure that it is the screws that hold the lower arm to the axis-3 gearbox that are removed! **Tip** Lubricate the guide pins with some grease to make the upper arm slide better.	Guide pin, M12x150: 3HAC13056-2 Guide pin, M12x200: 3HAC13056-3 Always use guide pins in pairs.  xx1300000659
2	Leave one of the remaining attachment screws fitted, remove the other screws.	 xx1300000747

Continues on next page

4.5.4 Replacing the lower arm

Continued

Removing the upper arm

	Action	Note
1	**Note** Make sure the lift is done completely leveled! In case of necessary adjustments, use the shortening loops on the lifting accessory (chain), and make sure to place the chain the right way through the loops.	 xx1400002197
2	Remove the remaining attachment screw and let the upper arm slide out from the lower arm with support from the guide pins.	 xx1300001610
3	Lift the upper arm and place it on the prepared area. **CAUTION** *Only valid when the upper arm is removed due to replacement of the axis-3 gearbox:* If the cable harness is still fitted or partly fitted, use caution when lifting the upper arm over to the other side of the robot, in order not to cause any damage to the cable harness.	
4	*This step is only valid when the upper arm is removed due to replacement of the axis-3 gearbox:* Place pieces of wood (or similar) under arm house and wrist. Lower the upper arm, and let the upper arm rest as shown in the figure. This is done in order to keep the axis-3 gearbox in a vertical position and to get the best position to replace the axis-3 gearbox, if applicable.	 xx1300000553

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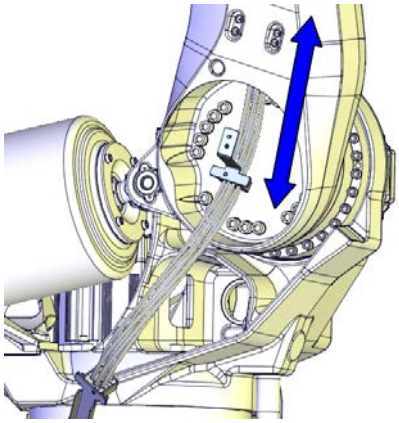
Preparations before removing the lower arm

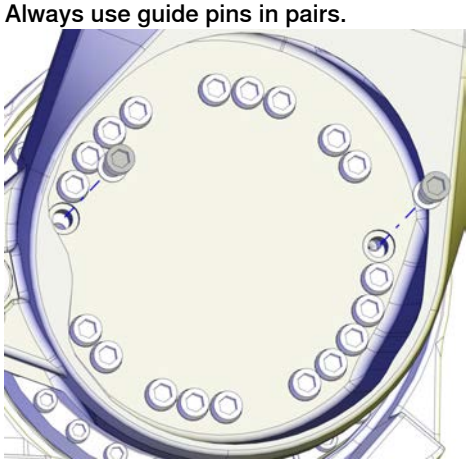
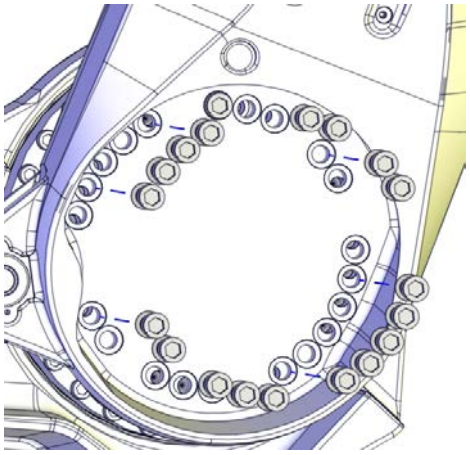
	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Loosen the axis-2 lower arm metal clamp and the axis-3 lower arm metal clamp located on the inside of the lower arm by removing the attachment screws. **Note** The screws are reached from outside the lower arm!	 xx1300000540
3	Remove the cable harness from inside the lower arm.	 xx1300000733
4	**CAUTION** The lower arm weighs 145 kg All lifting accessories used must be sized accordingly!	
5	Apply the lifting accessory to the lower arm.	

Continues on next page

4.5.4 Replacing the lower arm

Continued

Removing the lower arm

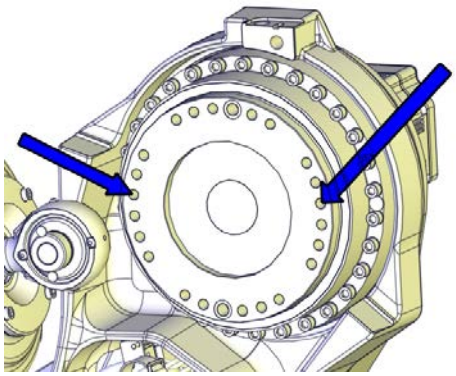
	Action	Note
1	Raise the lifting accessory to unload the lower arm.	
2	Remove two attachment screws in opposite holes and replace them with guide pins. **Tip** Lubricate the guide pins with some grease to make the lower arm slide better.	Guide pin, M16x150: 3HAC13120-2 Guide pin, M16x200: 3HAC13120-3 Always use guide pins in pairs.  xx1300000788
3	Remove all but one of the remaining attachment screws and washers that secure the lower arm to the axis 2 gearbox.	 xx1300000789
4	Make sure the lifting accessory is holding the weight of the arm system.	
5	Remove the remaining screw, slide the lower arm out on the guide pins and remove the lower arm.	

Continues on next page

Refitting the lower arm

Use these procedures to refit the lower arm.

Preparations before refitting the lower arm

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Fit two guide pins in opposite holes in the axis-2 gearbox. **Tip** Lubricate the guide pins with some grease to make the lower arm slide better.	Guide pin, M16x150: 3HAC13120-2 Always use guide pins in pairs.  xx1700000055
3	**CAUTION** The lower arm weighs 145 kg. All lifting accessories used must be sized accordingly.	
4	Attach the lifting accessory to the lower arm.	
5	Wipe clean all contact surfaces.	

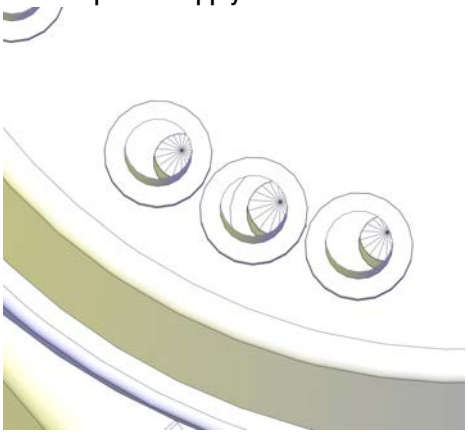
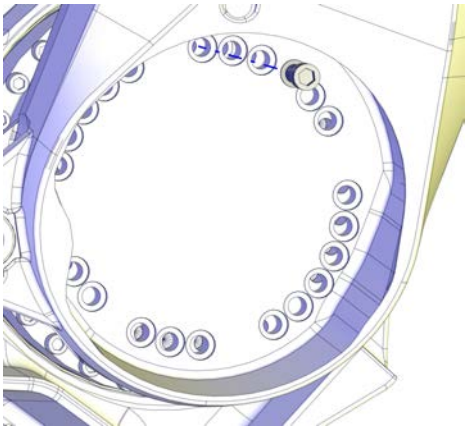
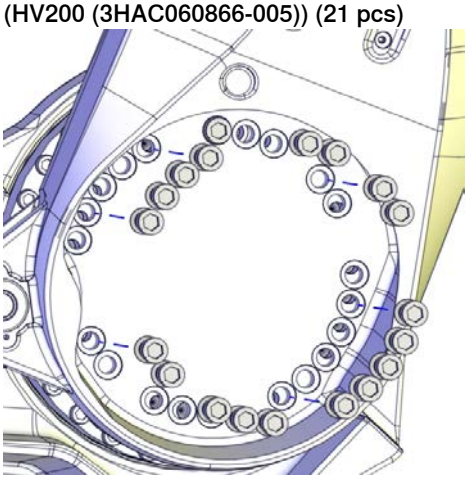
Securing the lower arm to the axis-2 gearbox

	Action	Note
1	**CAUTION** The lower arm weighs 145 kg. All lifting accessories used must be sized accordingly.	
2	Lift the lower arm onto the guide pins and slide it into position.	

Continues on next page

4.5.4 Replacing the lower arm

Continued

	Action	Note
3	In case the hole pattern of the lower arm and gearbox does not match: • Remove the motor cover. • Apply the rotation tool on the motor shaft. • Connect the 24 VDC power supply. • Release the brakes. • Rotate pinion and gear with the rotational tool until the holes matches. Connect 24 VDC the power supply to connector R2.MP2: • + = pin 2 • - = pin 5	Rotation tool 24 VDC power supply  xx1300000819
4	Fit one attachment screw in one of the upper holes using it for security and lower the lifting accessory a little.	 xx1300000790
5	Secure the lower arm with its attachment screws and washers.	Tightening torque M16: 300 Nm Attachment screws: M16x50 stainless steel (3HAC060786-041) (21 pcs) Washers: 17x25x3 coated stainless steel (HV200 (3HAC060866-005)) (21 pcs)  xx1300000789

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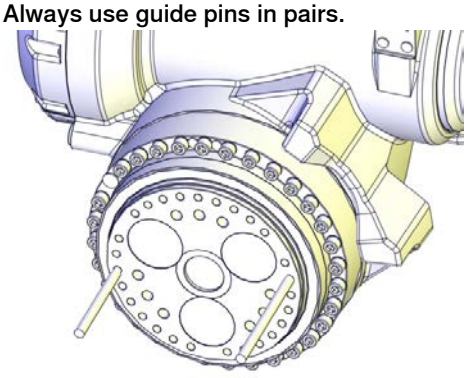
	Action	Note
6	Disconnect the 24 VDC power supply (if used).	
7	Remove the guide pins and replace them with the remaining attachment screws.	 xx1300000788
8	Secure the remaining attachment screws.	Tightening torque M16: 300 Nm
9	Remove the lifting accessory from the lower arm.	

Preparations before refitting the upper arm

	Action	Note
1	Wipe clean all contact surfaces.	
2	Fit two guide pins in opposite M12 holes in the axis-3 gearbox. **Tip** Lubricate the guide pins with some grease to make the upper arm slide better.	Guide pin, M12x150: 3HAC13056-2 Guide pin, M12x200: 3HAC13056-3 Always use guide pins in pairs.  xx1700000058

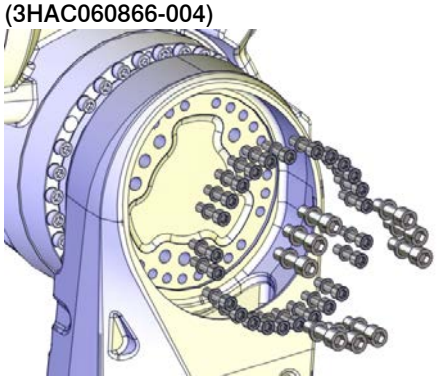
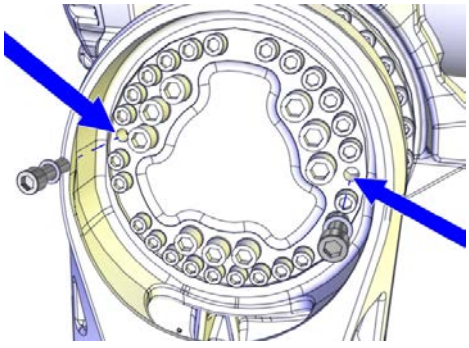
Securing the upper arm

	Action	Note
1	**CAUTION** The weight of the complete upper arm (including the wrist) is 360 kg All lifting accessories used must be sized accordingly.	

Continues on next page

4.5.4 Replacing the lower arm

Continued

	Action	Note
2	Attach the lifting accessories, if not already fitted.	See *Attaching lifting accessories to the upper arm on page 202*.
3	Lift the upper arm and put it on the guide pins.	
4	If the axis-3 motor is installed to the upper arm: In order to release the brakes, connect the 24 VDC power supply. Connect to R2.MP3-connector: • + = pin 2 • - = pin 5 Use the rotation tool and rotate the axis-3 motor to find the correct position for the guide pins in the lower arm.	24 VDC power supply Rotation tool
5	If the axis-3 motor is not installed to the upper arm: Use the pinion to rotate the axis-3 gearbox to find the correct position for the guide pins in the lower arm.	Pinion: 3HAC067546-001
6	Insert all nine M16 screws and 25 of the 27 M12 screws.	Screws: M16x50 stainless steel (3HAC060786-041) (9 pcs) M12x40 stainless steel (3HAC060786-031) (25 of 27 pcs) Washers: 17x25x3 coated stainless steel (HV200 (3HAC060866-005)) 13x19x2 coated stainless steel (3HAC060866-004)  xx1400000359
7	Remove the guide pins and fit the two remaining M12 screws.	 xx1300000659

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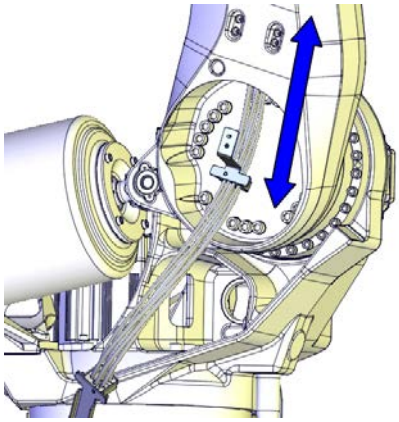
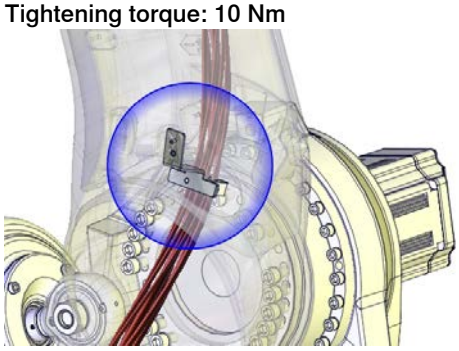
	Action	Note
8	Secure the upper arm by tightening the attachment screws.	Tightening torque depends on screw dimension. Tightening torque, M16: 300 Nm Tightening torque, M12: 120 Nm

Refitting the cable harness - lower arm

	Action	Note
1	**Tip** Use tape and tie the axis-5 and axis-6 connectors and carrier into a bundle (if not already done). This is done to facilitate the procedure and to avoid damaging the parts during the procedure. This will also make it easier to run the cable harness through the inside of the robot.	 xx1300000668
2	Run the upper end of the cable harness up through the lower arm.	 xx1300000733
3	Refit the axis-2 lower arm metal clamp located on the inside of the lower arm. **Note** The screws are reached from the outside of the lower arm.	Tightening torque: 10 Nm  xx1300000734

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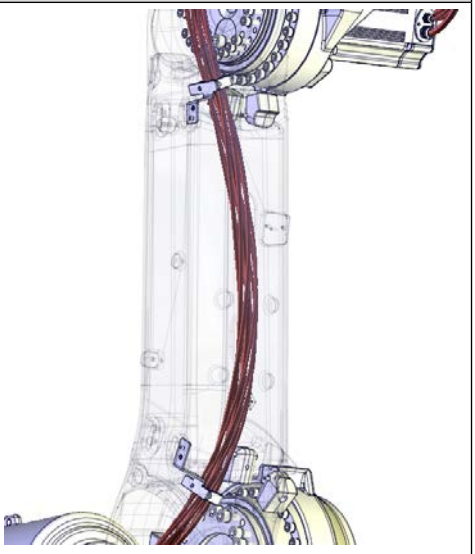
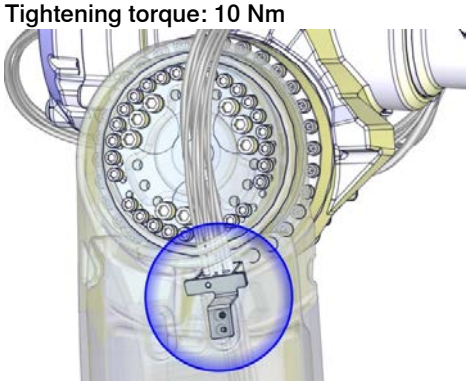
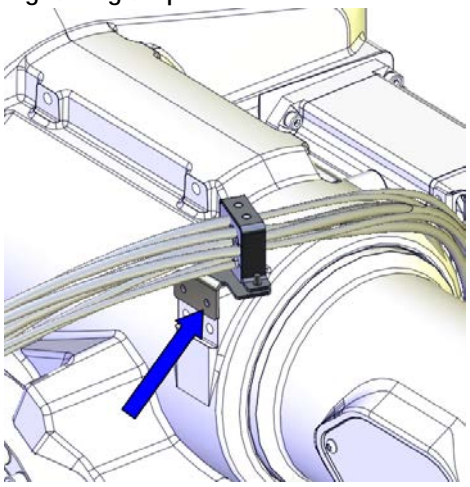
4.5.4 Replacing the lower arm
Continued

	Action	Note
4	Before fitting the remaining axis-3 lower arm cable bracket inside the lower arm, check that it will stay twisted a little between the metal clamps, after fitting, as shown in the figure. Do not change the position of the brackets!	 xx1300000595
5	Refit the axis-3 lower arm metal clamp located on the inside of the lower arm. **Note** The screws are reached from the outside of the lower arm.	Tightening torque: 10 Nm  xx1300000558

Refitting the cable harness - upper arm

	Action	Note
1	Refit the metal clamp on top of the arm house.	Tightening torque: 10 Nm  xx1300000541

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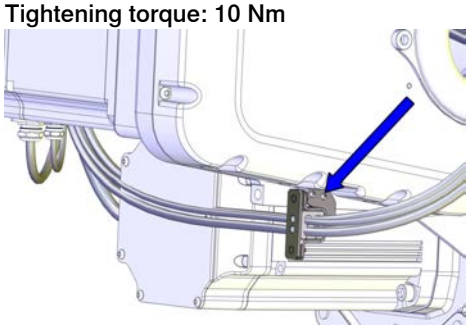
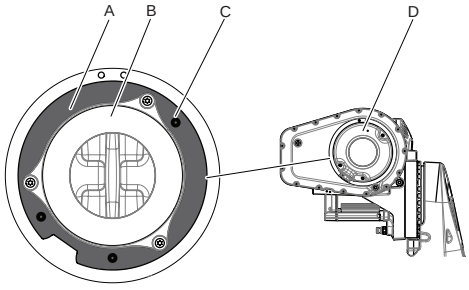
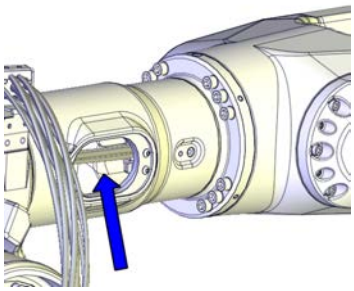
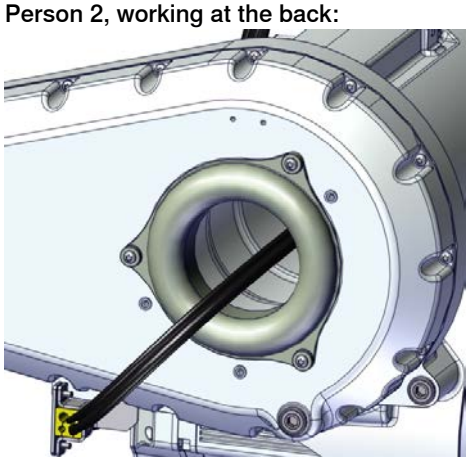
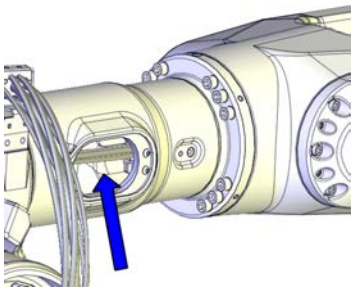
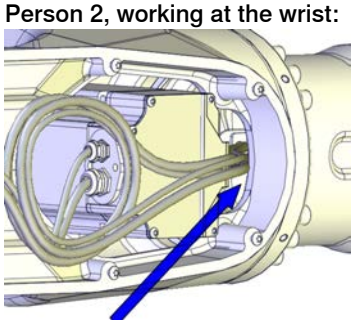
	Action	Note
2	Refit the arm house metal clamp.	Tightening torque: 10 Nm  xx1300000543
3	Arrange the cables between the cable clamps in the upper arm.	
4	**Tip** Use tape and tie the axis-5 and axis-6 connectors and carrier into a bundle (if not already done). This is done to facilitate the procedure and to avoid damaging the parts during the procedure. This will also make it easier to run the cable harness through the inside of the robot.	 xx1300000668
5	Make sure that the gasket underneath the cover is correctly fitted. Replace if damaged. The gasket is covered with adhesive on the side facing the upper arm cover. The three washers are pressed into the holes in the gasket. Make sure all three washers are fitted.	 xx1400000382 A Gasket B Cable guide C Washer D Cover

Continues on next page

4.5.4 Replacing the lower arm

Continued

	Action	Note
6	Run the cable harness through the cable guide and then into and through the upper arm tube. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side hole of the arm tube and take a hold of the cable harness. • Person 2: Take a hold on the cable harness at the back of the robot. • Together: Use caution and move the cable harness into the arm tube.	Person 1, working at the side hole:  xx1300000745 Person 2, working at the back:  xx1700001569
7	Use caution and push the cable harness into the wrist. **Tip** This step is best performed by two persons working together: • Person 1: Put one hand inside the side cover hole and take a hold of the cable harness. • Person 2: Take a hold of the cable harness from inside the wrist. • Together: Move the cable harness past the axis-5 motor and into the wrist.	Person 1, working at the side hole:  xx1300000745 Person 2, working at the wrist:  xx1300000746

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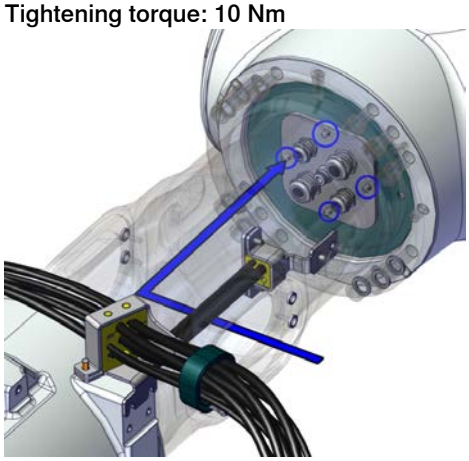
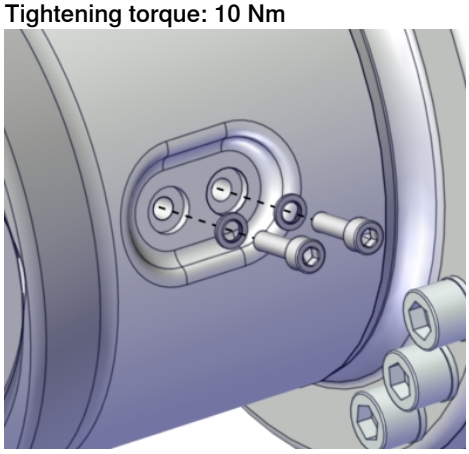
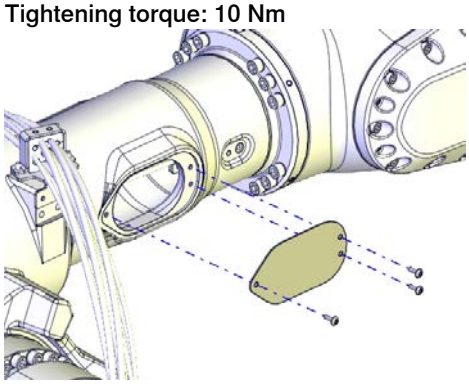
	Action	Note
8	Refit the four nuts to the cable plate between the wrist and the upper arm tube, by reaching into the upper arm tube through the arm tube side hole.	Tightening torque: 10 Nm  xx1700001567
9	Refit the metal clamp axis-4, inside the arm tube. **Note** Always use new sealing washers.	New washers are included in the spare part kit. Tightening torque: 10 Nm  xx1700001809
10	Refit the side cover. **Note** • Make sure the gasket is fitted correctly on the side cover • Use attachment screws made of stainless steel to fit the side cover.	Tightening torque: 10 Nm  xx1300000557

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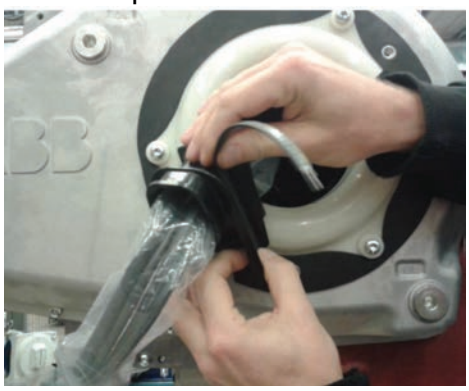
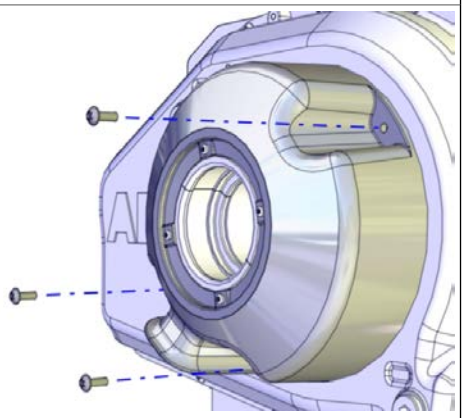
4.5.4 Replacing the lower arm

Continued

	Action	Note
11	Fit the cover insert around the new cabling and secure it with a weatherstrip.	Cover insert: 3HAC048520-001.  xx1700001803 Weatherstrip: 3HAC053986-001.  xx1700001804
12	Refit the cover with the tube guiding ring fitted. **Note** • Make sure the gasket is fitted correctly • Use attachment screws made of stainless steel to fit the cover.	 xx1200000045

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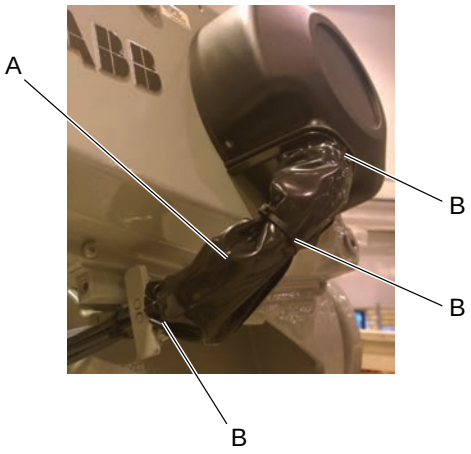
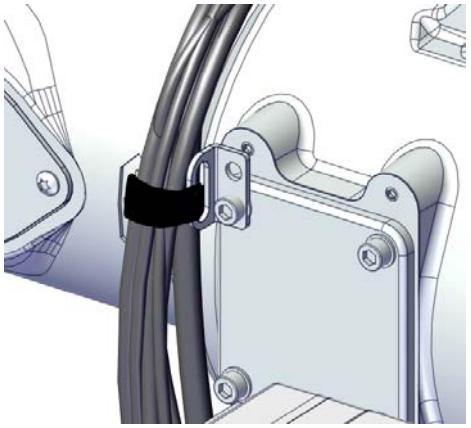
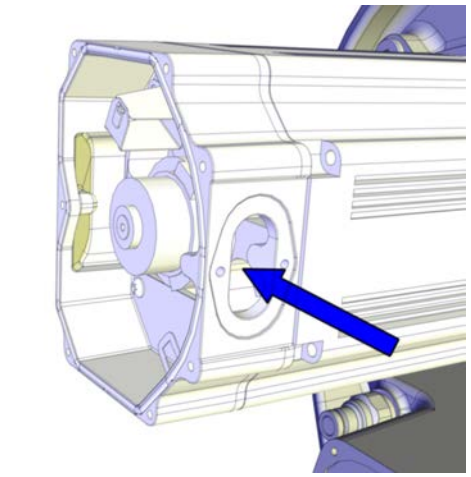
	Action	Note
13	Refit the cable protection by closing the zipper and securing with cable ties.	Cable protection, PU rubber: 3HAC055411-001.  xx1700001802 **A** Cable protection **B** Cable ties
14	Secure the cable harness to the cable fixing bracket with the velcro strap.	 xx1700001810

Connecting the axis-3 and axis-4 motor cables

	Action	Note
1	Push the motor cables through the cable gland opening.	 xx1300000738

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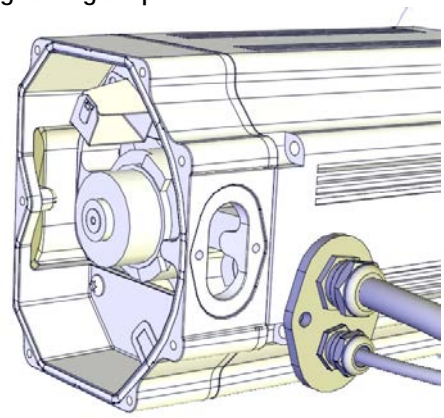
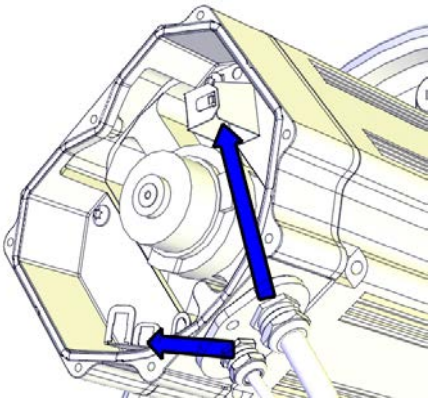
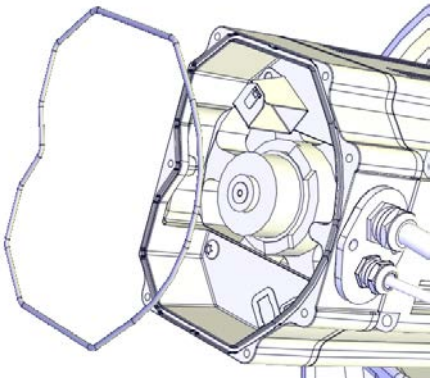
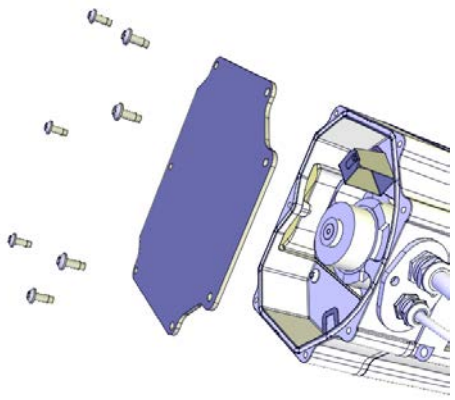
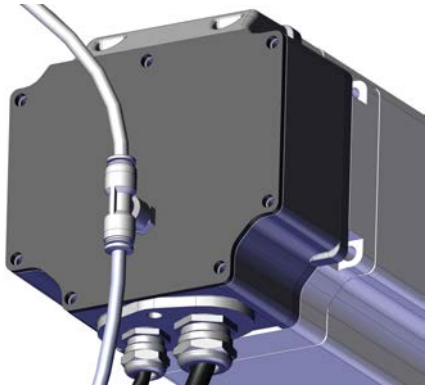
4.5.4 Replacing the lower arm

Continued

	Action	Note
2	Refit the cable gland cover. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001067
3	Connect the motor cables. Connect in accordance with the markings on the connectors.	 xx1200001066
4	Inspect the o-ring. **Note** Replace if damaged.	O-ring, axis-1: 3HAC067762-001 O-ring, axis-2: 3HAC067762-001 O-ring, axis-3: 3HAC067762-001 O-ring, axis-4: 3HAC067744-001  xx1200001070
5	Wipe clean o-ring and o-ring groove.	

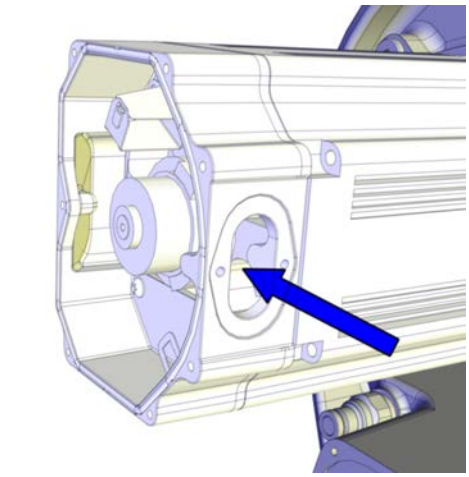
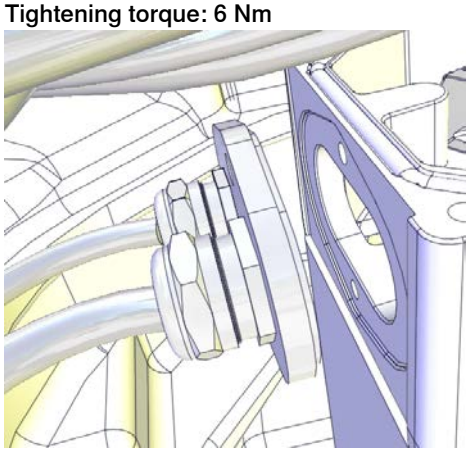
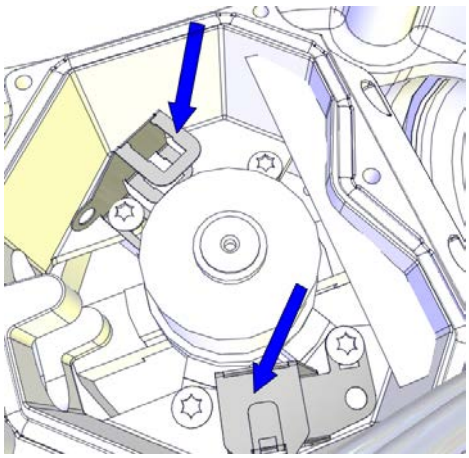
Continues on next page

	Action	Note
6	Refit the o-ring. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	
7	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
8	Refit the motor cover with it's attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Attachment screws: M5x12 Stainless steel A2-70 (7 pcs) (9ADA619-44) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001135
9	Make sure that the covers are tightly sealed.	
10	Connect air hose to air fitting on motor. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000568

Continues on next page

4.5.4 Replacing the lower arm
Continued

Connecting the axis-5 motor cables

	Action	Note
1	Push the motor cables in through the cable gland opening.	 xx1300000738
2	Refit the cable gland cover by performing the following steps: • Slide the cable gland cover onto the inner screw. • Refit and tighten the outer screw. • Tighten the inner screw. Make sure that the gasket is not damaged. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001016
3	Connect the connectors. Connect in accordance with the markings on the connectors.	 xx1200001015

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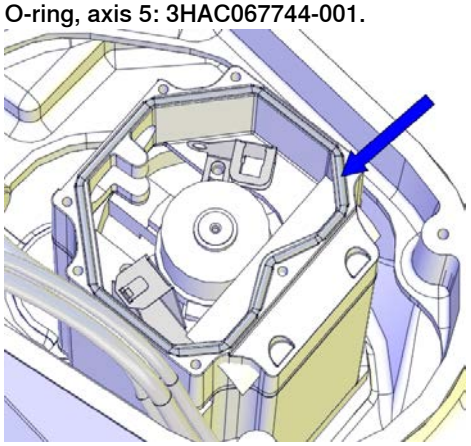
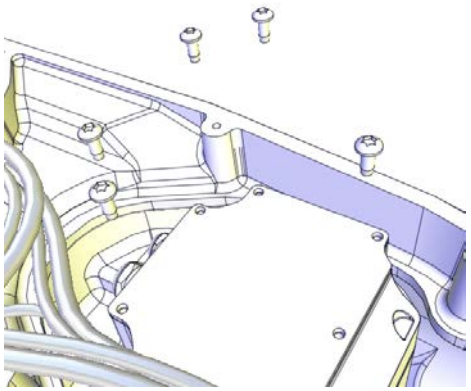
	Action	Note
4	Make sure the o-ring on the motor is undamaged. Replace if damaged.	O-ring, axis 5: 3HAC067744-001.  xx1200001021
5	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
6	Refit the motor cover with its attachment screws. **Note** Do not refit the screws that will hold the heat protection plate at this point. **Note** Do not reuse the self-threading attachment screws, it will damage the threads. Replace with standard attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Screws: M5x12. Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001013

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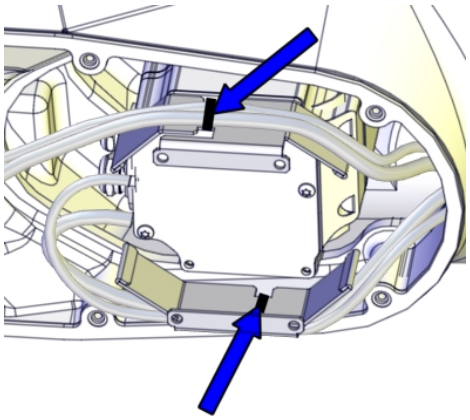
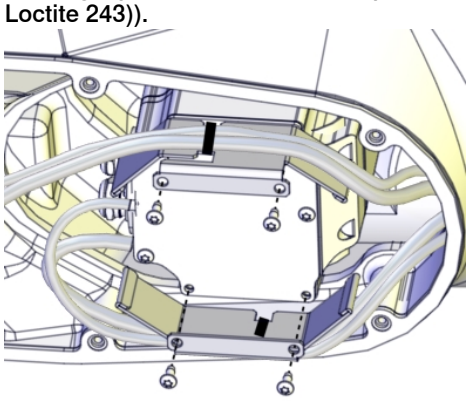
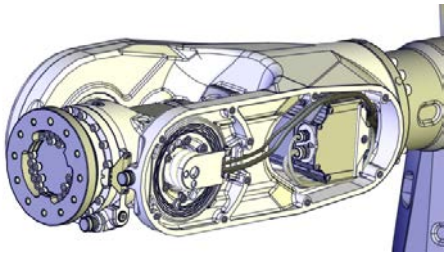
4.5.4 Replacing the lower arm
Continued

	Action	Note
7	Secure the cable harness with cable straps to the heat protection plate.	 xx1500001029
8	Fit the heat protection plate with the screws.	Screws: M5x12. Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1500001030

Connecting the axis-6 motor cables

	Action	Note
1	Make sure that the cable harness is placed in a way that it will not be damaged when the cover is fitted.	 xx1600002061

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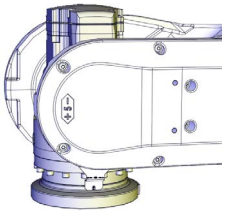
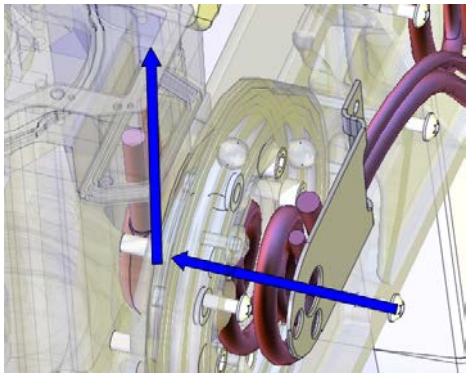
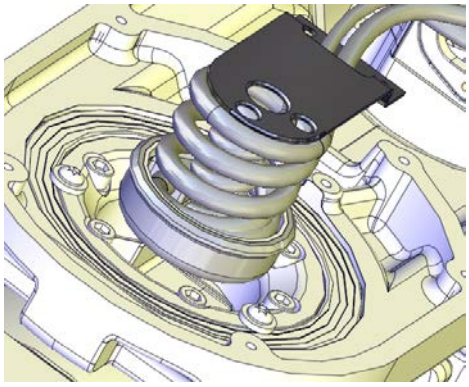
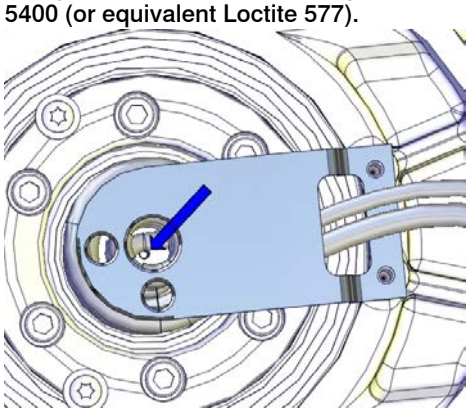
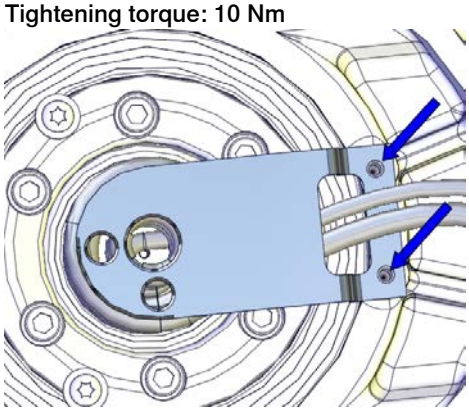
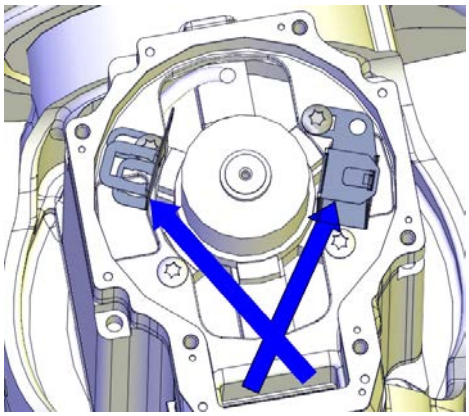
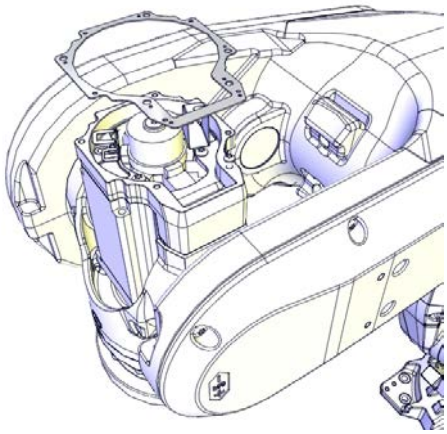
	Action	Note
2	**Note** Axis 5 must be in position +90° (or as close as possible) for a correct installation of the cable harness in the wrist. If not, connect the 24 VDC power supply, release the brakes and move axis 5 manually to +90°.	 xx1200001081
3	Push the cable harness into the wrist recess and up into the axis-6 motor.	 xx1300000667
4	Push the carrier carefully into position.	 xx1300001113
5	Secure the carrier with the M4 screw. Use flange sealant. **Note** The screw is located at the bottom of the carrier. **Tip** The attachment screw securing the carrier may be difficult to fit. Make sure the carrier is level and completely pressed against the bottom.	Tightening torque: 4 Nm Flange sealant for conical fittings: Loctite 5400 (or equivalent Loctite 577).  xx1300000485

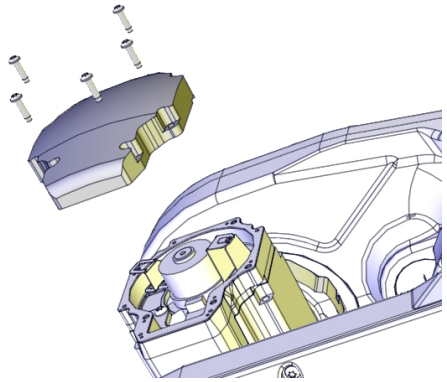
Continues on next page

4.5.4 Replacing the lower arm

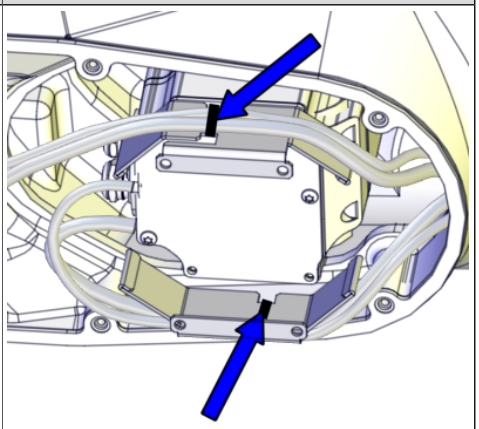
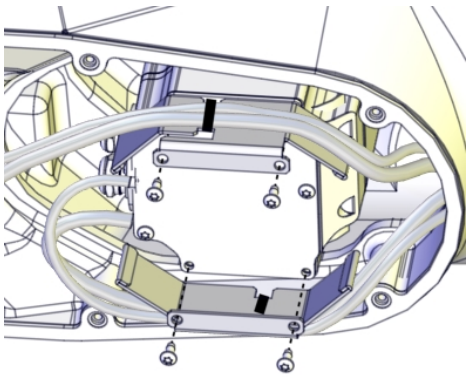
Continued

	Action	Note
6	Secure the cable bracket with its attachment screws.	Tightening torque: 10 Nm  xx1300000484
7	Reconnect the connectors to the axis-6 motor. **Note** Place the resolver cable under the motor cable.	 xx1300000488
8	Make sure the gasket is undamaged. Replace if damaged.	Gasket, 3HAC033489-002  xx1200001095
9	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	

Continues on next page

	Action	Note
10	Refit the motor cover.	Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001080

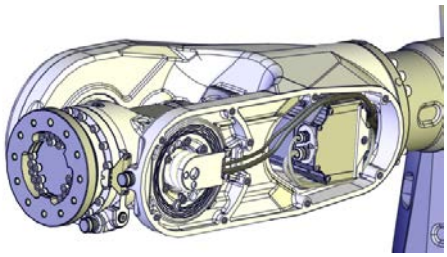
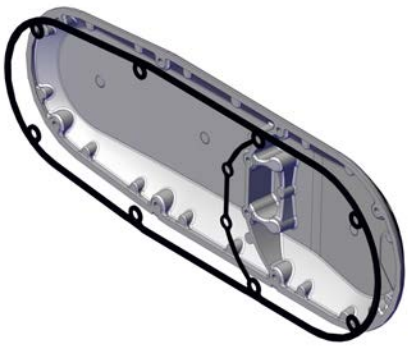
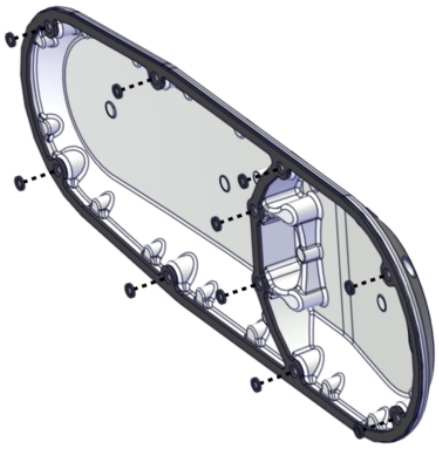
Concluded refitting of the cable harness

	Action	Note
1	Secure the cable harness with cable straps to the heat protection plate.	 xx1500001029
2	Fit the heat protection plate with the screws.	 xx1500001030

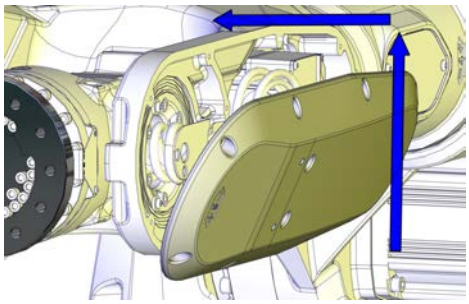
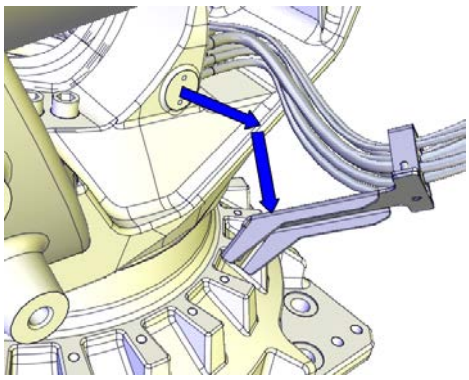
Continues on next page

4.5.4 Replacing the lower arm

Continued

	Action	Note
3	Make sure that the cable harness is placed so it will not be damaged when the wrist cover is fitted.	 xx1600002061
4	• Make sure that the gasket is undamaged on the cover. Replace gasket if damaged. • Clean the gasket from dirt and old grease residues. • Lubricate with grease between gasket and cover.	 xx2100000526 Grease: 3HAC042536-001 (Shell Gadus S2)
5	Put washers in the holes of the gasket.	 xx1900002085

Continues on next page

	Action	Note
6	Use caution in order not to damage the cable harness when the wrist cover is refitted, by following this method: 1 Hold the cover tilted. See figure! 2 Put the cable harness on the cover. 3 Lift the cover, still tilted. 4 Move the upper part of the cover into position. 5 Secure the cover with its attachment screws.	 xx1300000772 Tightening torque: 10 Nm. Torx pan head screw: 9ADA619-56 (M6x16 Stainless steel A2-70)
7	Refit the bracket to the frame.	 xx1200001184

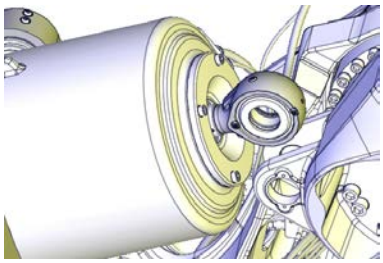
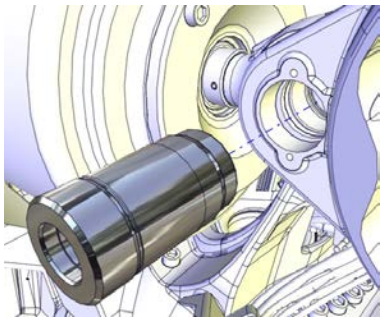
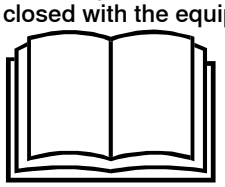
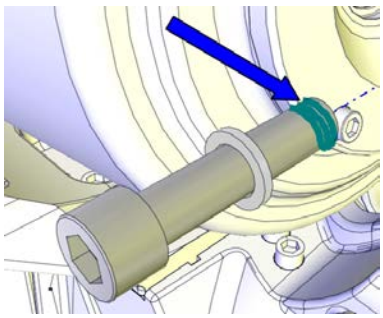
Refitting the front shaft of the balancing device

	Action	Note
1	Turn the power to the robot on temporarily.	
2	Use caution and jog the robot to the calibration position (if not already done).	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Apply the lifting accessory to the balancing device (if not already done).	Lifting shackle: SA-10-8-NA1 Lifting accessory (chain): 3HAC15556-1
5	Remove all residue of Loctite in the screw hole of the shaft.	
6	Wipe all contact surfaces inside the recess clean from contamination.	

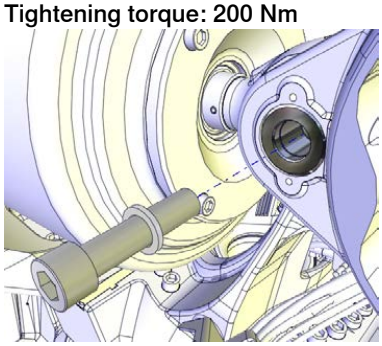
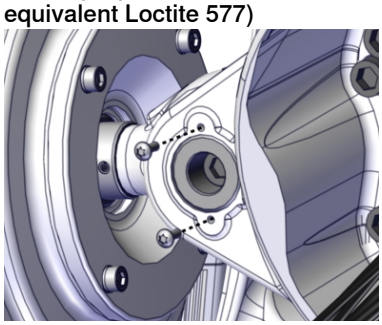
Continues on next page

4.5.4 Replacing the lower arm

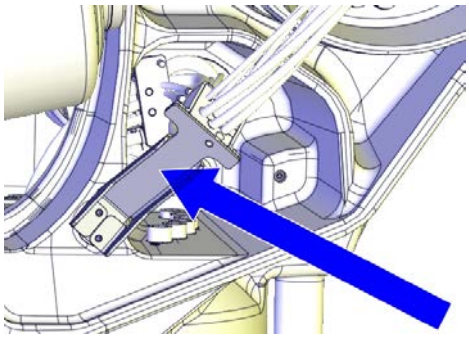
Continued

	Action	Note
7	Align the balancing device link ear with the hole in the lower arm. **Note** Verify that the link ear is correctly turned.	 xx1300000784
8	Lubricate the shaft and place it to the front ear.	 xx1200001280
9	Press in the shaft using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.
10	Apply locking liquid (Loctite 2701) on the threads of the screw, first entering the threads in the frame.	 xx1300000782

Continues on next page

	Action	Note
11	Secure the shaft with screw and washer.	Tightening torque: 200 Nm  xx1200001279
12	Refit the two screws and wipe clean from residual grease. Use locking liquid.	Tightening torque: 10 Nm Locking liquid: Loctite 5400 (or equivalent Loctite 577)  xx1900002146

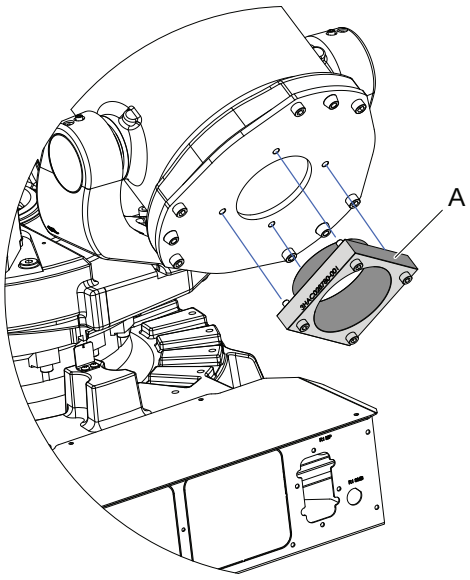
Concluded refitting of the front shaft

	Action	Note
1	Remove the lifting accessory from the balancing device.	
2	Refit the cable bracket (if not already refitted).	 xx1200001283

Continues on next page

4.5.4 Replacing the lower arm

Continued

	Action	Note
3	**DANGER** Do not use the Distance tool: 3HAC030662-001 to unload or restore the pressure of the balancing device spring unit! This tool is only used to lock the spring unit in a compressed position, after axis-2 has been jogged to -20° or +20°. Fitting and removal of the tool shall only be done with axis-2 in this position! To unload or restore a new balancing device or if the spring unit of the balancing device cannot be compressed by jogging the robot, only use the hydraulic press tool Dismantle and mounting tool 3HAC028920-001.	
4	Jog axis-2 to: • -30° or +30°.	This is done in order to compress the spring unit inside the balancing device before refitting or removal of the distance tool.
5	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
6	Remove the distance tool.	 xx0800000480 A Distance tool: 3HAC030662-001

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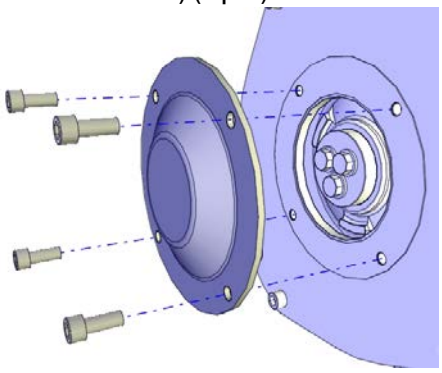
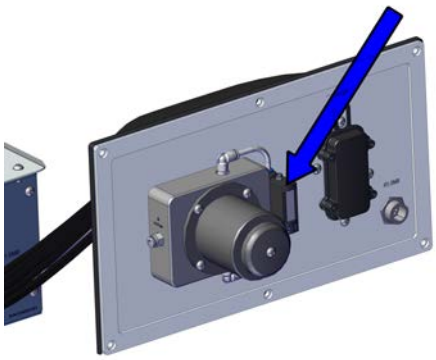
	Action	Note
7	Refit the cover plate.	Attachment screws: M10x30 stainless steel (3HAC060786-020) (4 pcs)  xx1300000554

Concluding procedure

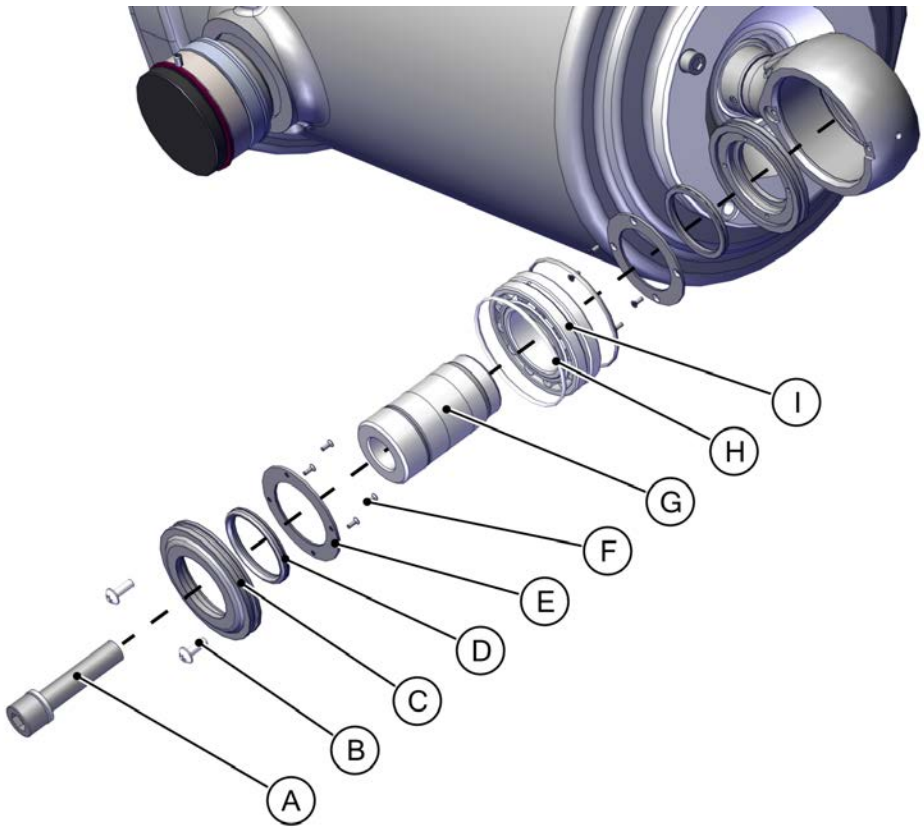
	Action	Note
1	Remove the lifting accessory.	
2	Turn on the air pressure supply to the overpressure system.	
3	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
4	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.
5	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.6 Frame and base

4.6.1 Replacing spherical roller bearing, link ear

Location of spherical roller bearing

The spherical roller bearing is located in the link ear of the balancing device.



xx1700001638

A	Hex socket head cap screw M16x70, stainless steel
B	Torx pan head screw M6x16, stainless steel (2 pcs)
C	End cover (2 pcs)
D	Turcon roto VL seal (2 pcs)
E	Washer (2 pcs)
F	Torx countersunk head screw (8 pcs)
G	Shaft
H	O-ring (2 pcs)
F	Spherical roller bearing

Summary of the replacement procedure

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

1 Unload the balancing device.

Continues on next page

2 Replace the spherical roller bearing.
3 Restore the balancing device.

Spare part

Equipment	Article number	Note
Spherical roller bearing kit	3HAC064119-001	The maintenance kit contains bearing grease and Loctite.

Consumables

Equipment, etc.	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Balancing device cover plate	M10x30 stainless steel (3HAC060786-020)	-	4 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Distance tool	3HAC030662-001	Only used to keep the balancing device in a locked position, after the balancing device springs has been unloaded with the help of the robot itself.  **DANGER** *Never* use this tool to unload or restore a balancing device!
Hydraulic press tool, balancing device	3HAC074411-001	Used to unload or restore a balancing device.
Dismantle and mounting tool	3HAC028920-001	Used for removing and fitting shaft and bearings.
Hydraulic cylinder	3HAC11731-1	To be used with the press tool.
Hydraulic pump 70 MPa	3HAC13086-1	To be used with the hydraulic cylinder.
Lock screw, M16x120	-	Used to secure lower arm.
Lifting shackle	-	SA-10-8-NA1
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.
Dismantle and mounting tool	3HAC028920-001	Used for removing and fitting shaft and bearings.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Continues on next page

4.6.1 Replacing spherical roller bearing, link ear
Continued

Unloading the balancing device

Use the correct tool for locking the balancing device springs in compressed position

Locking of the compressed balancing device springs in an unloaded position, can be done in two different ways using two different tools:

- Distance tool (compression of the balancing device springs is done with help of the robot itself)
- Hydraulic press tool, balancing device (compression of the balancing device springs is done with the tool)

The situations when to use which tool are very different, see *When to use which tool on page 390*.

The method described in this procedure, describes how to use the Distance tool (3HAC030662-001). The Distance tool can not be used to unload or restore the pressure of the balancing device spring unit! The Distance tool is only used to keep the balancing device springs in a locked position, after they have been unloaded with the help of the robot itself (as described in this procedure) and with the balancing device still being fitted on the robot.

When to use which tool

To unload or restore a balancing device which cannot be done with the help of the robot itself, the Hydraulic press tool, balancing device (3HAC074411-001) must be used. See user instructions enclosed with the tool.

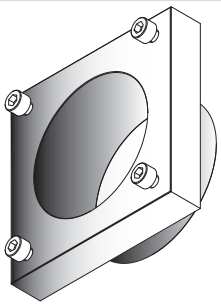
Illustration	Art. no.	Note
 xx1400000726	3HAC030662-001 Distance tool	This tool is only used to keep the balancing device in a locked, already unloaded position. The balancing device springs has been unloaded with the help of the robot itself. Use this tool: • to lock the balancing device springs in a compressed position (compressed by the robot) See *Unloading the balancing device springs with the robot and locking position with the Distance tool on page 393*. **DANGER** *Never* use this tool to unload or restore a balancing device! This means that this tool can never be removed from a balancing device while the balancing device is removed from the robot.

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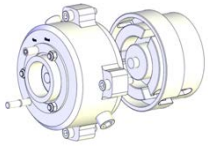
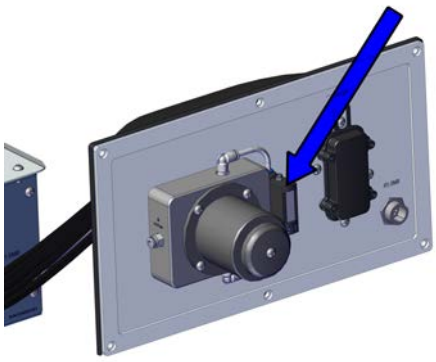
Illustration	Art. no.	Note
 xx1300000672	3HAC074411-001 Hydraulic press tool, balancing device	This tool is used to unload or restore a balancing device. The balancing device can either be installed on a robot or not. This tool also locks the balancing device in an unloaded position after unloading. Use this tool: • to unload a balancing device without the help of the robot itself • to unload a balancing device that needs to be restored after it has been removed from the robot • to unload a balancing device not fitted on the robot, such as a spare part. See *Unloading the balancing device springs and locking position with the Hydraulic press tool, balancing device on page 391*

DANGER

Never remove or fit the Distance tool on a balancing device which can not be unloaded by the robot. There is a severe risk of personal injury.

Unloading the balancing device springs and locking position with the Hydraulic press tool, balancing device

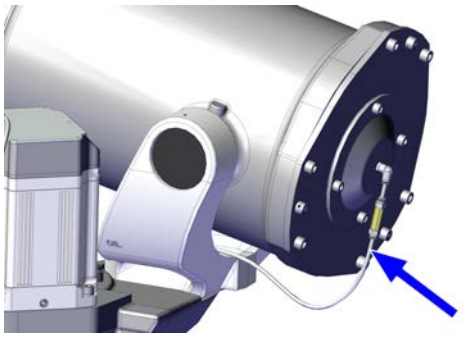
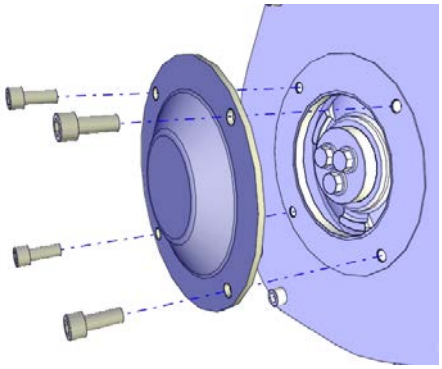
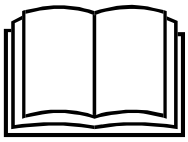
Use this procedure to unload and lock the balancing device in unloaded position with the Hydraulic press tool, balancing device (3HAC074411-001).

	Action	Note
1	Jog axis-2 to the calibration position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
3	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593

Continues on next page

4.6.1 Replacing spherical roller bearing, link ear

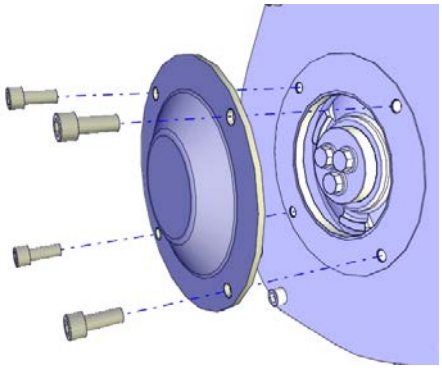
Continued

	Action	Note
4	**CAUTION** Turn off the air pressure supply.	
5	Disconnect air hose from air fitting on flow valve on balancing cylinder.	 xx2100000566
6	Remove the cover plate on the back of the balancing device. **DANGER** DO NOT remove any other screws than the rear cover attachment screws.	 xx1300000554
7	Unload the balancing device with the *press equipment* in order to make the piston rod and front ear adjustable when pulling the shaft out.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Hydraulic press tool, balancing device: 3HAC074411-001 User instructions are enclosed with the tool.

Continues on next page

Unloading the balancing device springs with the robot and locking position with the Distance tool

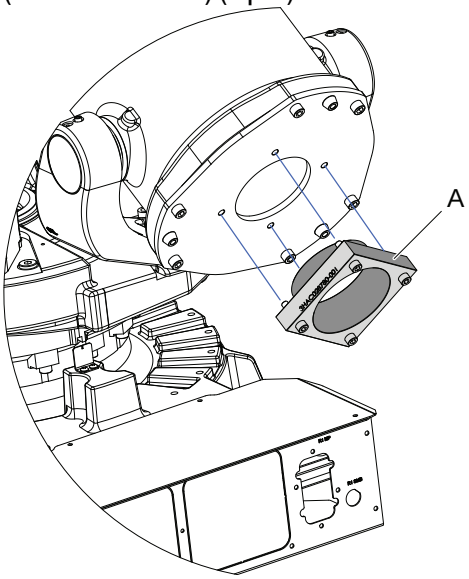
Use this procedure to unload the balancing device with the help of the robot, and lock the balancing device springs in a compressed position, using the Distance tool (3HAC030662-001).

	Action	Note
1	**DANGER** Do not use the Distance tool (3HAC030662-001) to unload or restore the pressure of the balancing device springs! This tool is only used to lock the spring unit in a compressed position, after axis-2 has been jogged to -30° or +30°. Fitting and removal of the tool shall only be done with axis-2 in this position! To unload or restore a new balancing device or if the spring unit of the balancing device cannot be compressed by jogging the robot, only use the Hydraulic press tool, balancing device (3HAC074411-001).	
2	Jog axis-2 to: • -30° or +30°	This is done in order to compress the balancing device springs inside the balancing device before fitting the Distance tool.
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Remove the cover plate on the back of the balancing device. **DANGER** DO NOT remove any other screws than the rear cover attachment screws.	 xx1300000554

Continues on next page

4.6.1 Replacing spherical roller bearing, link ear

Continued

	Action	Note
5	Fit the Distance tool on the back of the balancing device using the four screws. **DANGER** Use caution when tightening the screws. The threads in the cover can be damaged if more tightening torque than 45 Nm is used, risking that the Distance tool is not properly fitted.	Tightening torque: 45 Nm Attachment screws: M10x30 stainless steel (3HAC060786-020) (4 pcs)  xx0800000480 A Distance tool: 3HAC030662-001
6	Turn the power on temporary.	
7	Jog axis-2 to the calibration position. The balancing device is now unloaded.	This is done to compress the balancing device springs, making it possible to remove the front shaft of the balancing device.
8	Let the Distance tool stay fitted during the continued procedure.	
9	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	

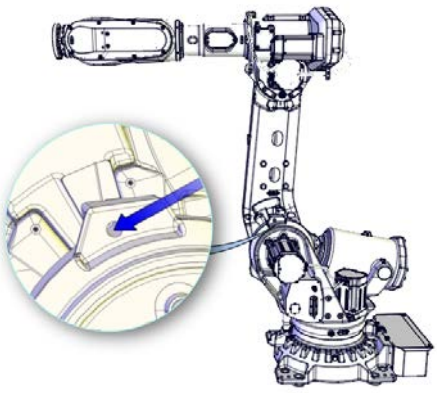
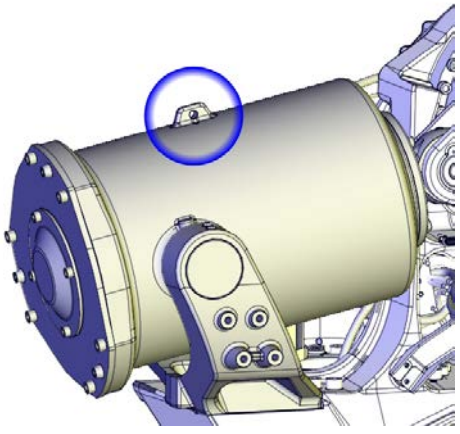
Removing the spherical roller bearing

Use these procedures to remove the spherical roller bearing in the link ear.

Preparations before removing the spherical roller bearing

	Action	Note
1	Verify that the balancing device is unloaded.	See *Unloading the balancing device on page 390*.
2	Jog axis-2 to the calibration position (if not already in this position).	

Continues on next page

	Action	Note
3	Fit a lock screw through the hole for the lock screw in the frame and into the lower arm (or using a lifting accessory or similar). The lock screw is used to secure the weight of the lower arm, to avoid accidents or damage.	Lock screw, M16x120  xx1200001116
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
5	Remove any equipment, if fitted, on or close to the balancing device.	
6	**CAUTION** The weight of the balancing device (excluding cradle) is 140 kg All lifting accessories used must be sized accordingly.	
7	Fit a lifting shackle to the balancing device.	Lifting shackle: SA-10-8-NA1  xx1300000661

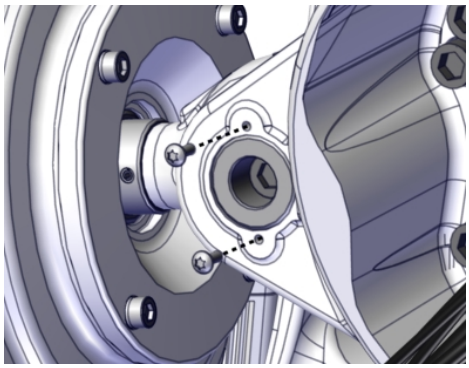
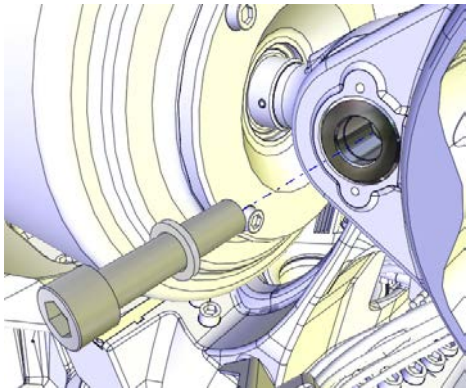
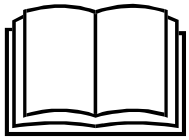
Continues on next page

4.6.1 Replacing spherical roller bearing, link ear

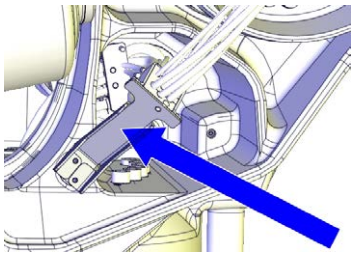
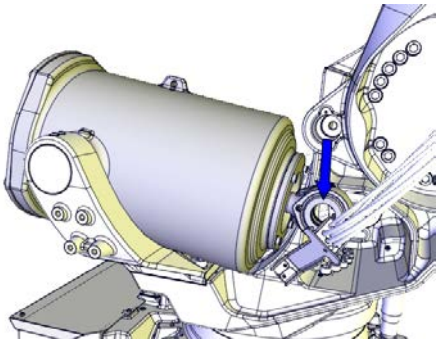
Continued

	Action	Note
8	Fit the lifting accessory to the shackle and raise to unload the weight.	Lifting accessory (chain): 3HAC15556-1

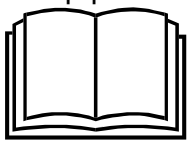
Removing the shaft in the front (link ear)

	Action	Note
1	Remove the two screws.	 xx1900002146
2	Unscrew the attachment screw and washer.	 xx1200001279 • M16x70, stainless steel
3	Pull the shaft out using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.

Continues on next page

	Action	Note
4	Remove the attachment screws of the cable bracket on the frame and let it hang loose.	 xx1200001283
5	Put down the balancing device and let it rest on the frame.	 xx1200001281

Removing the spherical roller bearing, link ear

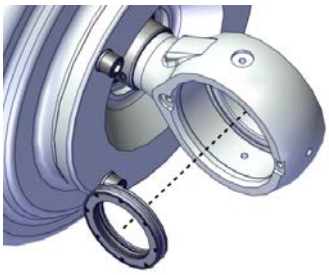
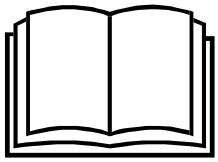
	Action	Note
1	Check that the link ear is in a position where it is possible to apply the dismantle and mounting tool. If not, adjust with the lifting accessory.	
2	Pull out the spherical roller bearing assembly, including the both end covers, using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool.  **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.

Continues on next page

4.6.1 Replacing spherical roller bearing, link ear
Continued

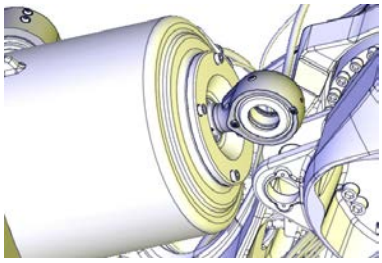
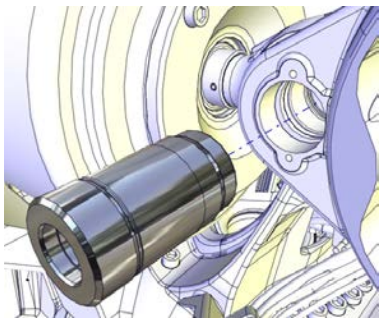
Refitting the spherical roller bearing

Refitting the spherical roller bearing, link ear

	Action	Note
1	Wipe clean all contact surfaces.	
2	Refit the smaller end cover by hand.	 xx1700001764
3	Apply some grease on the surface for the bearing.	Grease: 3HAC042536-001.
4	Press in the spherical roller bearing using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.
5	Lubricate the o-ring on the end cover and refit the cover by hand. Tighten screws.	Grease: 3HAC042536-001.  xx1700001662

Continues on next page

Refitting the front shaft of the balancing device

	Action	Note
1	Turn the power to the robot on temporarily.	
2	Use caution and jog the robot to the calibration position (if not already done).	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Apply the lifting accessory to the balancing device (if not already done).	Lifting shackle: SA-10-8-NA1 Lifting accessory (chain): 3HAC15556-1
5	Remove all residue of Loctite in the screw hole of the shaft.	
6	Wipe all contact surfaces inside the recess clean from contamination.	
7	Align the balancing device link ear with the hole in the lower arm. **Note** Verify that the link ear is correctly turned.	 xx1300000784
8	Lubricate the shaft and place it to the front ear.	 xx1200001280

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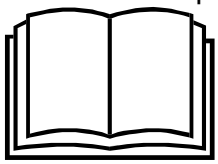
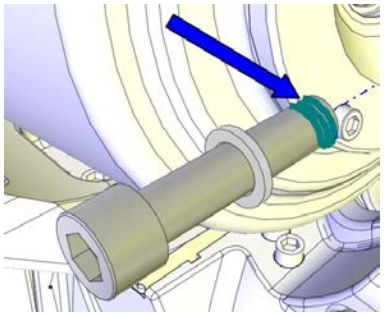
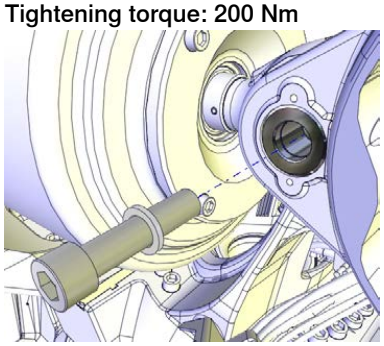
4.6.1 Replacing spherical roller bearing, link ear

Continued

	Action	Note
9	Press in the shaft using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool.  **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.
10	Apply locking liquid (Loctite 2701) on the threads of the screw, first entering the threads in the frame.	 xx1300000782
11	Secure the shaft with screw and washer.	Tightening torque: 200 Nm  xx1200001279

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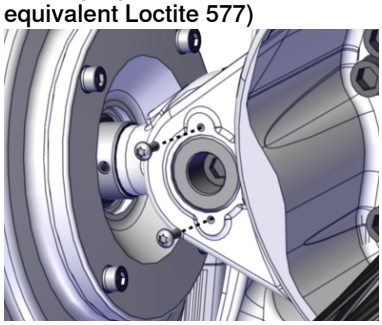
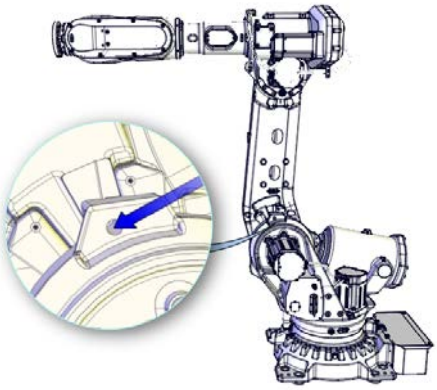
	Action	Note
12	Refit the two screws and wipe clean from residual grease. Use locking liquid.	Tightening torque: 10 Nm Locking liquid: Loctite 5400 (or equivalent Loctite 577)  xx1900002146

Concluded refitting of the front shaft

	Action	Note
1	Remove the lifting accessory from the balancing device.	
2	Remove the locking screw (M16x120).	 xx1200001116
3	If the balancing device springs have been locked in unloaded position with the Distance tool:	
	Jog axis-2 to: • -30° or +30°.	
	DANGER Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
	Remove the Distance tool.	

Continues on next page

4.6.1 Replacing spherical roller bearing, link ear

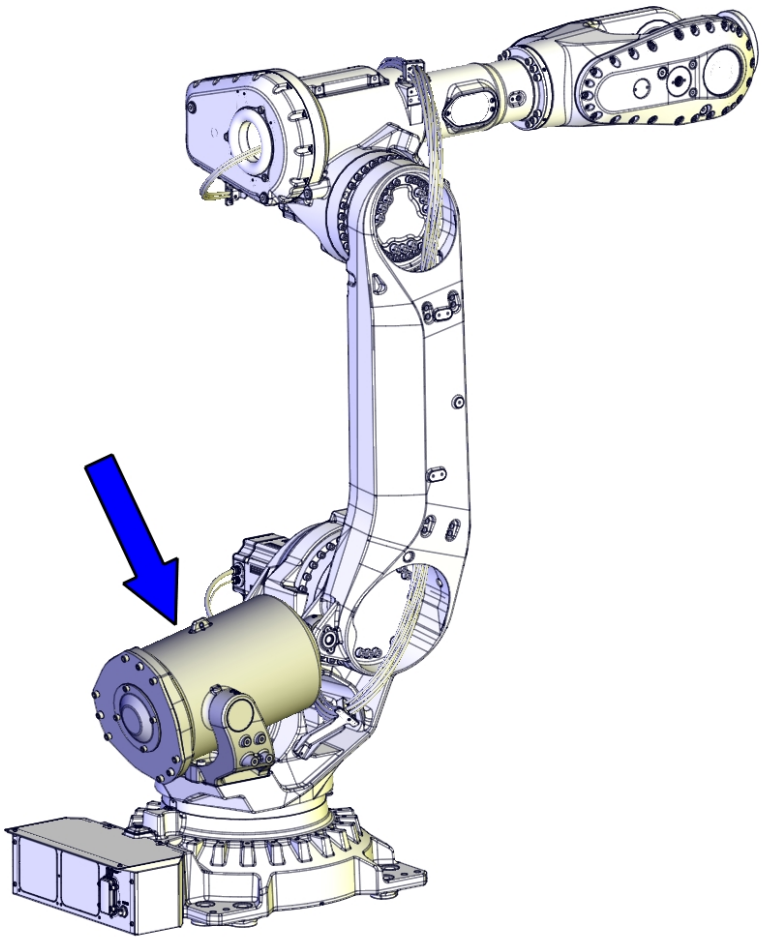
Continued

	Action	Note
4	If the balancing device springs have been unloaded and locked in unloaded position with the Hydraulic press tool, balancing device:	
	Restore the balancing device according to instructions for the *press equipment*. xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	User instructions are enclosed with the tool.
5	Apply flange sealant and refit the cover plate on the back of the balancing device.	Screws: M10x30 stainless steel (3HAC060786-020). Tightening torque: 50 Nm. Flange sealant for conical fittings: Loctite 5400 (or equivalent Loctite 577). xx1300000554

4.6.2 Replacing the balancing device

Location of the balancing device

The balancing device is located as shown in the figure.



xx1300000660

Summary of the replacement procedure

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

1 Unload the balancing device.
2 Replace the balancing device.

Spare part

Spare parts	Spare part number	Note
Balancing device	See *Product manual, spare parts - IRB 6790*	

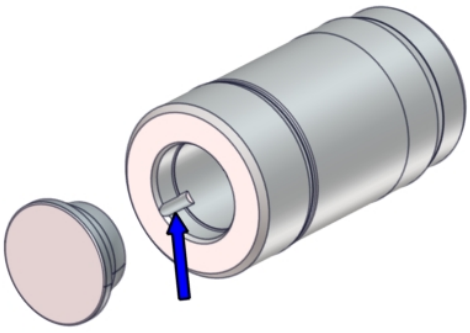
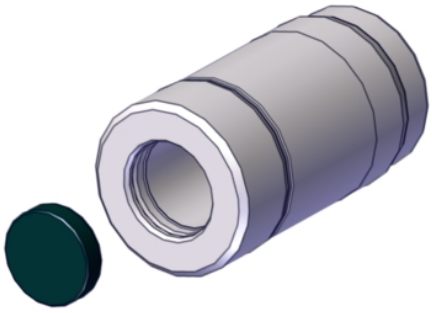
Continues on next page

4.6.2 Replacing the balancing device
Continued

Consumables

Equipment, etc.	Article number	Note
VK cover, 90x12	3HAA2166-36	Included in the in the Maintenance set cradle.
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)
Flange sealant	-	Loctite 574 (or equivalent)
Activator	3HAC074342-001	Loctite 7091
Flange sealant for conical fittings	-	Loctite 5400 (or equivalent Loctite 577)

Shaft link ear versions

Shaft link ear 3HAC072597-001	Shaft link ear 3HAC044036-001
 xx1900002309	 xx1900002310

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Balancing device cover plate	M10x30 stainless steel (3HAC060786-020)	-	4 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Distance tool	3HAC030662-001	Only used to keep the balancing device in a locked position, after the balancing device springs has been unloaded with the help of the robot itself. **DANGER** *Never* use this tool to unload or restore a balancing device!
Lock screw, M16x120	-	Used to secure lower arm.

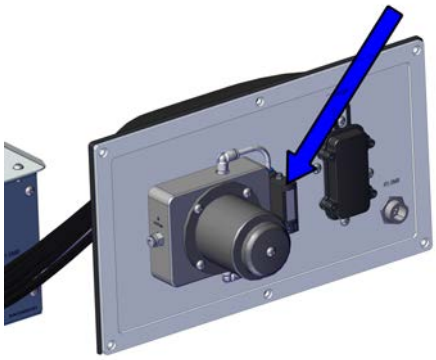
Continues on next page

Equipment, etc.	Article number	Note
Threaded bar, M16x340	-	
Anvil	3HAC047273-001	Included in the tool kit Dismantle and mounting tool (3HAC028920-001).
Hydraulic press tool, balancing device	3HAC074411-001	Used to unload or restore a balancing device.
Dismantle and mounting tool	3HAC028920-001	Used for removing and fitting shaft and bearings.
Hydraulic pump 70 MPa	3HAC13086-1	To be used with the hydraulic cylinder.
Hydraulic cylinder	3HAC11731-1	To be used with the press tool.
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.
Lifting shackle	-	SA-10-8-NA1
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Unloading the balancing device

Unloading the balancing device springs and locking position with the Hydraulic press tool, balancing device

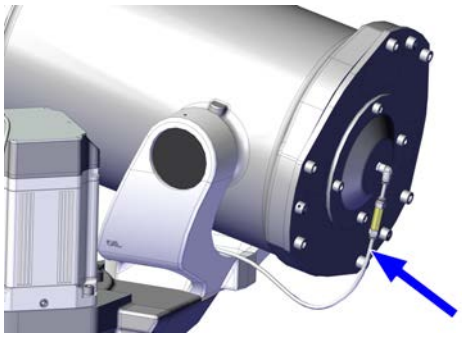
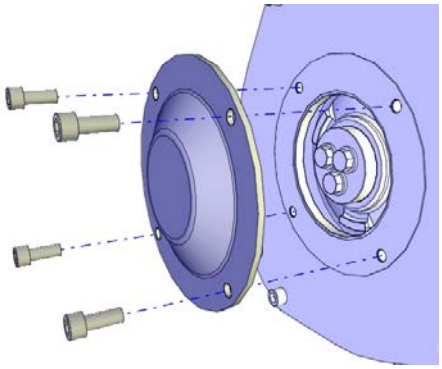
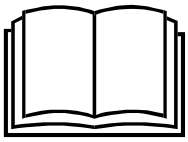
Use this procedure to unload and lock the balancing device in unloaded position with the Hydraulic press tool, balancing device (3HAC074411-001).

	Action	Note
1	Jog axis-2 to the calibration position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
3	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593

Continues on next page

4.6.2 Replacing the balancing device

Continued

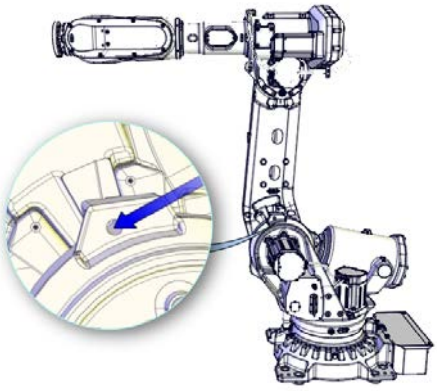
	Action	Note
4	**CAUTION** Turn off the air pressure supply.	
5	Disconnect air hose from air fitting on flow valve on balancing cylinder.	 xx2100000566
6	Remove the cover plate on the back of the balancing device. **DANGER** DO NOT remove any other screws than the rear cover attachment screws.	 xx1300000554
7	Unload the balancing device with the *press equipment* in order to make the piston rod and front ear adjustable when pulling the shaft out.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Hydraulic press tool, balancing device: 3HAC074411-001 User instructions are enclosed with the tool.

Continues on next page

Removing the balancing device

Use these procedures to remove the balancing device.

Preparations before removing the balancing device

	Action	Note
1	Verify that the balancing device is unloaded.	See *Unloading the balancing device on page 405*.
2	Jog axis-2 to the calibration position (if not already in this position).	
3	Fit a locking screw M16x120 through the hole for the lock screw in the frame and into the lower arm (or using a lifting accessory or similar). The lock screw is used to secure the weight of the lower arm, in order to avoid accidents or damage.	 xx1200001116
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
5	Remove any equipment, if fitted, on or close to the balancing device.	

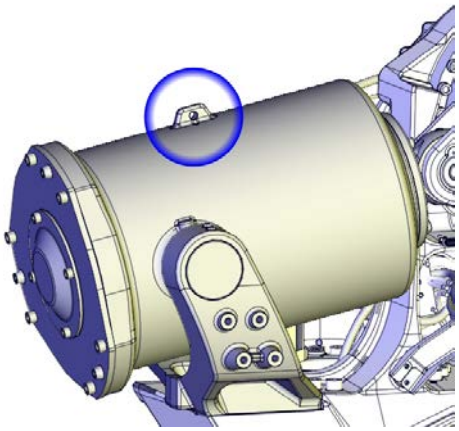
Attaching lifting accessory to the balancing device

	Action	Note
1	**CAUTION** The weight of the balancing device (excluding cradle) is 140 kg All lifting accessories used must be sized accordingly.	

Continues on next page

4.6.2 Replacing the balancing device

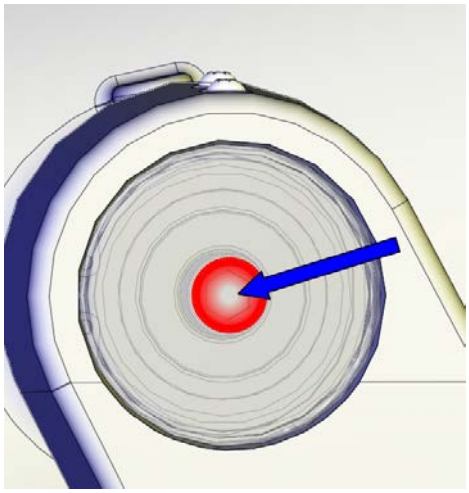
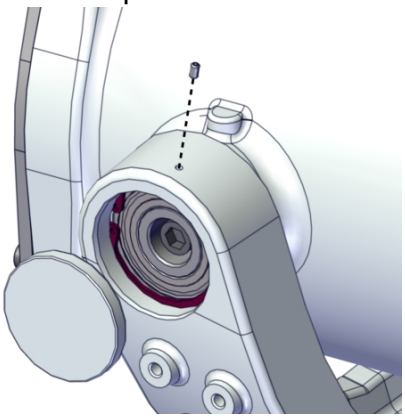
Continued

	Action	Note
2	Fit a lifting shackle to the balancing device.	Lifting shackle: SA-10-8-NA1  xx1300000661
3	Fit the lifting accessory to the shackle and raise to unload the weight.	Lifting accessory (chain): 3HAC15556-1

Continues on next page

Removing the rear shafts

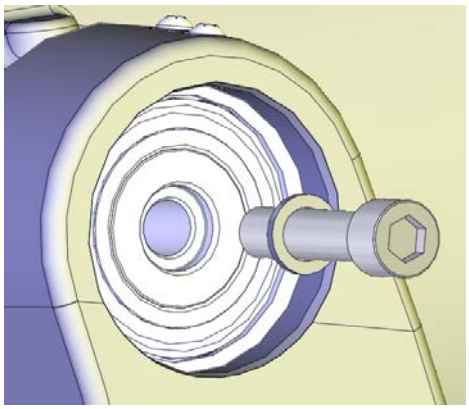
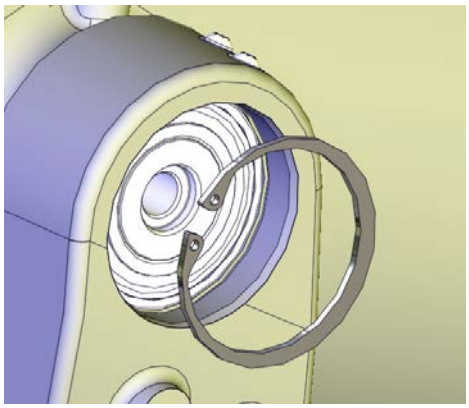
Perform this procedure on both sides.

	Action	Note
1	Remove the both VK covers using one of the recommended methods: • Drive a screwdriver (or similar) through the VK cover, as close as possible to the center of the VK cover, and bend out the cover. If not making a hole in the center of the VK cover, there is a risk of damaging the bearing inside. The damaged VK cover must be replaced with a new. • Remove the protection screw from the vent hole and use air pressure through the hole to blow out the cover. The cover can be reused if not damaged.	VK cover, 90x12: 3HAA2166-36 Position for screwdriver:  xx1300000662 Vent hole for air pressure:  xx1700001800
2	Wipe off any residual grease inside the recess.	

Continues on next page

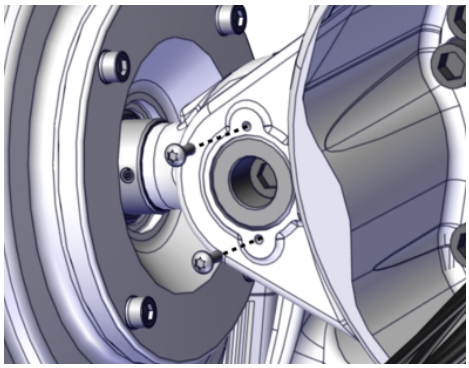
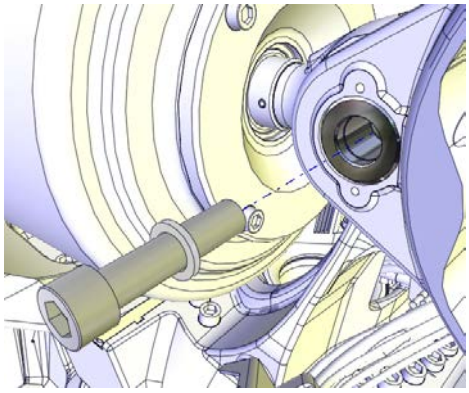
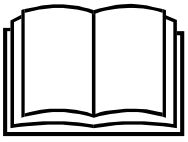
4.6.2 Replacing the balancing device

Continued

	Action	Note
3	Unscrew the attachment screws on each shaft.	 xx1300000663 M16x50 stainless steel
4	Remove retaining ring, bore on one side.	 xx1300000664
5	Use the removal tool and pull the shaft out a few millimeters, just long enough for the balancing device to go free.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.

Continues on next page

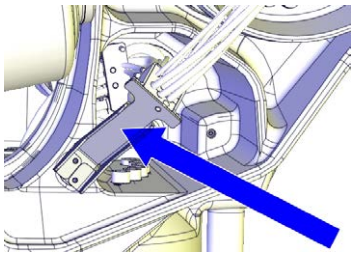
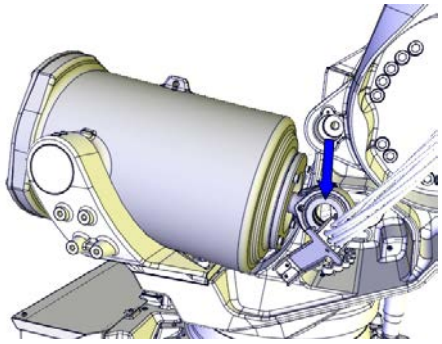
Removing the shaft in the front (link ear)

	Action	Note
1	Remove the two screws.	 xx1900002146
2	Unscrew the attachment screw and washer.	 xx1200001279 • M16x70, stainless steel
3	Pull the shaft out using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.

Continues on next page

4.6.2 Replacing the balancing device

Continued

	Action	Note
4	Remove the attachment screws of the cable bracket on the frame and let it hang loose.	 xx1200001283
5	Put down the balancing device and let it rest on the frame.	 xx1200001281

Concluding procedure

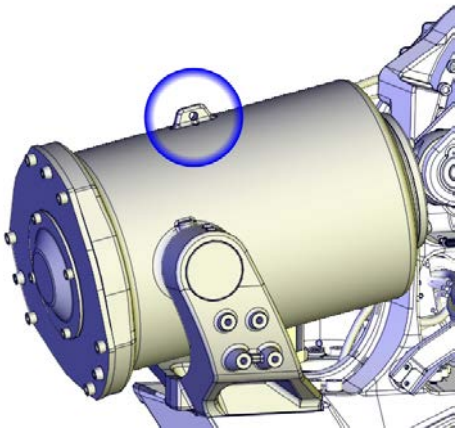
	Action	Note
1	Remove the balancing device.	
2	If the same balancing device shall be refitted, the Distance tool 3HAC030662-001 must stay fitted during the time the balancing device is removed from the robot. **DANGER** The distance tool shall, under no circumstance, be fitted on or be removed from a balancing device that not is fitted to the robot! Fitting and removing this tool can only be done in a safe way with axis-2 in -30° or +30° position and with the balancing device fitted to the robot.	

Continues on next page

Refitting the balancing device

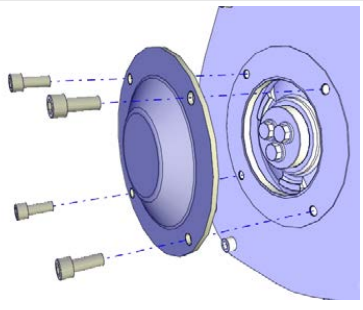
Use this procedure to refit the balancing device.

Attaching lifting accessory to the balancing device

	Action	Note
1	**CAUTION** The weight of the balancing device (excluding cradle) is 140 kg All lifting accessories used must be sized accordingly.	
2	Fit a lifting shackle to the balancing device.	Lifting shackle: SA-10-8-NA1  xx1300000661
3	Fit the lifting accessory to the shackle and raise to unload the weight.	Lifting accessory (chain): 3HAC15556-1

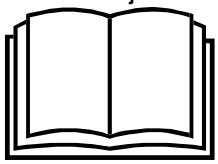
Unloading a new spare part, balancing device

Before a new spare part balancing device is fitted, the springs must be unloaded using the Hydraulic press tool, balancing device (3HAC074411-001).

	Action	Note
1	Remove the cover plate on the back of the balancing device. **DANGER** DO NOT remove any other screws than the rear cover attachment screws.	 xx1300000554

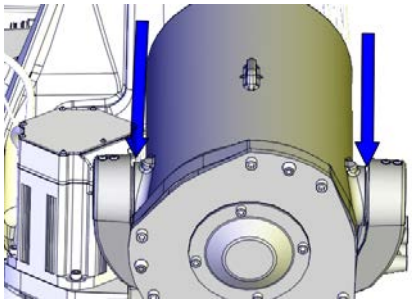
Continues on next page

4.6.2 Replacing the balancing device
Continued

	Action	Note
2	Unload the balancing device with the *press equipment* in order to make the piston rod and front ear adjustable when pulling the shaft out.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Hydraulic press tool, balancing device: 3HAC074411-001 User instructions are enclosed with the tool.

Refitting the rear shafts

Perform this procedure on both sides.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	Lift the balancing device into position in the cradle.	
3	Apply a big screwdriver between the cradle and the balancing device, as shown in the figure when the shafts are refitted.	 xx1300000838

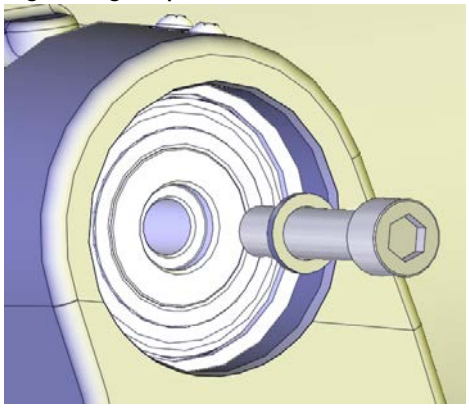
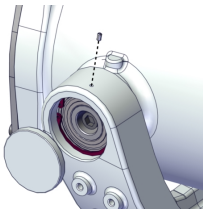
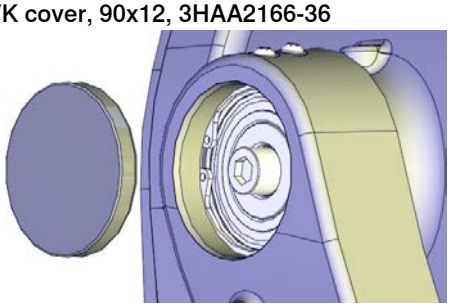
Continues on next page

	Action	Note
4	Apply the refitting tool and press the shafts into position one at a time. xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.
5	Apply flange sealant on the contact surface of the balancing device. See the figure. Apply an activator on the corresponding contact surface of the shaft. **Note** The activator must be used to harden the flange sealant.	Flange sealant: - (Loctite 574 (or equivalent)). Activator: 3HAC074342-001 (Loctite 7091). xx1400000367 A Loctite 574 (or equivalent) (red dotted lines) B Balancing device C Shaft
6	Fit the retaining ring.	 xx1300000664

Continues on next page

4.6.2 Replacing the balancing device

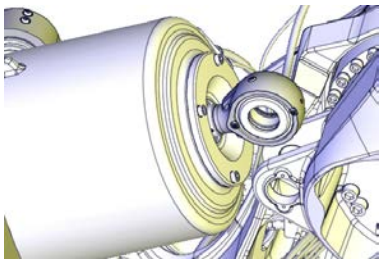
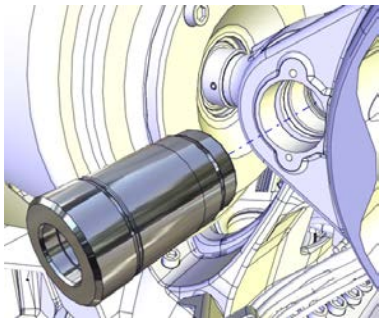
Continued

	Action	Note
7	Apply locking liquid on the screws and secure the shafts on both sides.	Loctite 2400 (or equivalent Loctite 243) M16x50 stainless steel Tightening torque: 300 Nm  xx1300000663
8	Refit new VK covers. **Note** Temporarily remove the screw on the cradle to let go of overpressure if the VK covers are hard to fit. Apply Loctite 5400 (or equivalent Loctite 577) on the threads and refit the screw.  xx1700001800	VK cover, 90x12, 3HAA2166-36  xx1300000837
9	Wipe clean from residual grease.	
10	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

Refitting the front shaft of the balancing device

	Action	Note
1	Turn the power to the robot on temporarily.	
2	Use caution and jog the robot to the calibration position (if not already done).	

Continues on next page

	Action	Note
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Apply the lifting accessory to the balancing device (if not already done).	Lifting shackle: SA-10-8-NA1 Lifting accessory (chain): 3HAC15556-1
5	Remove all residue of Loctite in the screw hole of the shaft.	
6	Wipe all contact surfaces inside the recess clean from contamination.	
7	Align the balancing device link ear with the hole in the lower arm. **Note** Verify that the link ear is correctly turned.	 xx1300000784
8	Lubricate the shaft and place it to the front ear.	 xx1200001280

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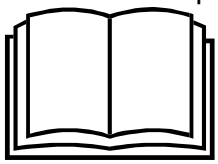
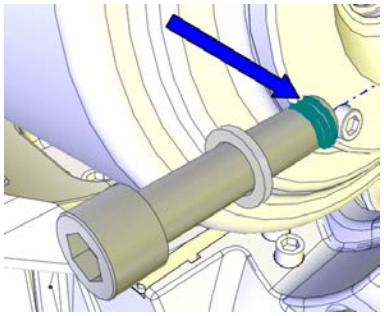
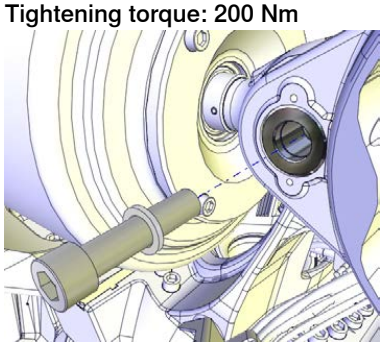
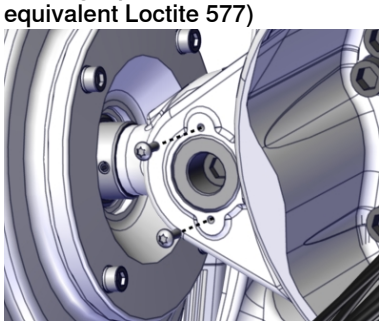
4.6.2 Replacing the balancing device

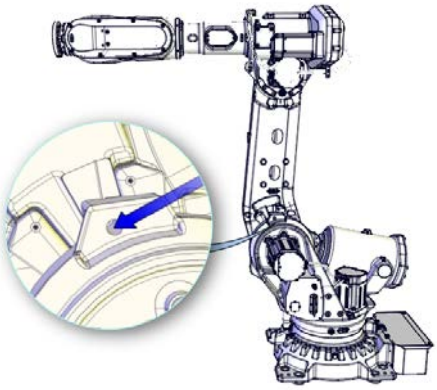
Continued

	Action	Note
9	Press in the shaft using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool.  **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.
10	Apply locking liquid (Loctite 2701) on the threads of the screw, first entering the threads in the frame.	 xx1300000782
11	Secure the shaft with screw and washer.	Tightening torque: 200 Nm  xx1200001279

Continues on next page

	Action	Note
12	Refit the two screws and wipe clean from residual grease. Use locking liquid.	Tightening torque: 10 Nm Locking liquid: Loctite 5400 (or equivalent Loctite 577)  xx1900002146

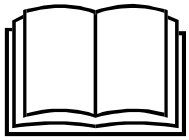
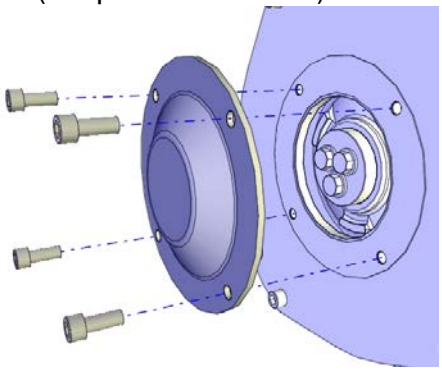
Concluded refitting of the front shaft

	Action	Note
1	Remove the lifting accessory from the balancing device.	
2	Remove the locking screw (M16x120).	 xx1200001116
3	If the balancing device springs have been locked in unloaded position with the Distance tool:	
	Jog axis-2 to: • -30° or +30°.	
	DANGER Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
	Remove the Distance tool.	

Continues on next page

4.6.2 Replacing the balancing device

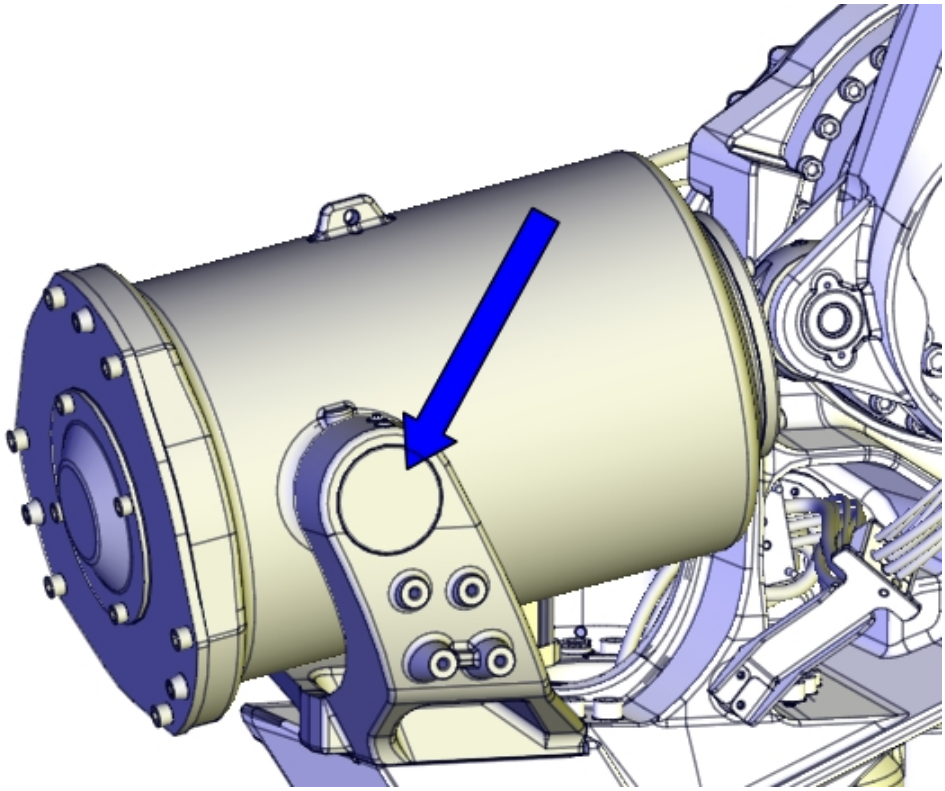
Continued

	Action	Note
4	If the balancing device springs have been unloaded and locked in unloaded position with the Hydraulic press tool, balancing device:	
	Restore the balancing device according to instructions for the *press equipment*.  xx0900000813 Go to the user instructions enclosed with the press tool.  **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	User instructions are enclosed with the tool.
5	Apply flange sealant and refit the cover plate on the back of the balancing device.	Screws: M10x30 stainless steel (3HAC060786-020). Tightening torque: 50 Nm. Flange sealant for conical fittings: Loctite 5400 (or equivalent Loctite 577).  xx1300000554

4.6.3 Replacing the rear bearings on the balancing device

Location of rear bearings, balancing device

The rear bearings of the balancing device are located in the cradle, one on each side.



xx1300000785

Spare parts

Equipment	Article number	Note
Maintenance set cradle	3HAC064403-001	The maintenance set contains all necessary parts to replace the bearings, including VK covers. 3HAA2166-36 (2 pcs).

Consumables

Equipment	Article number	Note
VK cover, 90x12	3HAA2166-36	Included in the in the Maintenance set cradle.
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)
Flange sealant	-	Loctite 574 (or equivalent)
Activator	3HAC074342-001	Loctite 7091
Flange sealant for conical fittings	-	Loctite 5400 (or equivalent Loctite 577)

Continues on next page

4.6.3 Replacing the rear bearings on the balancing device
Continued

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Balancing device cover plate	M10x30 stainless steel (3HAC060786-020)	-	4 pcs

Required tools and equipment

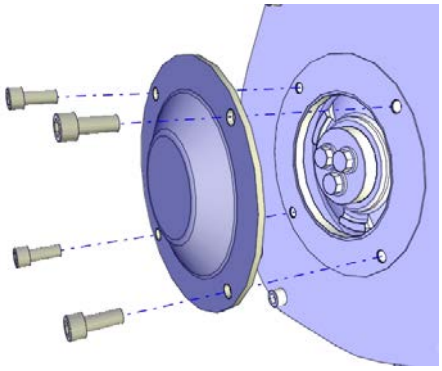
Equipment	Article number	Note
Distance tool	3HAC030662-001	Only used to keep the balancing device in a locked position, after the balancing device springs has been unloaded with the help of the robot itself.  **DANGER** *Never* use this tool to unload or restore a balancing device!
Lock screw, M16x120	-	Used to secure lower arm.
Lifting shackle	-	SA-10-8-NA1
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.
Threaded bar, M16x340	-	
Dismantle and mounting tool	3HAC028920-001	Used for removing and fitting shaft and bearings.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Continues on next page

Unloading the balancing device

Unloading the balancing device springs with the robot and locking position with the Distance tool

Use this procedure to unload the balancing device with the help of the robot, and lock the balancing device springs in a compressed position, using the Distance tool (3HAC030662-001).

	Action	Note
1	**DANGER** Do not use the Distance tool (3HAC030662-001) to unload or restore the pressure of the balancing device springs! This tool is only used to lock the spring unit in a compressed position, after axis-2 has been jogged to -30° or +30°. Fitting and removal of the tool shall only be done with axis-2 in this position! To unload or restore a new balancing device or if the spring unit of the balancing device cannot be compressed by jogging the robot, only use the Hydraulic press tool, balancing device (3HAC074411-001).	
2	Jog axis-2 to: • -30° or +30°	This is done in order to compress the balancing device springs inside the balancing device before fitting the Distance tool.
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Remove the cover plate on the back of the balancing device. **DANGER** DO NOT remove any other screws than the rear cover attachment screws.	 xx1300000554

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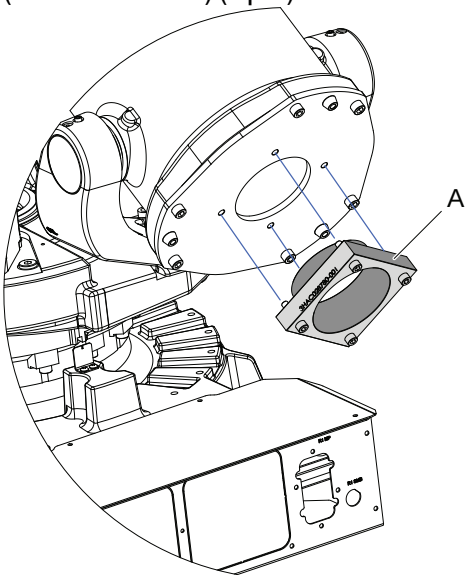
4.6.3 Replacing the rear bearings on the balancing device
Continued

	Action	Note
5	Fit the Distance tool on the back of the balancing device using the four screws. **DANGER** Use caution when tightening the screws. The threads in the cover can be damaged if more tightening torque than 45 Nm is used, risking that the Distance tool is not properly fitted.	Tightening torque: 45 Nm Attachment screws: M10x30 stainless steel (3HAC060786-020) (4 pcs)  xx0800000480 A Distance tool: 3HAC030662-001
6	Turn the power on temporary.	
7	Jog axis-2 to the calibration position. The balancing device is now unloaded.	This is done to compress the balancing device springs, making it possible to remove the front shaft of the balancing device.
8	Let the Distance tool stay fitted during the continued procedure.	
9	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	

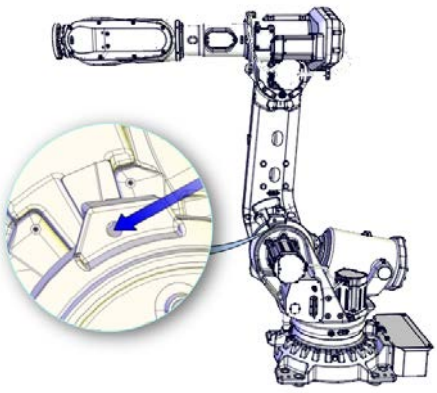
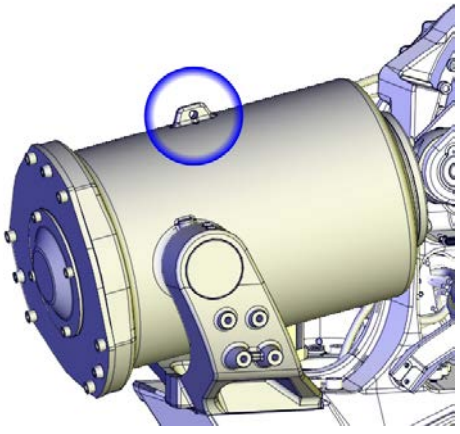
Removing the bearing, cradle

Use these procedures to remove the bearing in the cradle.

Preparations before removing the rear bearings

	Action	Note
1	Jog axis-2 to the calibration position (if not already in this position).	

Continues on next page

	Action	Note
2	Fit a locking screw through the hole for the lock screw in the frame and into the lower arm (or using a lifting accessory or similar). The lock screw is used to secure the weight of the lower arm, in order to avoid accidents or damage.	Lock screw, M16x120  xx1200001116
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Remove any equipment, if fitted, on or close to the balancing device.	
5	**CAUTION** The weight of the balancing device (excluding cradle) is 140 kg All lifting accessories used must be sized accordingly.	
6	Fit a lifting shackle to the balancing device.	Lifting shackle: SA-10-8-NA1  xx1300000661

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4.6.3 Replacing the rear bearings on the balancing device
Continued

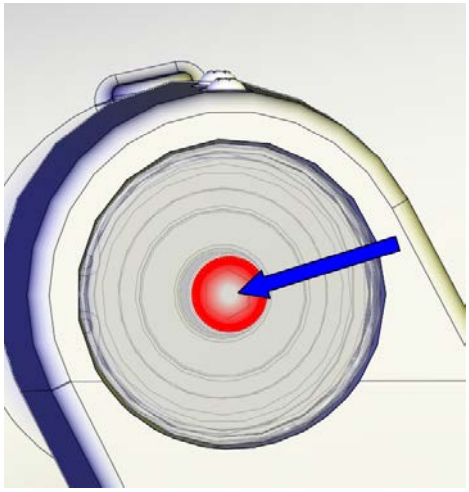
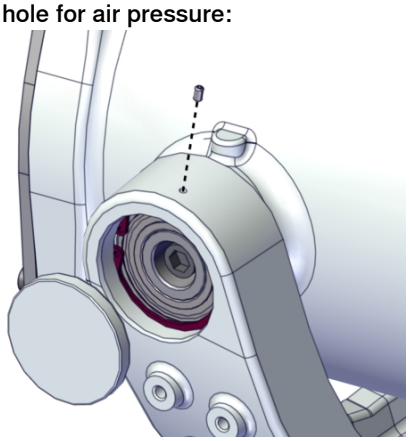
	Action	Note
7	Fit the lifting accessory to the shackle and raise to unload the weight.	Lifting accessory (chain): 3HAC15556-1

Removing the shaft end, cradle

The procedure of removing the shaft end in the cradle is the same on both sides.

Note

Remove one shaft end at a time!

	Action	Note
1	Remove the VK cover using one of the recommended methods: • Drive a screwdriver (or similar) through the VK cover, as close as possible to the center of the VK cover, and bend out the cover. If not making a hole in the center of the VK cover, there is a risk of damaging the bearing inside. The damaged VK cover must be replaced with a new. • Remove the protection screw from the vent hole and use air pressure through the hole to blow out the cover. The cover can be reused if not damaged.	VK cover, 90x12: 3HAA2166-36 Position for screwdriver:  xx1300000662 Vent hole for air pressure:  xx1700001800
2	Wipe off all residual grease inside the recess.	

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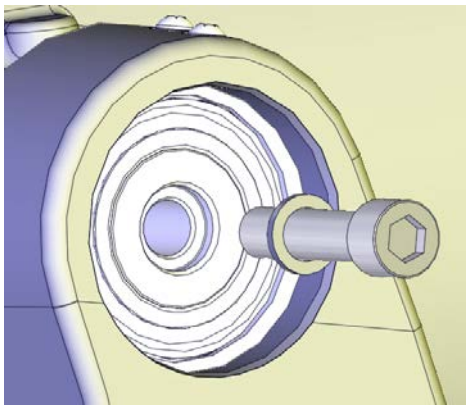
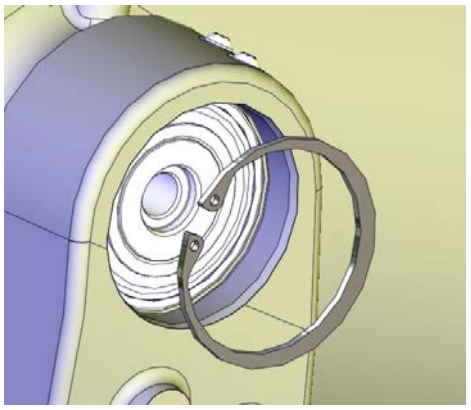
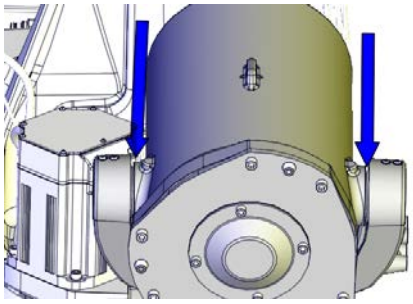
	Action	Note
3	Unscrew the attachment screw securing the shaft.	 xx1300000663
4	Remove the retaining ring bore.	 xx1300000664
5	Before pulling out the shaft end, put a big screw driver between the cradle and balancing device and use it as a distance tool.	 xx1300000838

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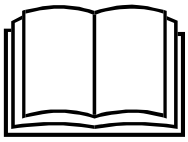
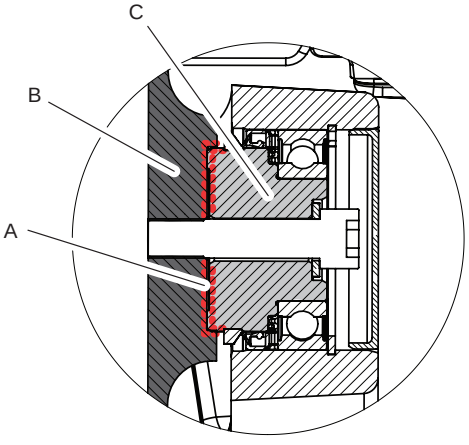
4.6.3 Replacing the rear bearings on the balancing device
Continued

	Action	Note
6	Pull out the shaft end with bearing, sealing and distance using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool.  **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.

Refitting the bearing, cradle

Use these procedures to refit the bearing in the cradle.

Refitting the shaft end and rear bearings

	Action	Note
1	Wipe clean all contact surfaces from residual grease and other contamination inside the recess.	
2	Apply flange sealant on the contact surface of the balancing device. See the figure. Apply an activator on the corresponding contact surface of the shaft.  **Note** The activator must be used to harden the flange sealant.	Flange sealant: - (Loctite 574 (or equivalent)). Activator: 3HAC074342-001 (Loctite 7091).  xx1400000367 A Loctite 574 (or equivalent) (red dotted lines) B Balancing device C Shaft

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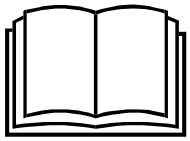
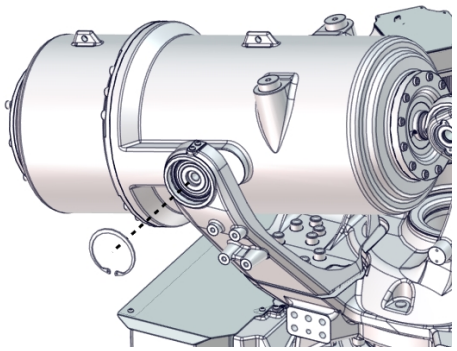
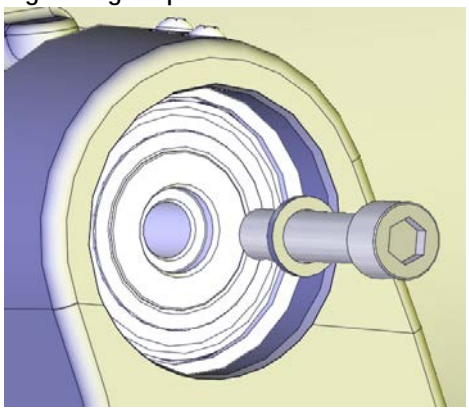
	Action	Note
3	Apply some grease in the hole for the bearing in the cradle. **Note** Do not apply grease on surfaces with Mercasol.	
4	Apply a threaded bar into the hole in the balancing device using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.
5	Fit the retaining ring bore.	 xx1700000343
6	Apply locking liquid on the attachment screw.	Loctite 2400 (or equivalent Loctite 243)

Continues on next page

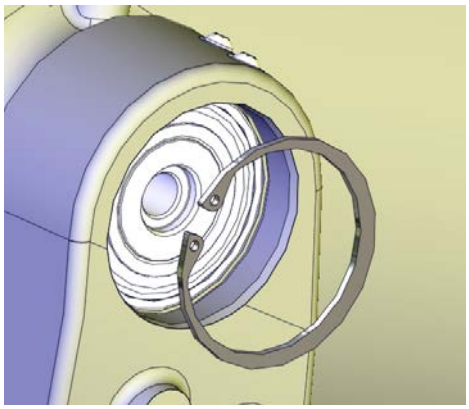
4.6.3 Replacing the rear bearings on the balancing device
Continued

	Action	Note
7	While using the screw driver between the cradle and balancing device as a distance tool, tighten the attachment screw completely. Secure the balancing device.	Tightening torque: 300 Nm.  xx1300000663
8	Fit a VK cover to protect the bearing.	

Remove the lifting accessories

	Action	Note
1	Remove the lifting accessories.	

Concluding procedure

	Action	Note
1	Refit the retaining ring bore.	 xx1300000664

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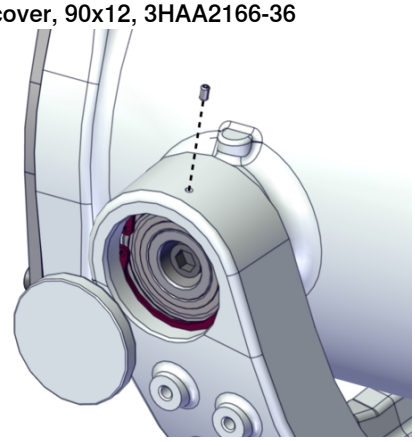
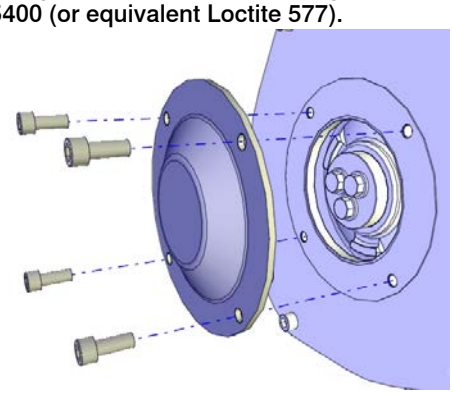
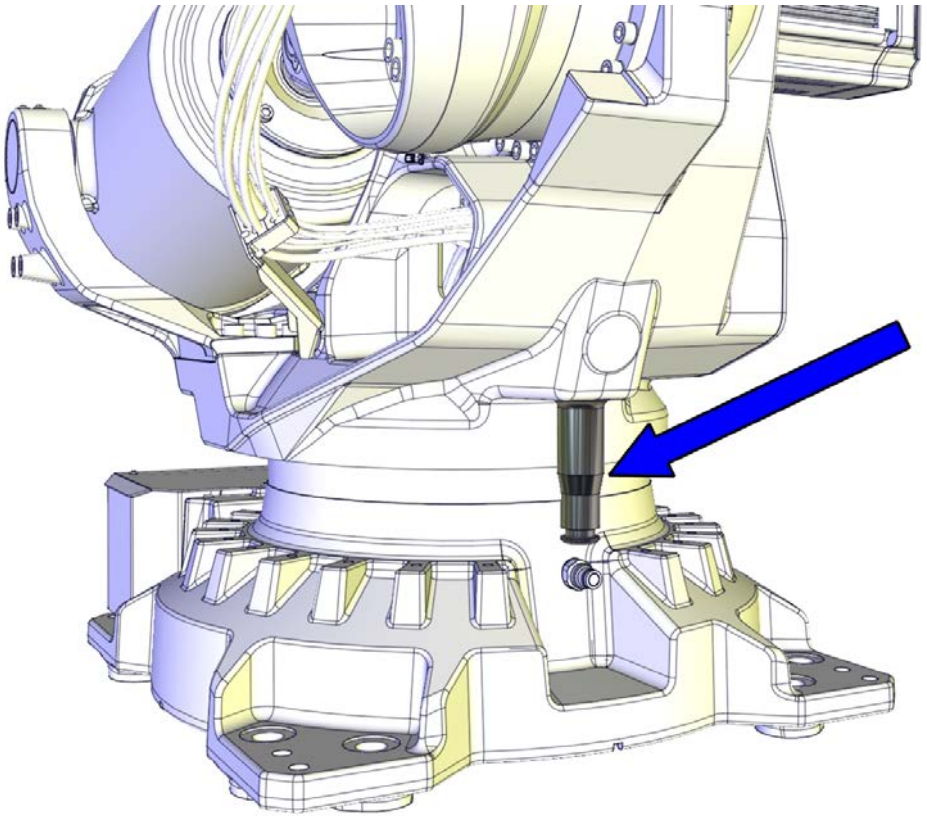
	Action	Note
2	Refit the VK-cover. **Note** Temporarily remove the screw on the cradle to let go of overpressure if the VK covers are hard to fit. Apply Loctite 5400 (or equivalent Loctite 577) on the threads and refit the screw.	VK cover, 90x12, 3HAA2166-36  xx1700001800
3	Wipe clean from residual grease.	
4	Remove the Distance tool.	
5	Apply flange sealant and refit the cover plate on the back of the balancing device.	Screws: M10x30 stainless steel (3HAC060786-020). Tightening torque: 50 Nm. Flange sealant for conical fittings: Loctite 5400 (or equivalent Loctite 577).  xx1300000554
6	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.6.4 Replacing the stop pin

Location of the stop pin

The stop pin is located as shown in the figure.



xx1300000475

Spare part

Equipment	Article number	Note
Stop pin	See *Product manual, spare parts - IRB 6790*	

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Mechanical stop	M10x20 Stainless Steel 9ADJ400914P1259	-	1 pcs

Continues on next page

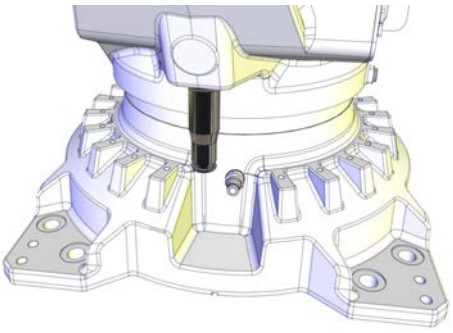
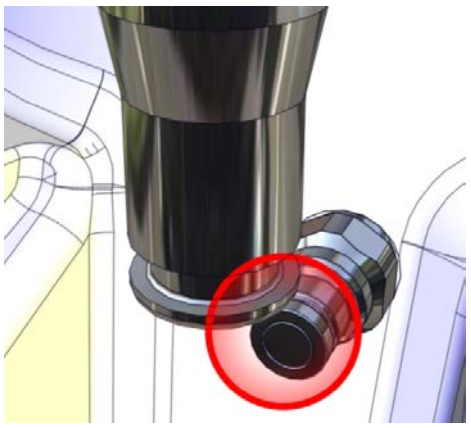
Required tools and equipment

Equipment, etc.	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required consumables

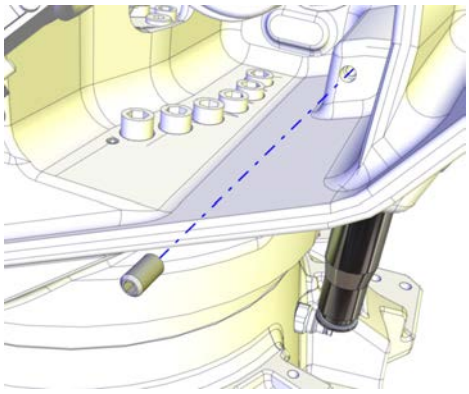
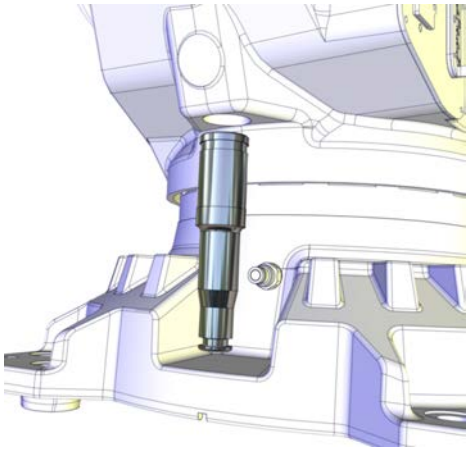
Consumable	Article number	Note
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)
Rust preventive	3HAC034903-001	Mercasol 3110 Waxcoat. Recommended drying time is 24h.

Removing the stop pin

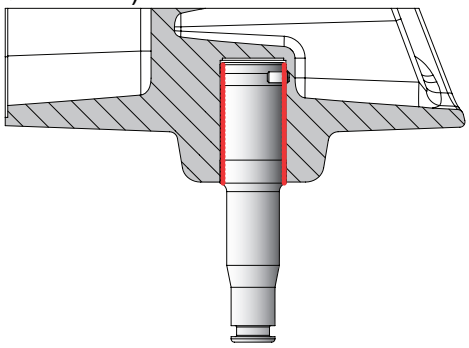
	Action	Note
1	Jog the robot to this position: • axis 1 = -5°	 xx1300000479
2	**Note** If the axis-1 is not in this position the stop pin will not be able to go free from the axis-1 oil plug draining, when removed.	 xx1300000478
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	

Continues on next page

4.6.4 Replacing the stop pin
Continued

	Action	Note
4	Hold the mechanical stop pin in a firm grip, use caution and remove it by unscrewing the set screw, cup point. **CAUTION** The mechanical stop weighs 5 kg and may unexpectedly fall down when the set screw is removed.	 xx1300000476
5	Remove the stop pin.	 xx1300000477

Refitting the stop pin

	Action	Note
1	Apply Mercasol on the surfaces shown in the figure, on stop pin and in the hole as shown in the figure.	Rust preventive: 3HAC034903-001 (Mercasol 3110 Waxcoat. Recommended drying time is 24h.).  xx1400000378

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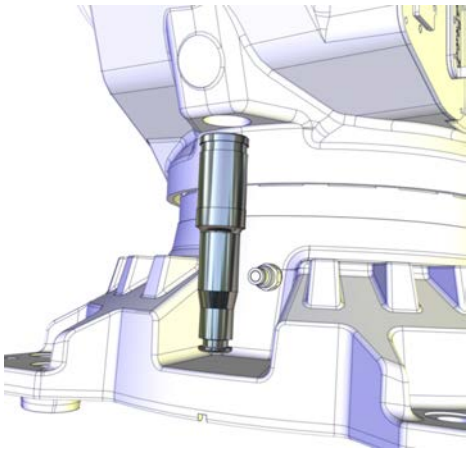
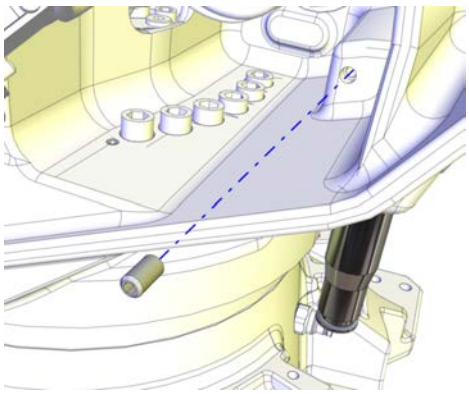
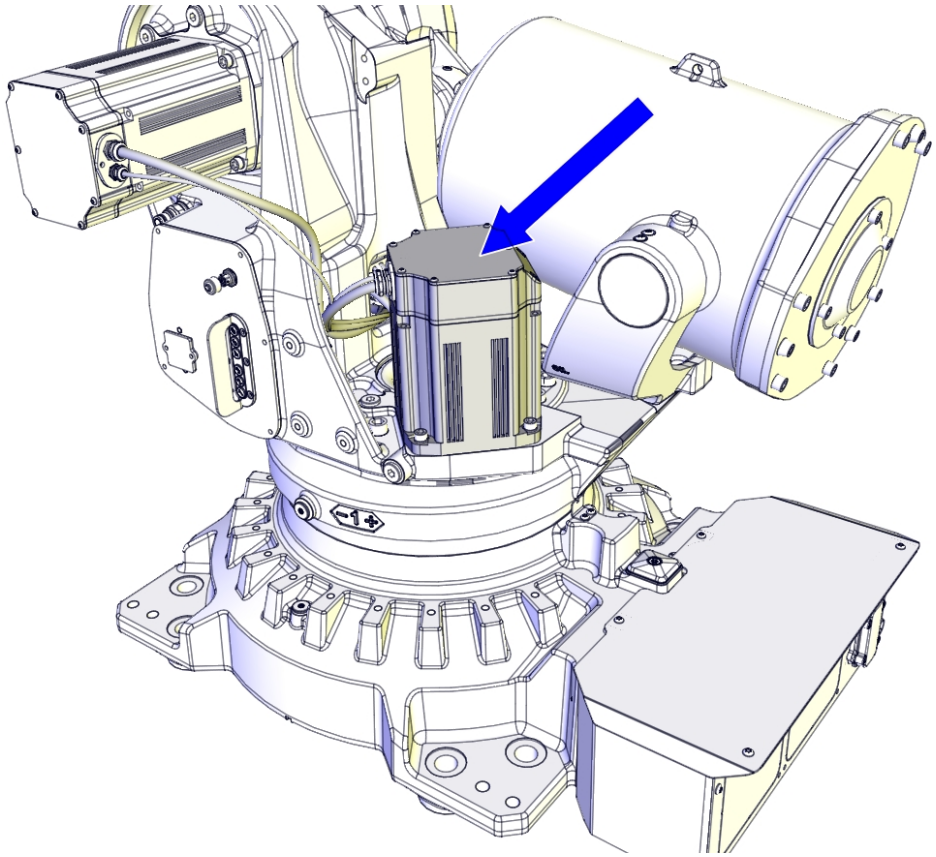
	Action	Note
2	Fit the stop pin.	 xx1300000477
3	Apply locking liquid on the set screw, and secure the stop pin.	Loctite 2400 (or equivalent Loctite 243) Set screw: M10x20 Stainless Steel 9ADJ400914P1259  xx1300000476

4.7 Motors

4.7.1 Replacing the axis-1 motor

Location of the axis-1 motor

The motor is located as shown in the figure.



xx1200001064

Summary of the replacement procedure

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

1 Attach the lifting tools
2 Replace the motor
3 Remove the lifting tools.

Spare parts

Spare part	Spare part number	Note
Axis-1 motor	See *Product manual, spare parts - IRB 6790*	

Continues on next page

Consumables

Equipment, etc.	Article number	Note
Grease	3HAC042536-001	Used to lubricate o-rings, Shell Gadus S2.
O-ring	3HAC067762-001	D=169.5x3 Used on motor cover.
O-ring	3HAB3772-107	D=102x3 Used on motor flange.

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Motor, axis-1	M10x30 stainless steel 3HAC060786-020	13x17x2 stainless steel 3HAC060866-003	4 pcs
Motor cover	M5x12 Stainless steel A2-70 9ADA619-44	-	7 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Lifting accessory, motor	3HAC14459-1	
Roundsling, 1 m	-	Length: 1 m, lifting capacity: 1,000 kg.
Removal tool motor M12	3HAC14631-1	Used to push out the motor, if necessary. Always use removal tools in pairs.
Guide pin, M10x150	3HAC15521-2	Always use guide pins in pairs.
Bits extender	3HAC12342-1	300 mm, bits 1/2"
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
24 VDC power supply	-	Used to release the motor brakes.
Leak-down tester	-	
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Continues on next page

4.7.1 Replacing the axis-1 motor
Continued

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 651*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the axis-1 motor

These procedures describe how to remove the 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 the robot to the synchronization position.	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	

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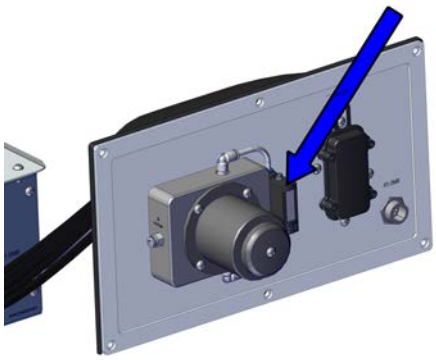
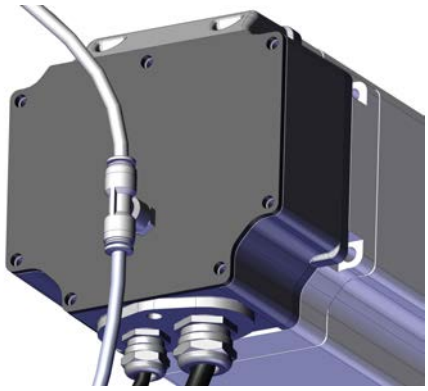
	Action	Note
4	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593
5	**CAUTION** Turn off the air pressure supply.	

Disconnecting the motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Disconnect air hose from air fitting on motor cover.	 xx2100000568

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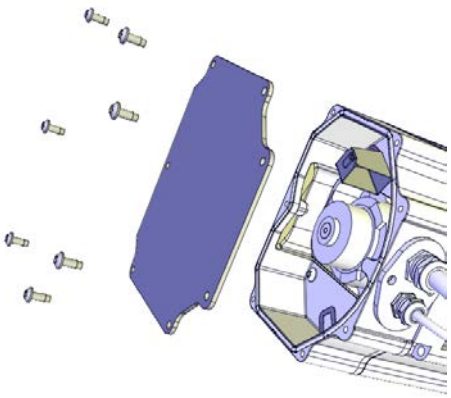
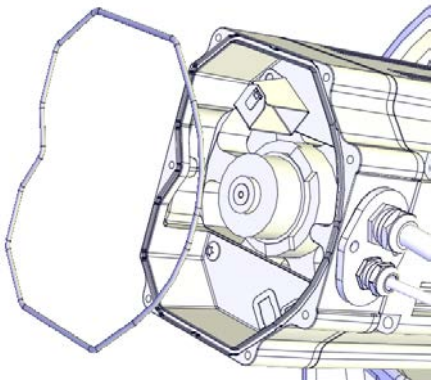
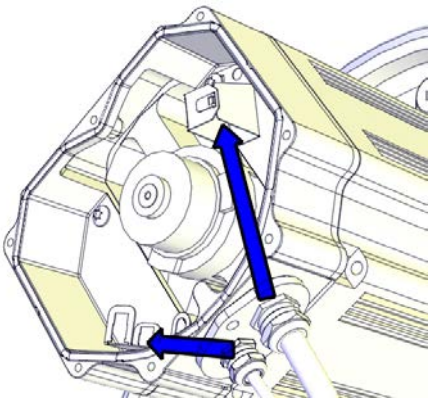
4.7.1 Replacing the axis-1 motor

Continued

	Action	Note
3	Unscrew the attachment screws and washers and remove the motor cover. **Note** Axis 3 and 4 motors only: Be careful not to damage the air hose or air nipple.	 xx1200001135
4	Make sure the o-ring is present.	 xx1200001070
5	Disconnect the motor cables.	 xx1200001066

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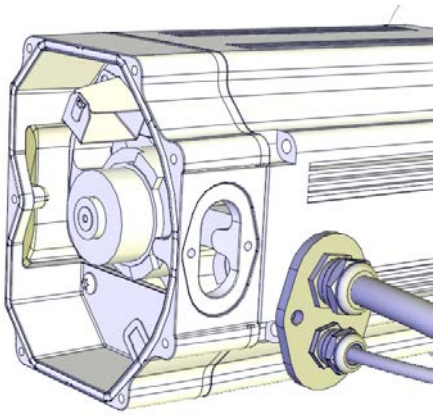
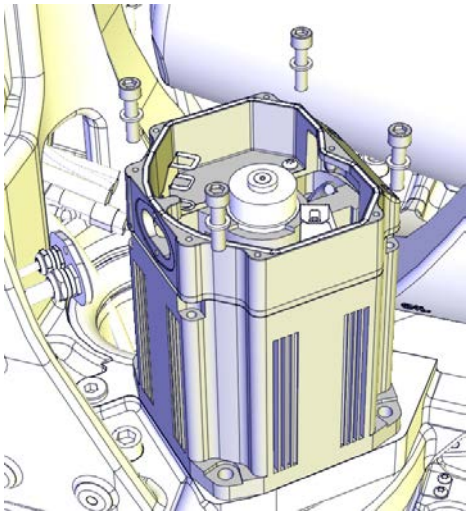
	Action	Note
6	Remove the cable gland cover. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable gland hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1200001067
7	Use caution and pull out the motor cables.	

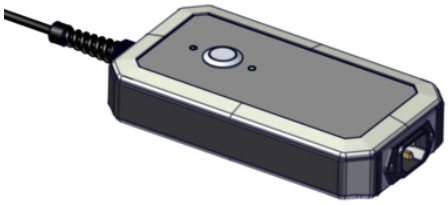
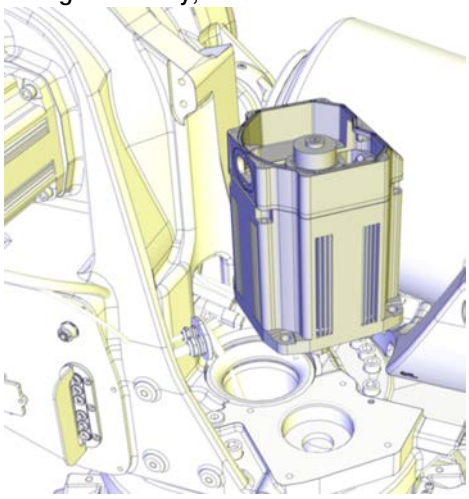
Removing the axis-1 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Unscrew the attachment screws and washers. Use a bits extender to reach the screws.	Bits extender: 3HAC12342-1  xx1200001071
3	Fit guide pins in opposite holes.	Guide pin, M12x150: 3HAC13056-2 Always use guide pins in pairs.
4	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

Continues on next page

4.7.1 Replacing the axis-1 motor

Continued

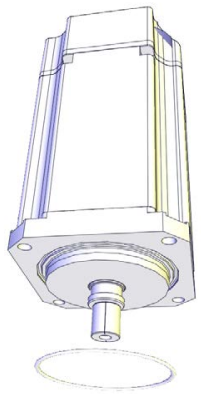
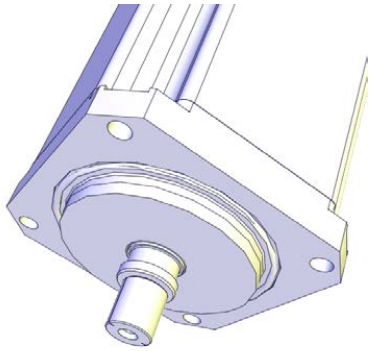
	Action	Note
5	If needed, use removal tools to help loosen the motor.	Removal tool motor M12: 3HAC14631-1 Used to push out the motor, if necessary. Always use removal tools in pairs.
6	**CAUTION** The weight of the motor is 25 kg All lifting accessories used must be sized accordingly.	
7	Attach the lifting accessories.	Lifting accessory (chain): 3HAC15556-1 Lifting accessory, motor: 3HAC14459-1.
8	Release the brakes of the axis-1 motor with the brake release tool. 1 Turn off the brake release tool. 2 Connect the tool to the R2.MP1 connector. 3 Release the brakes by turning on the brake release tool and pressing the brake release button on the tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Brake release tool: 3HAC081310-001 User instructions are enclosed with the tool.  xx2100000666
9	Use caution and lift the motor straight up to get the pinion parted from the gear.	Lifting accessory (chain): 3HAC15556-1 Lifting accessory, motor: 3HAC14459-1.  xx1200001072
10	Disconnect the brake release tool / 24 VDC power supply.	

Continues on next page

Refitting the axis-1 motor

These procedures describes how to refit the motor.

Preparations prior to refitting motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Remove any old paint residues or other contamination from the contact surfaces on both the motor and the mating parts. Wipe clean the contact surfaces and the o-ring groove.	
3	Fit a new o-ring.	 xx1200001019
4	Make sure the o-ring is seated in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	 xx1200001020

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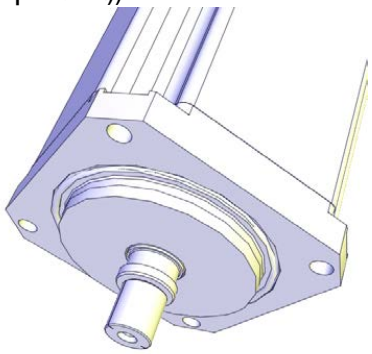
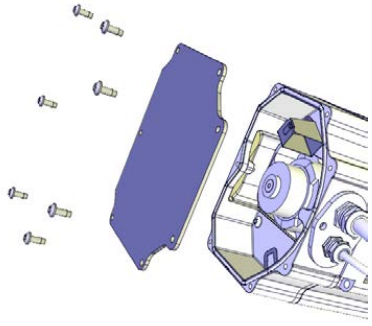
4.7.1 Replacing the axis-1 motor

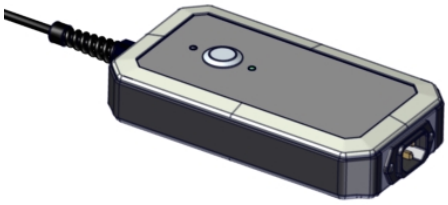
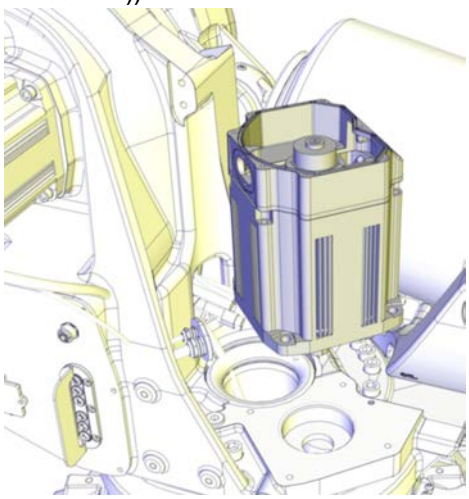
Continued

	Action	Note
5	Apply locking liquid with activator on the motor flange.	Activator (Loctite 7091). Flange sealant (Loctite 574 (or equivalent)).  xx1200001020
6	If the motor is a new spare part, remove the cover.	 xx1200001135

Securing the axis-1 motor

	Action	Note
1	Fit guide pins in opposite holes.	Guide pin, M12x150: 3HAC13056-2 Always use guide pins in pairs.
2	**CAUTION** The motor weighs 25 kg. All lifting accessories used must be sized accordingly.	
3	Apply the lifting accessory.	Lifting accessory, motor: 3HAC14459-1.
4	Fit the rotation tool.	Rotation tool: 3HAB7887-1

Continues on next page

	Action	Note
5	Release the brakes of the axis-1 motor with the brake release tool. 1 Turn off the brake release tool. 2 Connect the tool to the R2.MP1 connector. 3 Release the brakes by turning on the brake release tool and pressing the brake release button on the tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool. **Note** If a 24 VDC power supply is used instead of the brake release tool, connect it to connector R2.MP1: • pin 2 = 24V • pin 5 = 0V	Brake release tool: 3HAC081310-001 User instructions are enclosed with the tool.  xx2100000666
6	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
7	Lower the motor into position. • Make sure that the motor pinion is properly mated to the gear in the gearbox. • Make sure that the motor pinion does not get damaged. • Make sure that the direction of the cable gland exit is facing the correct way.	Lifting accessory (chain): 3HAC15556-1 Lifting accessory, motor: 3HAC14459-1. Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001072

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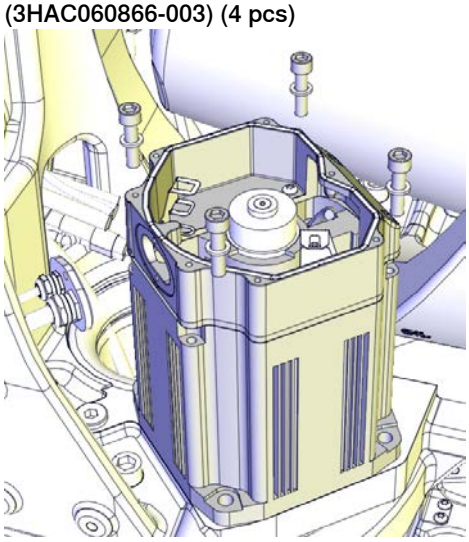
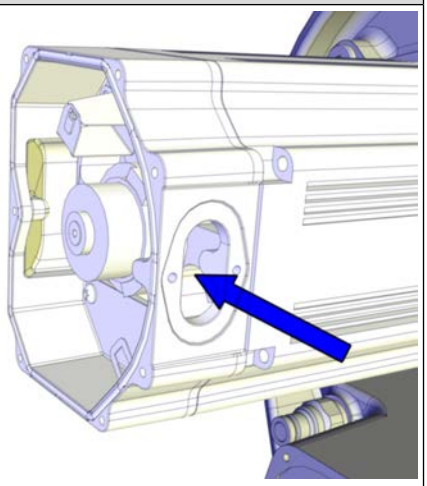
4.7.1 Replacing the axis-1 motor

Continued

	Action	Note
8	Secure the motor with its attachment screws and washers. Use a bits extender to reach the screws.	Bits extender: 3HAC12342-1 Tightening torque: 50 Nm. Screws: M10x30 stainless steel (3HAC060786-020) (4 pcs) Washers: 13x17x2 stainless steel (3HAC060866-003) (4 pcs)  xx1200001071
9	Perform a leak-down test (if not already done).	See *Performing a leak-down test on page 184*.
10	Disconnect the brake release tool / 24 VDC power supply.	

Connecting the motor cables

	Action	Note
1	Push the motor cables through the cable gland opening.	 xx1300000738

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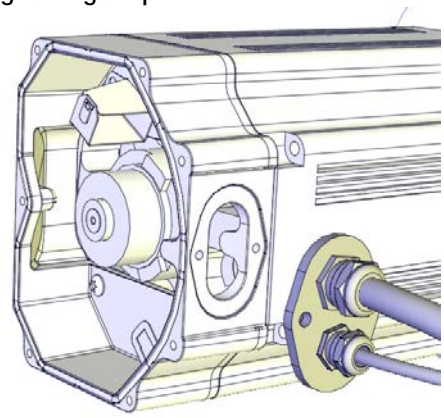
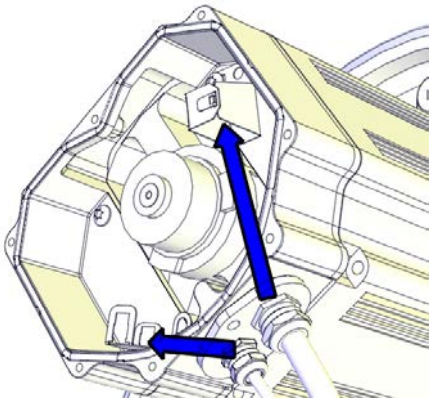
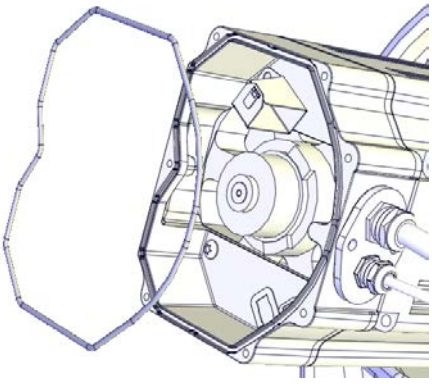
	Action	Note
2	Refit the cable gland cover. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001067
3	Connect the motor cables. Connect in accordance with the markings on the connectors.	 xx1200001066
4	Inspect the o-ring. **Note** Replace if damaged.	O-ring, axis-1: 3HAC067762-001 O-ring, axis-2: 3HAC067762-001 O-ring, axis-3: 3HAC067762-001 O-ring, axis-4: 3HAC067744-001  xx1200001070
5	Wipe clean o-ring and o-ring groove.	

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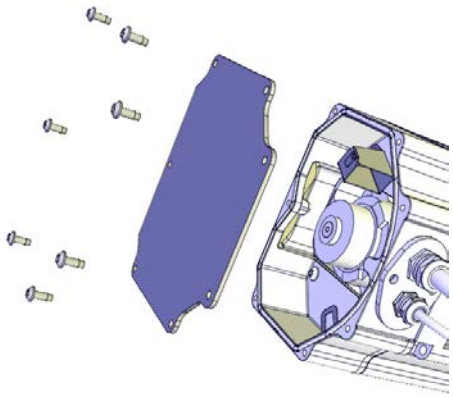
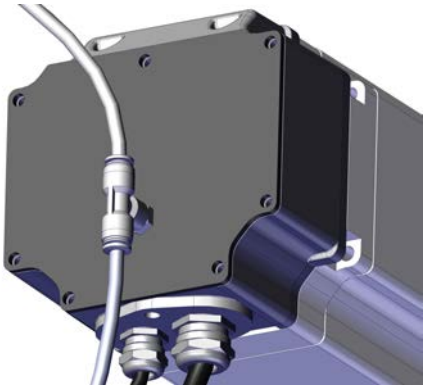
4.7.1 Replacing the axis-1 motor

Continued

	Action	Note
6	Refit the o-ring. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	
7	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
8	Refit the motor cover with it's attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Attachment screws: M5x12 Stainless steel A2-70 (7 pcs) (9ADA619-44) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001135
9	Make sure that the covers are tightly sealed.	
10	Connect air hose to air fitting on motor. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000568

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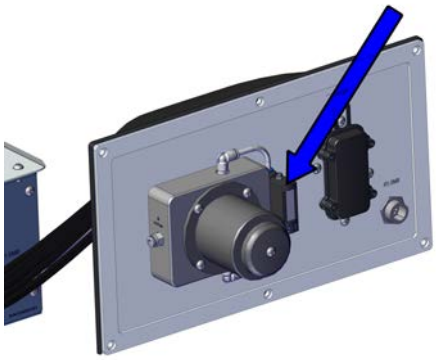
Concluding procedure

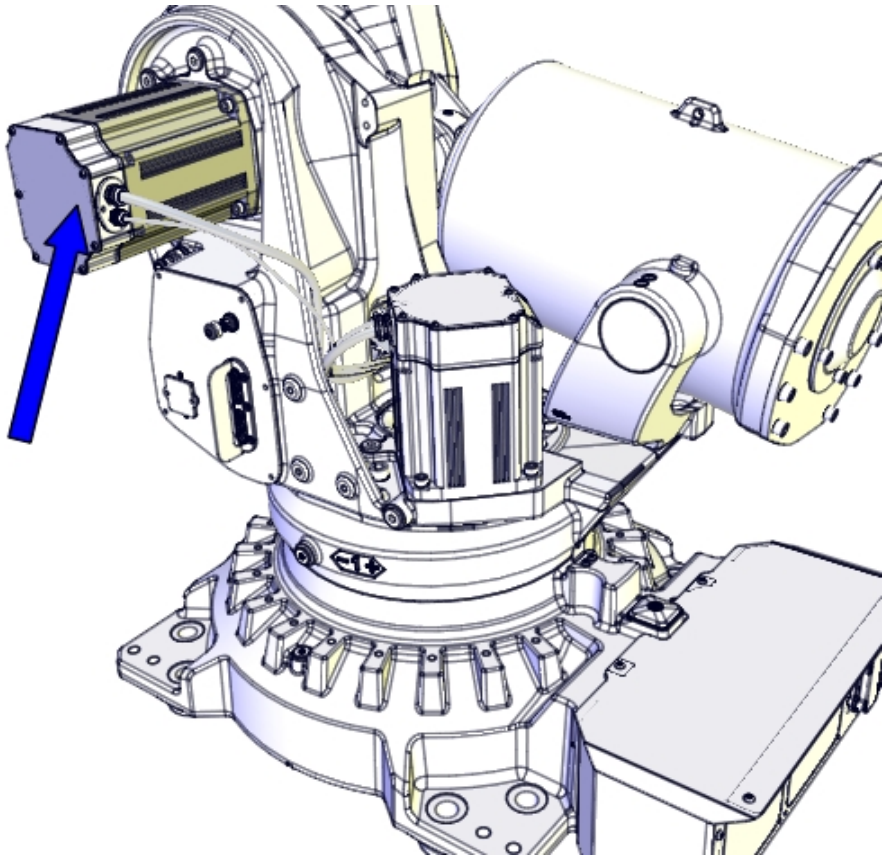
Use this procedure for the concluding refitting.

	Action	Note
1	Turn on the air pressure supply to the overpressure system.	
2	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
3	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.
4	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.7.2 Replacing the axis-2 motor

Location of the motor

The motor is located as shown in the figure.



xx1200001112

Summary of the replacement procedure

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

1. Drain the axis-2 gearbox
2. Attach the lifting tools
3. Replace the motor
4. Remove the lifting tools
5. Refill the axis-2 gearbox with oil.

Spare parts

Spare part	Spare part number	Note
Axis-2 motor	See *Product manual, spare parts - IRB 6790*	

Continues on next page

Consumables

Equipment, etc.	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.
O-ring	3HAC067762-001	D=169.5x3 Used on motor cover.
O-ring	3HAB3772-107	D=102x3 Used on motor flange.

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Motor, axis-2	M10x30 stainless steel 3HAC060786-020	13x17x2 stainless steel 3HAC060866-003	4 pcs
Motor cover	M5x12 Stainless steel A2-70 9ADA619-44	-	7 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Lifting accessory, motor	3HAC15534-1	Lifting instruction 3HAC15640-2 enclosed.
Roundsling, 1 m	-	Length: 1 m, lifting capacity: 1,000 kg.
Removal tool motor M12	3HAC14631-1	Used to push out the motor, if necessary. Always use removal tools in pairs.
Guide pin, M10x150	3HAC15521-2	Always use guide pins in pairs.
Bits extender	3HAC12342-1	300 mm, bits 1/2"
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
24 VDC power supply	-	Used to release the motor brakes.
Lock screw, M16x120	-	Used to secure lower arm.
Leak-down tester	-	
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Continues on next page

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 651*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

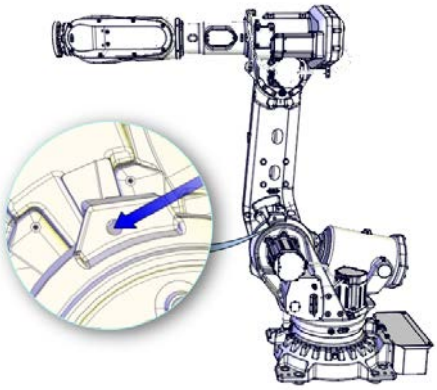
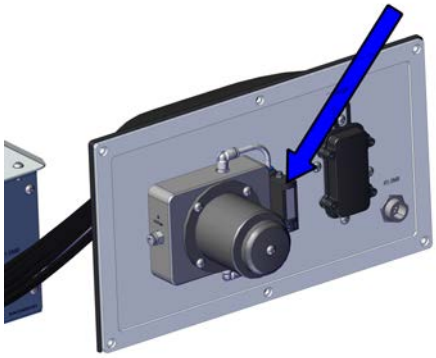
Removing the motor

These procedures describes how to remove the 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	Drain the oil from the gearbox.	See *Draining the axis-2 gearbox on page 151*.
3	Jog the robot to the calibration position.	
4	**DANGER** Secure the weight of the lower arm with a lock screw, before releasing the brakes on the axis-2 motor as well as before removing the axis-2 motor or the axis-2 gearbox.	

Continues on next page

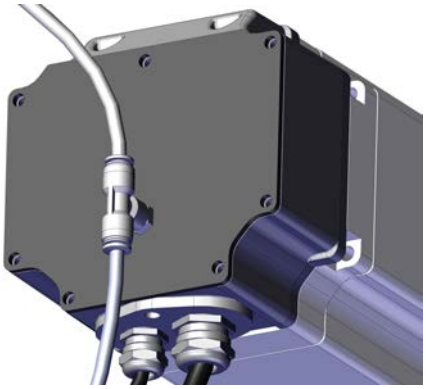
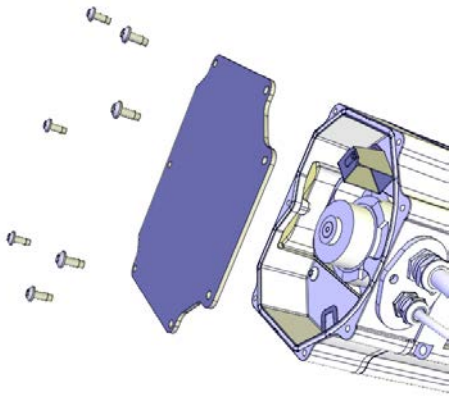
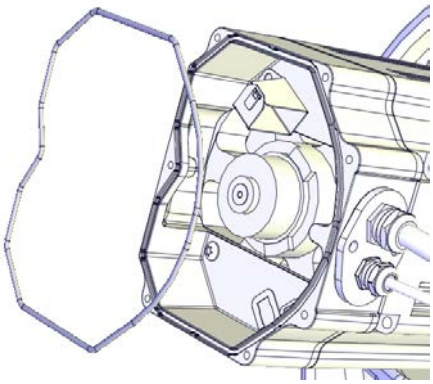
	Action	Note
5	Insert the lock screw into the frame. If needed, adjust the position of axis-2 to make it possible to insert the lock screw. The lock screw is used to secure the weight of the lower arm, in order to avoid accidents or damage. **Note** Tighten the lock screw manually, no tools needed.	Lock screw, M16x120  xx1200001116
6	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
7	Remove any equipment hindering access to the motor.	
8	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593
9	**CAUTION** Turn off the air pressure supply.	

Continues on next page

4.7.2 Replacing the axis-2 motor

Continued

Disconnecting the motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Disconnect air hose from air fitting on motor cover.	 xx2100000568
3	Unscrew the attachment screws and washers and remove the motor cover. **Note** Axis 3 and 4 motors only: Be careful not to damage the air hose or air nipple.	 xx1200001135
4	Make sure the o-ring is present.	 xx1200001070

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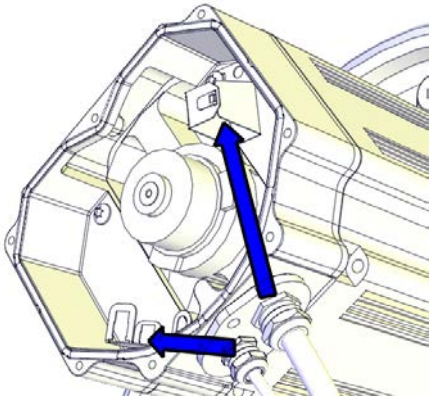
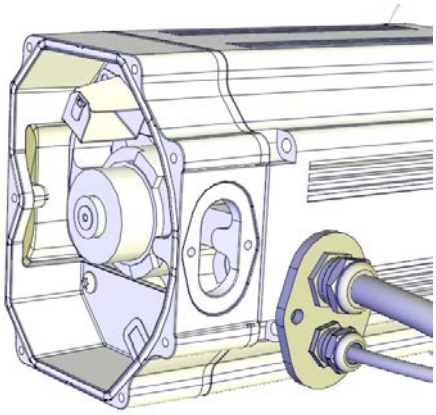
	Action	Note
5	Disconnect the motor cables.	 xx1200001066
6	Remove the cable gland cover. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable gland hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1200001067
7	Use caution and pull out the motor cables.	

Removing the axis-2 motor

	Action	Note
1	Before removing the motor, make sure that the axis-2 gearbox is completely drained.	
2	**DANGER** When releasing the holding brakes of the motor, the lower arm will be movable and may fall down if not secured. Verify that the lower arm is secured as previously described, before continuing.	
3	To release the brake, connect the 24 VDC power supply. Connect to connector R2.MP2, axis-2 motor: • + = pin 2 • - = pin 5	

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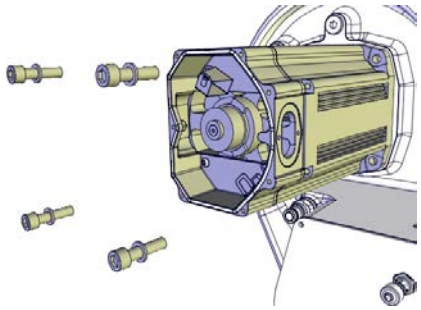
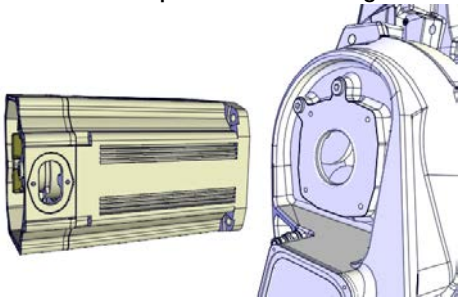
4.7.2 Replacing the axis-2 motor

Continued

	Action	Note
4	Remove the attachment screws. Use a bits extender in order to reach the screws.	Bits extender: 3HAC12342-1  xx1200001117
5	Fit guide pins in opposite holes. **Tip** Lubricate the guide pins with some grease to make the motor slide better.	Guide pin, M10x150: 3HAC15521-2 Always use guide pins in pairs.
6	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
7	If required, press the motor out of its position by using the removal tool in opposite holes of the motor.	Removal tool motor M12: 3HAC14631-1 Always use removal tools in pairs.
8	Disconnect the 24 VDC power supply.	
9	**CAUTION** The motor weighs 28 kg. All lifting accessories used must be sized accordingly.	
10	Carefully lift the motor out on the guide pins, in order to get the pinion away from the gear and let it rest on the guide pins.	
11	Fasten the lifting accessory. Attach the lifting chain to the accessory and an overhead crane.	Lifting accessory, motor: 3HAC15534-1 Lifting accessory (chain): 3HAC15556-1
12	Remove the motor by sliding it out on the guide pins and lift it off.	Make sure the pinion is not damaged.  xx1200001118

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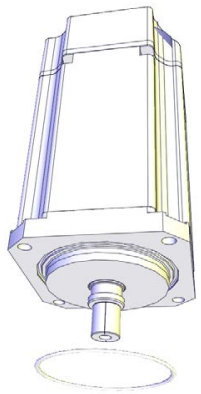
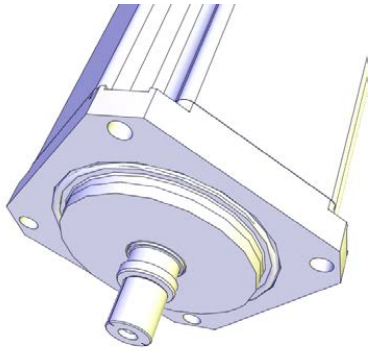
Refitting the motor

These procedures describes how to refit the motor.

Preparations prior to refitting motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Remove any old paint residues or other contamination from the contact surfaces on both the motor and the mating parts. Wipe clean the contact surfaces and the o-ring groove.	
3	Fit a new o-ring.	 xx1200001019
4	Make sure the o-ring is seated in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	 xx1200001020

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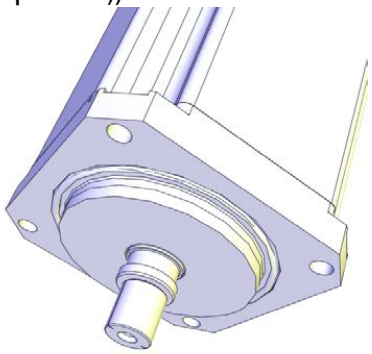
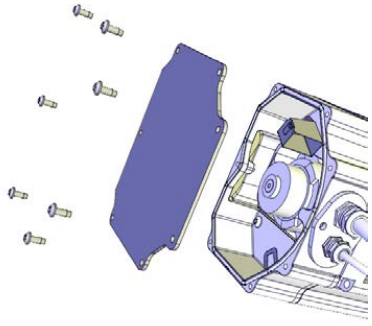
4.7.2 Replacing the axis-2 motor

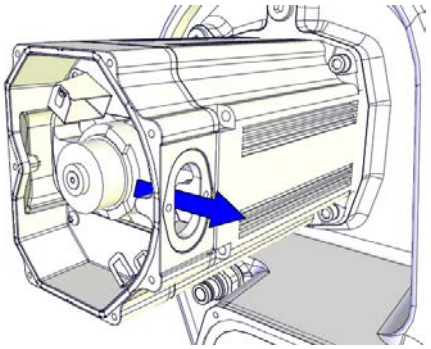
Continued

	Action	Note
5	Apply locking liquid with activator on the motor flange.	Activator (Loctite 7091). Flange sealant (Loctite 574 (or equivalent)).  xx1200001020
6	If the motor is a new spare part, remove the cover.	 xx1200001135

Securing the axis-2 motor

	Action	Note
1	Fit guide pins in opposite holes.	Guide pin, M10x150: 3HAC15521-2 Always use guide pins in pairs.
2	**CAUTION** The motor weighs 28 kg. All lifting accessories used must be sized accordingly.	
3	Apply the lifting accessory.	Lifting accessory, motor: 3HAC15534-1 Lifting accessory (chain): 3HAC15556-1

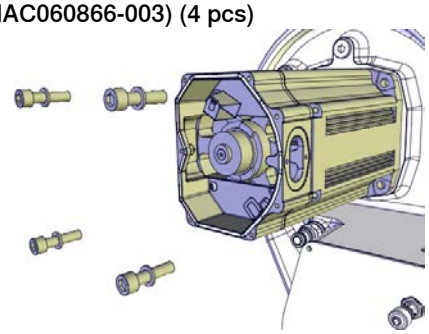
Continues on next page

	Action	Note
4	**Note** Make sure the cable gland opening is turned the correct way.	 xx1200001120
5	Lift the motor and put it on the guide pins as close as possible to its final position without pushing the motor pinion into the gear.	
6	Remove the lifting accessory and allow the motor to rest on the guide pins.	
7	Apply the rotation tool and use it to rotate the pinion when mating it into the gear.	Rotation tool: 3HAB7887-1
8	To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP2, axis-2 motor: • + = pin 2 • - = pin 5	
9	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
10	Use caution and fit the motor in its final position while at the same time rotating the motor pinion slightly using the rotation tool. • Make sure that the motor pinion is properly mated to the gear of the gearbox. • Make sure that the motor pinion does not get damaged. • Make sure that the direction of the cable exit is facing the correct way.	
11	Fit two of the attachment screws and washers.	Screws: M10x30 stainless steel (3HAC060786-020) Washers: 13x17x2 stainless steel (3HAC060866-003)
12	Remove the guide pins and replace with the remaining attachment screws.	

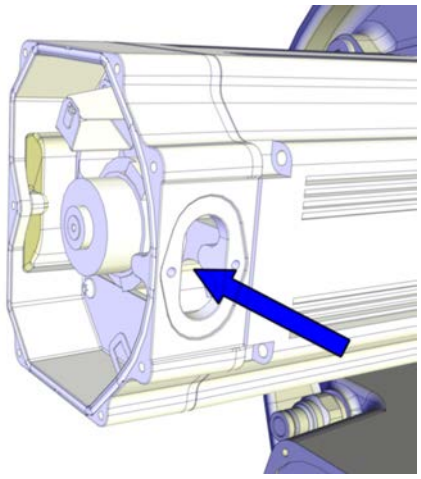
Continues on next page

4.7.2 Replacing the axis-2 motor

Continued

	Action	Note
13	Secure the motor with its attachment screws and washers. Use a bits extender in order to reach the screws.	Bits extender: 3HAC12342-1 Tightening torque: 50 Nm. Screw dimension: M10x30 stainless steel (3HAC060786-020) (4 pcs) Washers: 13x17x2 stainless steel (3HAC060866-003) (4 pcs)  xx1200001117
14	Perform a leak-down test.	See *Performing a leak-down test on page 184*.

Connecting the motor cables

	Action	Note
1	Push the motor cables through the cable gland opening.	 xx1300000738

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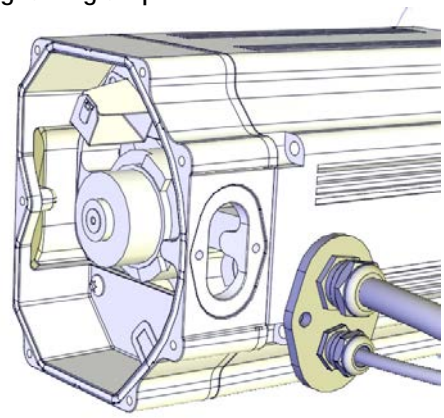
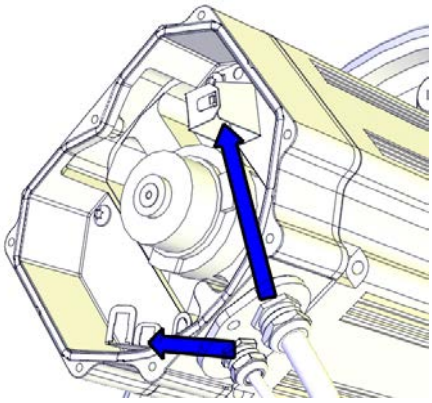
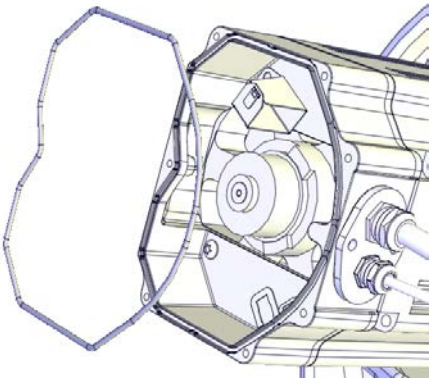
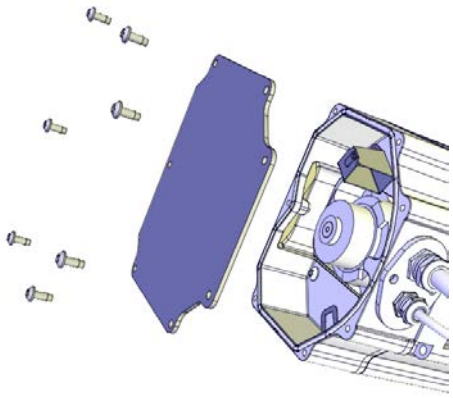
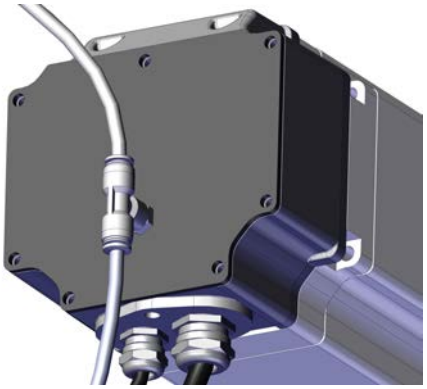
	Action	Note
2	Refit the cable gland cover. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001067
3	Connect the motor cables. Connect in accordance with the markings on the connectors.	 xx1200001066
4	Inspect the o-ring. **Note** Replace if damaged.	O-ring, axis-1: 3HAC067762-001 O-ring, axis-2: 3HAC067762-001 O-ring, axis-3: 3HAC067762-001 O-ring, axis-4: 3HAC067744-001  xx1200001070
5	Wipe clean o-ring and o-ring groove.	

Continues on next page

4.7.2 Replacing the axis-2 motor

Continued

	Action	Note
6	Refit the o-ring. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	
7	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
8	Refit the motor cover with it's attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Attachment screws: M5x12 Stainless steel A2-70 (7 pcs) (9ADA619-44) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001135
9	Make sure that the covers are tightly sealed.	
10	Connect air hose to air fitting on motor. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000568

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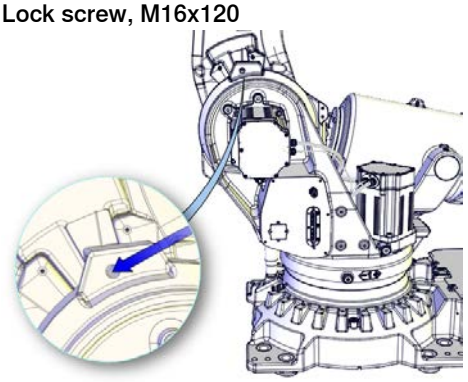
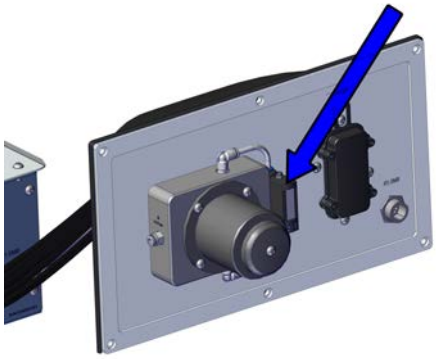
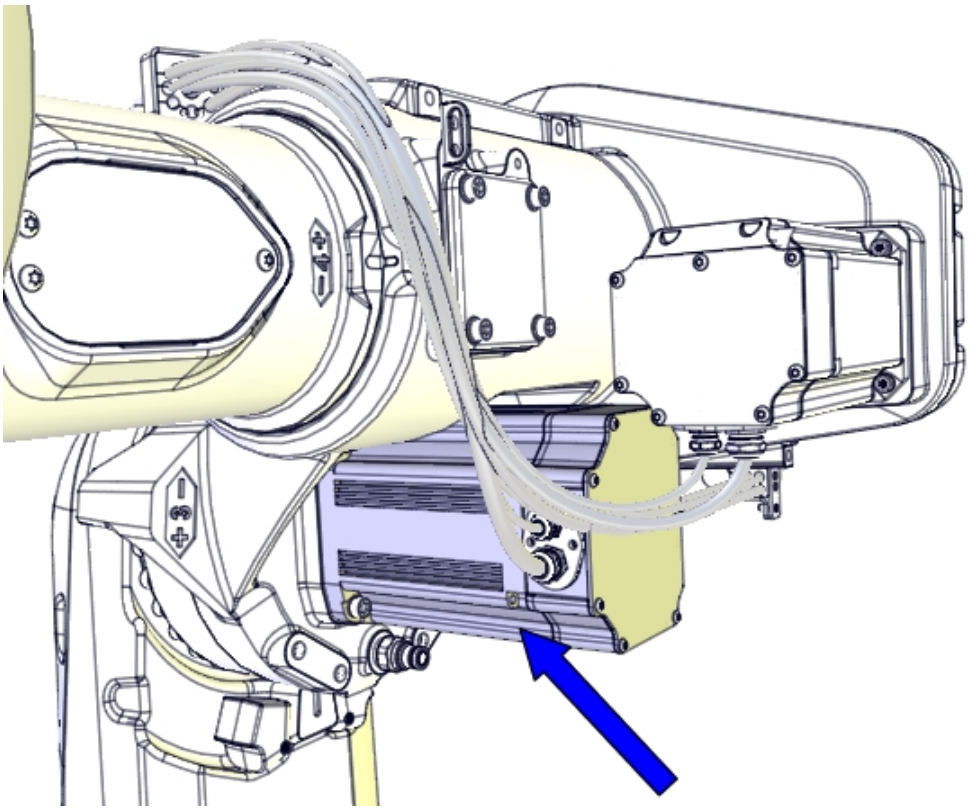
Concluding procedure

	Action	Note
1	Use caution and jog axis-2 a little to facilitate the removal of the lock screw.	
2	Remove the lock screw securing the lower arm.	Lock screw, M16x120  xx1200001115
3	Refill the gearbox with oil.	See *Filling oil into the axis-2 gearbox on page 152*.
4	Turn on the air pressure supply to the overpressure system.	
5	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
6	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.
7	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.7.3 Replacing the axis-3 motor

Location of the axis-3 motor

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



xx1200001113

Spare part

Spare part	Spare part number	Note
Axis-3 motor	See *Product manual, spare parts - IRB 6790*	

Consumables

Equipment, etc.	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.
O-ring	3HAC067762-001	D=169.5x3 Used on motor cover.
O-ring	3HAB3772-107	D=102x3 Used on motor flange.

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Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Motor, axis-3	M10x30 stainless steel 3HAC060786-020	13x17x2 stainless steel 3HAC060866-003	4 pcs
Motor cover	M5x12 Stainless steel A2-70 9ADA619-44	-	7 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.
Lifting accessory, motor	3HAC15534-1	Lifting instruction 3HAC15640-2 enclosed.
Roundsling, 1 m	-	Length: 1 m, lifting capacity: 1,000 kg.
Removal tool motor M12	3HAC14631-1	Used to push out the motor, if necessary. Always use removal tools in pairs.
Guide pin, M10x150	3HAC15521-2	Always use guide pins in pairs.
Bits extender	3HAC12342-1	300 mm, bits 1/2"
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
24 VDC power supply	-	Used to release the motor brakes.
Leak-down tester	-	
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

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.	

Continues on next page

4.7.3 Replacing the axis-3 motor
Continued

	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 651*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the motor

These procedures describes how to remove the motor.

Preparations before removing the axis-3 motor

Use this procedure to do the necessary preparations before removing the motor.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Drain the axis-3 gearbox.	See *Draining the axis-3 gearbox on page 156*.
3	Unload the upper arm using one of these methods: • Use caution and jog axis-3 to maximum + position. Release the brakes and let the upper arm rest against the axis-3 damper. • Use a fork lift to rest the upper arm onto. • Use lifting slings and an overhead crane to rest the upper arm onto.	
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
5	Remove any equipment hindering access to the motor.	

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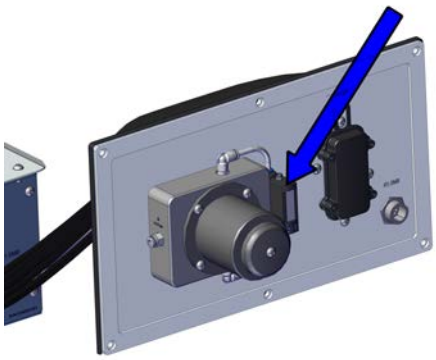
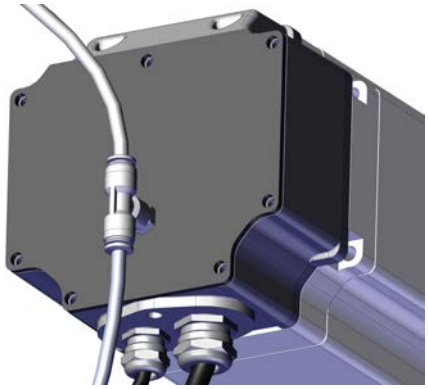
	Action	Note
6	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593
7	Disconnect the air hose from the nipple on the connection box.	
8	**CAUTION** Turn off the air pressure supply.	

Disconnecting the motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Disconnect air hose from air fitting on motor cover.	 xx2100000568

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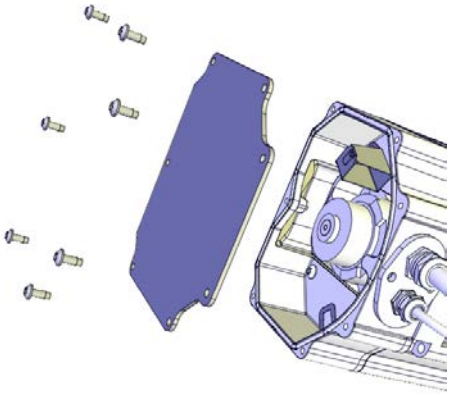
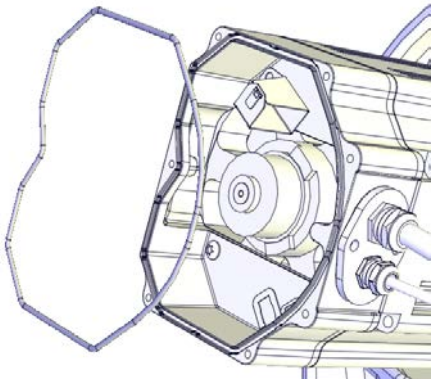
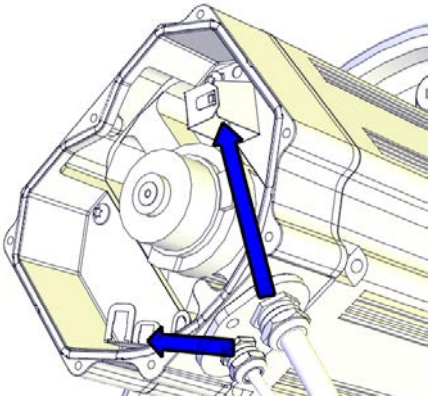
4.7.3 Replacing the axis-3 motor

Continued

	Action	Note
3	Unscrew the attachment screws and washers and remove the motor cover. **Note** Axis 3 and 4 motors only: Be careful not to damage the air hose or air nipple.	 xx1200001135
4	Make sure the o-ring is present.	 xx1200001070
5	Disconnect the motor cables.	 xx1200001066

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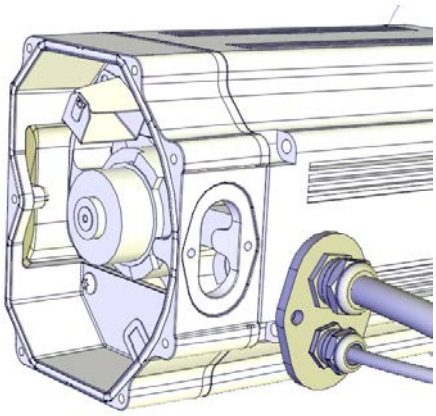
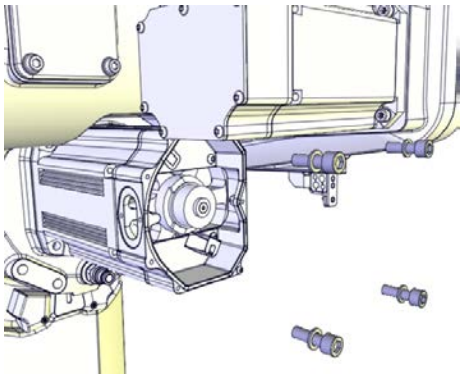
	Action	Note
6	Remove the cable gland cover. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable gland hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1200001067
7	Use caution and pull out the motor cables.	

Removing the axis-3 motor

	Action	Note
1	Before removing the motor, make sure that the axis-3 gearbox is completely drained.	
2	**DANGER** When releasing the holding brakes of the motor, the upper arm will be movable and may fall down if not secured. Verify that the upper arm is secured as previously described, before continuing.	
3	To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP3: • + = pin 2 • - = pin 5	
4	Unscrew the attachment screws that hold the motor. Use a bits extender to reach the screws.	Bits extender: 3HAC12342-1  xx1200001126

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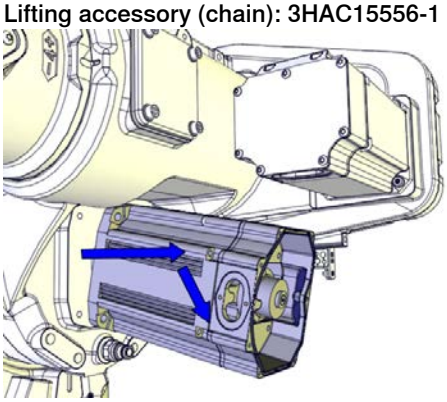
4.7.3 Replacing the axis-3 motor

Continued

	Action	Note
5	Fit guide pins in opposite holes. **Tip** Lubricate the guide pins with some grease to make the motor slide better.	Guide pin, M10x150: 3HAC15521-2 Always use guide pins in pairs.
6	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
7	If required, press the motor out of position by using the removal tool in the remaining holes for the motor.	Removal tool motor M12: 3HAC14631-1 Always use removal tools in pairs.
8	Use caution and lift the motor out on the guide pins, in order to get the pinion away from the gear, and let the motor rest on the guide pins.	
9	**CAUTION** The motor weighs 26 kg. All lifting accessories used must be sized accordingly.	
10	Fasten the lifting accessory to the motor. Attach the lifting chain to the accessory and an overhead crane.	Lifting accessory, motor: 3HAC15534-1 Lifting accessory (chain): 3HAC15556-1
11	When the motor is hanging in the lifting accessory, and the pinion no longer is mated to the gear, let the outer end of the motor hang lower so that it will hang in an angle. This position makes it easier to remove the axis-3 motor with the axis-4 motor still fitted. **CAUTION** The pinion must have been parted from the gear before the motor is angled. If not there is a risk of damaging the pinion and gear.	 xx1200001125
12	Disconnect the 24 VDC power supply.	

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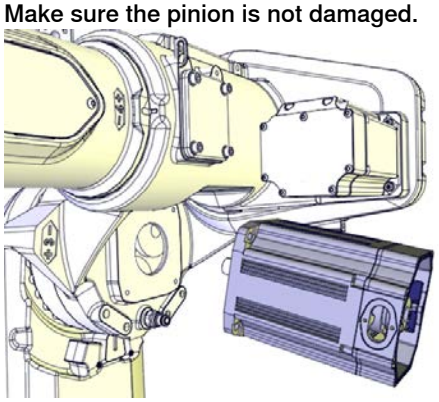
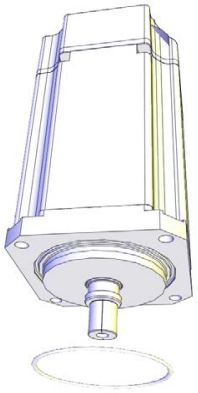
	Action	Note
13	Remove the motor by lifting it straight out.	Make sure the pinion is not damaged.  xx1200001131

Refitting the motor

These procedures describes how to refit the motor.

Preparations prior to refitting motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Remove any old paint residues or other contamination from the contact surfaces on both the motor and the mating parts. Wipe clean the contact surfaces and the o-ring groove.	
3	Fit a new o-ring.	 xx1200001019

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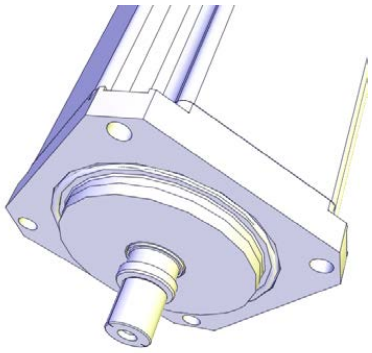
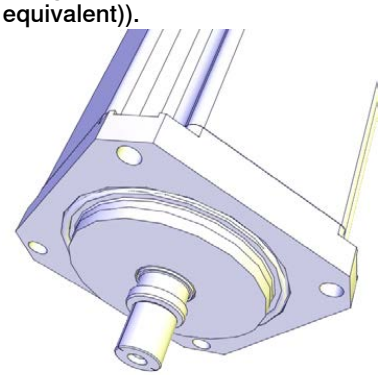
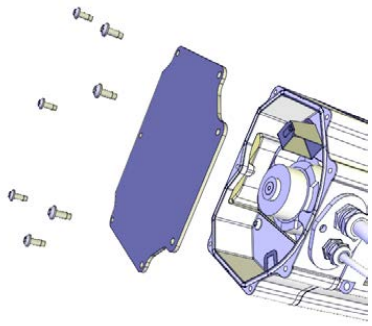
4.7.3 Replacing the axis-3 motor

Continued

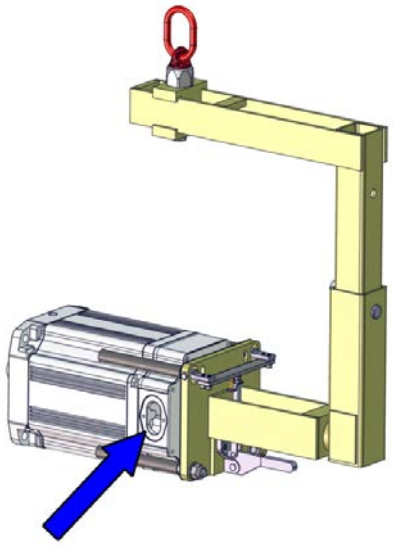
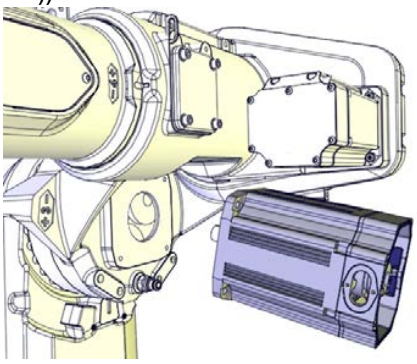
	Action	Note
4	Make sure the o-ring is seated in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	 xx1200001020
5	Apply locking liquid with activator on the motor flange.	Activator (Loctite 7091). Flange sealant (Loctite 574 (or equivalent)).  xx1200001020
6	If the motor is a new spare part, remove the cover.	 xx1200001135

Securing the axis-3 motor

Use this procedure to secure the motor.

	Action	Note
1	Fit guide pins in opposite holes.	Guide pin, M10x150: 3HAC15521-2 Always use guide pins in pairs.

Continues on next page

	Action	Note
2	**CAUTION** The motor weighs 26 kg. All lifting accessories used must be sized accordingly.	
3	Apply the lifting accessories to the motor. **Note** Make sure the cable gland exit is turned according to figure.	Lifting accessory, motor: 3HAC15534-1  xx1700000273
4	Lift the motor on to the guide pins and let it hang with the outer end a little lower when resting on the guide pins. Do not push the motor pinion into the gear yet. This is done in order to fit the motor with the axis-4 motor still fitted.	Activator (Loctite 7091). Flange sealant (Loctite 574 (or equivalent)).  xx1200001131
5	Remove the lifting accessory and allow the motor to rest on the guide pins.	
6	Apply the rotation tool and use it to rotate the pinion when mating it into the gear.	Rotation tool: 3HAB7887-1
7	To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP3: • + = pin 2 • - = pin 5	

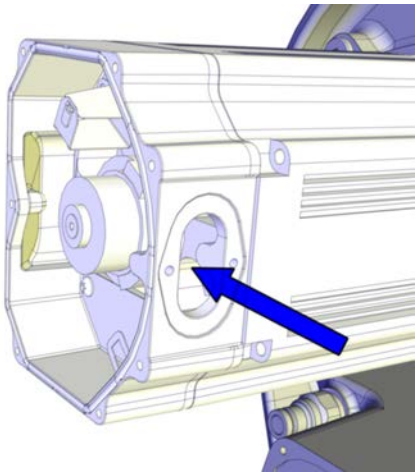
Continues on next page

4.7.3 Replacing the axis-3 motor

Continued

	Action	Note
8	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
9	Use caution and push the motor in position while at the same time the motor pinion is slightly rotated. Pay attention to following points: • Mate the motor pinion properly to the gear of the gearbox. • Do not damage the motor pinion.	
10	Fit two of the attachment screws and washers.	Screws: M10x30 stainless steel (3HAC060786-020) Washers: 13x17x2 stainless steel (3HAC060866-003)
11	Remove the guide pins.	
12	Fit the remaining attachment screws and washers.	Screws: M10x30 stainless steel (3HAC060786-020) Washers: 13x17x2 stainless steel (3HAC060866-003)
13	Tighten the screws.	Tightening torque: 50 Nm
14	Remove the rotation tool.	
15	Perform a leak-down test.	See *Performing a leak-down test on page 184*.
16	Disconnect the 24 VDC power supply.	

Connecting the motor cables

	Action	Note
1	Push the motor cables through the cable gland opening.	 xx1300000738

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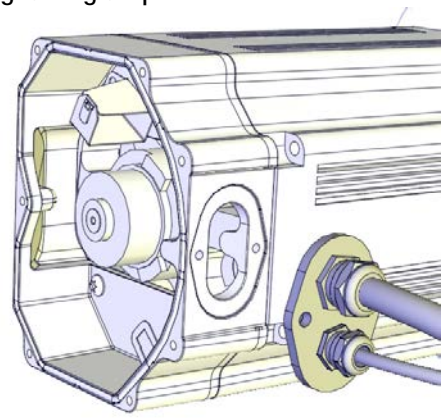
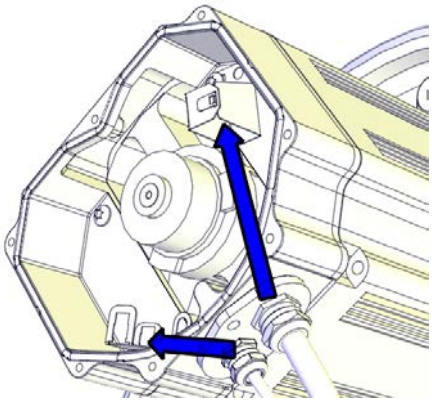
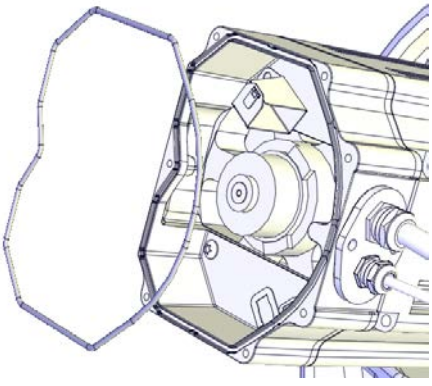
	Action	Note
2	Refit the cable gland cover. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001067
3	Connect the motor cables. Connect in accordance with the markings on the connectors.	 xx1200001066
4	Inspect the o-ring. **Note** Replace if damaged.	O-ring, axis-1: 3HAC067762-001 O-ring, axis-2: 3HAC067762-001 O-ring, axis-3: 3HAC067762-001 O-ring, axis-4: 3HAC067744-001  xx1200001070
5	Wipe clean o-ring and o-ring groove.	

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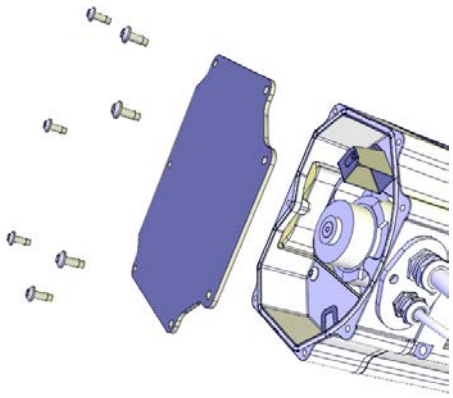
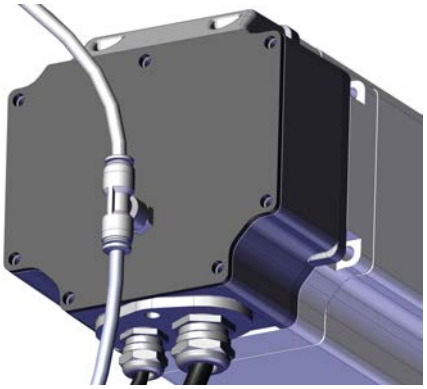
4.7.3 Replacing the axis-3 motor

Continued

	Action	Note
6	Refit the o-ring. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	
7	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
8	Refit the motor cover with it's attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Attachment screws: M5x12 Stainless steel A2-70 (7 pcs) (9ADA619-44) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001135
9	Make sure that the covers are tightly sealed.	
10	Connect air hose to air fitting on motor. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000568

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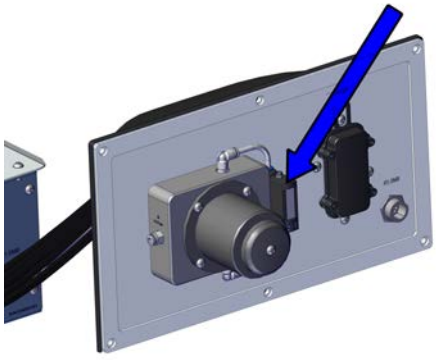
Concluding procedure

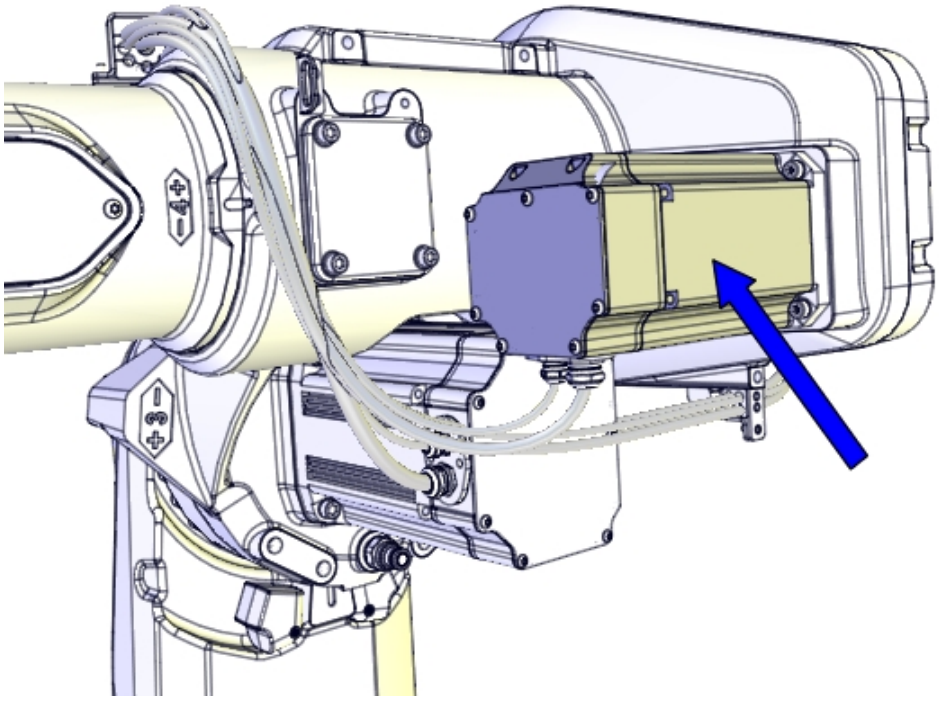
Use this procedure for the concluding refitting.

	Action	Note
1	Remove the equipment used to unload the upper arm.	
2	Refill the gearbox with oil.	See *Filling oil into the axis-3 gearbox on page 157*.
3	Connect the air hose to the nipple on the connection box.	
4	Turn on the air pressure supply to the overpressure system.	
5	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
6	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.
7	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.7.4 Replacing the axis-4 motor

Location of the axis-4 motor

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



xx1200001114

Spare parts

Spare part	Spare part number	Note
Axis-4 motor	See *Product manual, spare parts - IRB 6790*	

Consumables

Equipment, etc.	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.
O-ring	3HAC067744-001	D=119x3 Used on motor cover.
O-ring	3HAB3772-107	D=102x3 Used on motor flange.

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Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Motor, axis-4	M8x30 stainless steel 3HAC060786-011	8.4x16x1.6 stainless steel 3HAC060866-002	4 pcs
Motor cover	M5x12 Stainless steel A2-70 9ADA619-44	-	7 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Removal tool motor M12	3HAC14631-1	Used to push out the motor, if necessary. Always use removal tools in pairs.
Guide pin, M8x150	3HAC15520-2	Always use guide pins in pairs.
Long AllenKeySocketIN19L 6-140	-	Length: 140 mm.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
24 VDC power supply	-	Used to release the motor brakes.
Leak-down tester	-	
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

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.	

Continues on next page

4.7.4 Replacing the axis-4 motor
Continued

	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 651*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

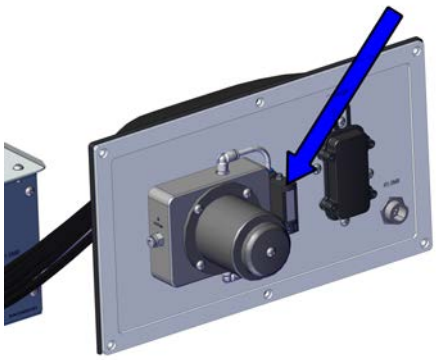
Removing the motor

These procedures describes how to remove the motor.

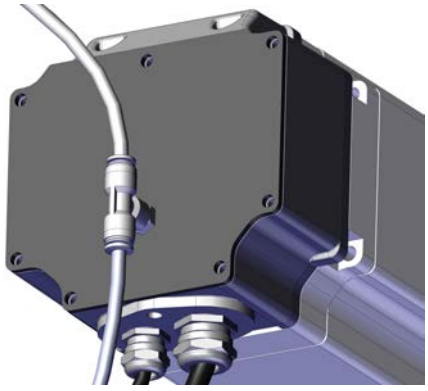
Preparations before removing the axis-4 motor

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Jog the robot into position: • axis 1 = no significance. • axis 2 = -65° • axis 3 = upper arm pointing straight up (if possible). With the robot in this position, there is no need to drain oil from the axis-4 gearbox when the motor is replaced.	
3	If there is no space to position the upper arm pointed straight up, drain the axis-4 gearbox.	
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	

Continues on next page

	Action	Note
5	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593
6	Disconnect the air hose from the nipple on the connection box.	
7	**CAUTION** Turn off the air pressure supply.	

Disconnecting the motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Disconnect air hose from air fitting on motor cover.	 xx2100000568

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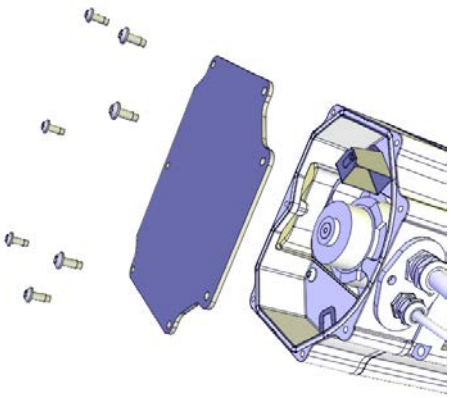
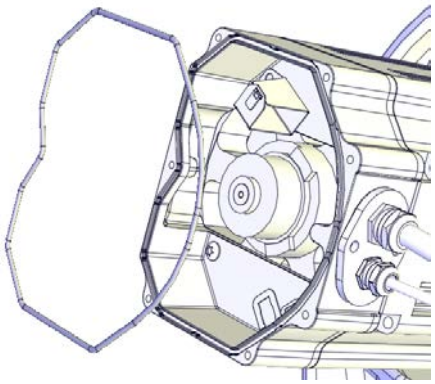
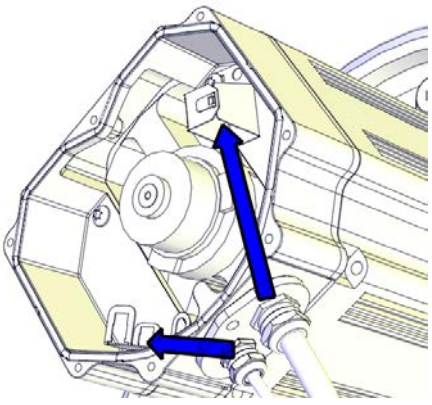
4.7.4 Replacing the axis-4 motor

Continued

	Action	Note
3	Unscrew the attachment screws and washers and remove the motor cover. **Note** Axis 3 and 4 motors only: Be careful not to damage the air hose or air nipple.	 xx1200001135
4	Make sure the o-ring is present.	 xx1200001070
5	Disconnect the motor cables.	 xx1200001066

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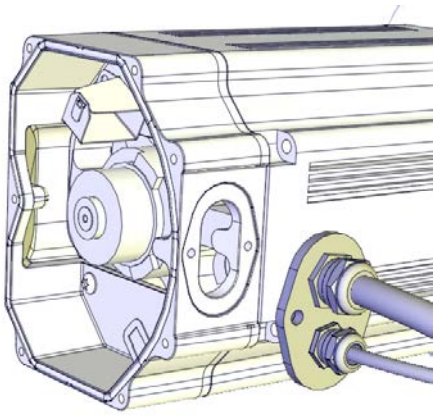
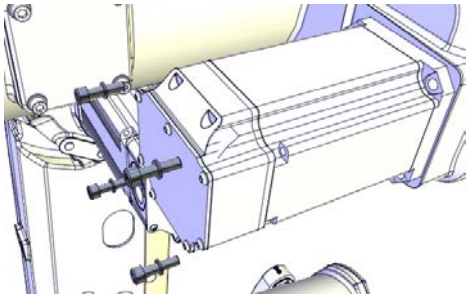
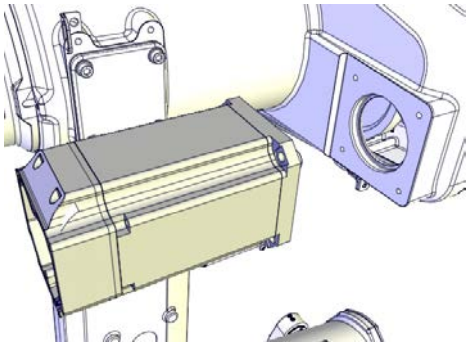
	Action	Note
6	Remove the cable gland cover. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable gland hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1200001067
7	Use caution and pull out the motor cables.	

Removing the axis-4 motor

	Action	Note
1	**CAUTION** Use caution when releasing the brakes! Axis-4 can move unexpectedly!	
2	To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP4: • + = pin 2 • - = pin 5	
3	Unscrew the attachment screws that secure the motor.	 xx1200001137
4	Apply two guide pins in opposite holes.	Guide pin, M8x150: 3HAC15520-2 Always use guide pins in pairs.
5	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
6	Press the motor out of position by fitting the removal tool in the remaining attachment holes for the motor.	Removal tool motor M12: 3HAC14631-1 Always use removal tools in pairs.

Continues on next page

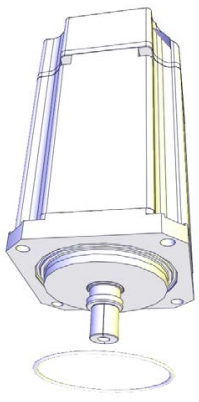
4.7.4 Replacing the axis-4 motor
Continued

	Action	Note
7	**CAUTION** The motor weighs 13 kg. All lifting accessories used must be sized accordingly.	
8	Disconnect the 24 VDC power supply.	
9	Remove the motor by carefully lifting it straight out/straight up (if the upper arm points upwards). Make sure the pinion is not damaged.	 xx1200001138

Refitting the motor

These procedures describes how to refit the motor.

Preparations prior to refitting motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Remove any old paint residues or other contamination from the contact surfaces on both the motor and the mating parts. Wipe clean the contact surfaces and the o-ring groove.	
3	Fit a new o-ring.	 xx1200001019

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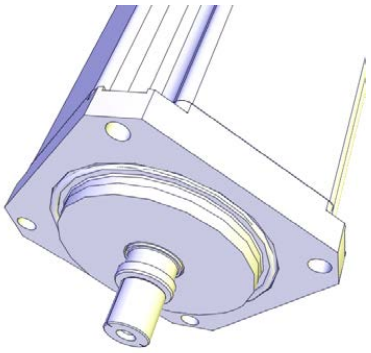
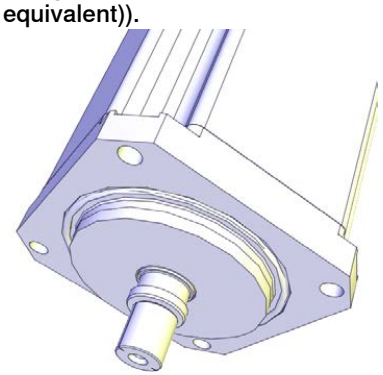
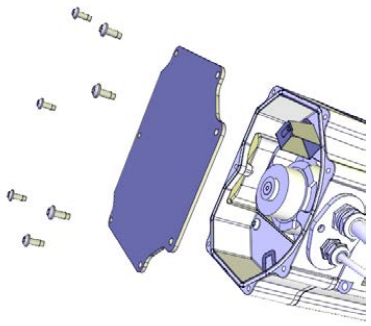
	Action	Note
4	Make sure the o-ring is seated in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	 xx1200001020
5	Apply locking liquid with activator on the motor flange.	Activator (Loctite 7091). Flange sealant (Loctite 574 (or equivalent)).  xx1200001020
6	If the motor is a new spare part, remove the cover.	 xx1200001135

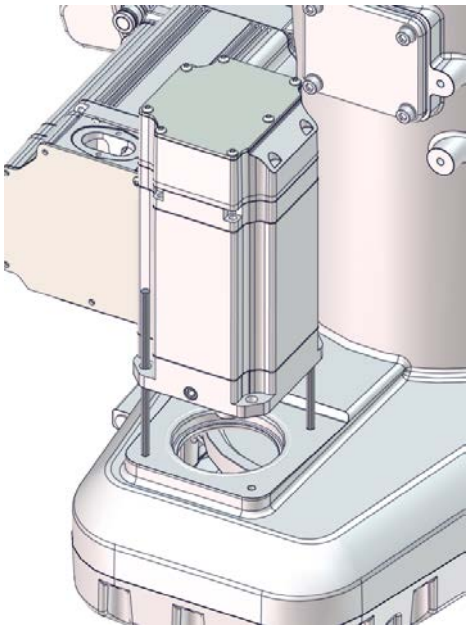
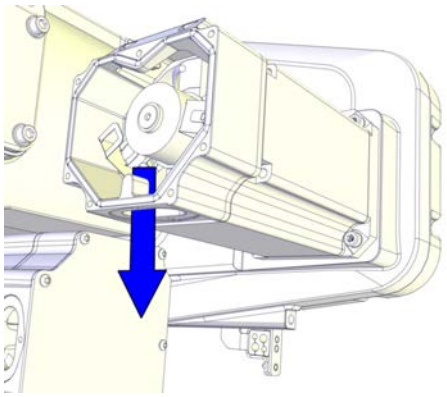
Securing the axis-4 motor

	Action	Note
1	Apply two guide pins in opposite holes.	Guide pin, M8x150: 3HAC15520-2 Always use guide pins in pairs.

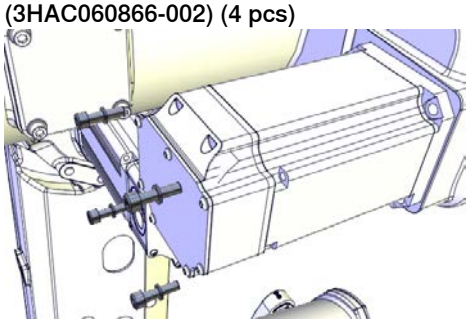
Continues on next page

4.7.4 Replacing the axis-4 motor

Continued

	Action	Note
2	Put the motor onto the guide pins.	 xx1700000291
3	**Note** Make sure the cable gland opening is turned the correct way.	 xx1200001130
4	**CAUTION** The motor weighs 13 kg. All lifting accessories used must be sized accordingly.	
5	Apply the rotation tool and use it to rotate the pinion when mating it into the gear. This requires two persons co-operating, if the motor is installed from above (if the upper arm is pointing upwards).	Rotation tool: 3HAB7887-1
6	To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP2: • + = pin 2 • - = pin 5	

Continues on next page

	Action	Note
7	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
8	Push the motor carefully in position while at the same time rotating the motor pinion slightly. • Make sure that the motor pinion is properly mated to the gear of the gearbox. • Make sure that the motor pinion does not get damaged. • Make sure that the direction of the cable gland is facing the correct way.	
9	Remove the guide pins.	
10	Secure the motor with its attachment screws and washers.	Tightening torque: 30 Nm. Screws: M8x30 stainless steel (3HAC060786-011) (4 pcs) Washers: 8.4x16x1.6 stainless steel (3HAC060866-002) (4 pcs)  xx1200001137
11	Perform a leak-down test.	See *Performing a leak-down test on page 184*.
12	Disconnect the 24 VDC power supply.	

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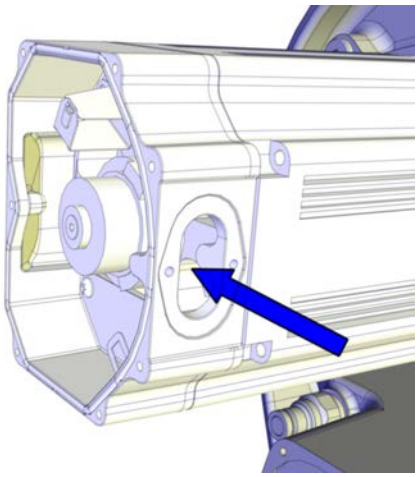
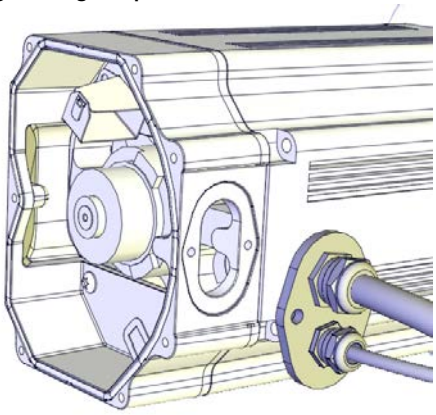
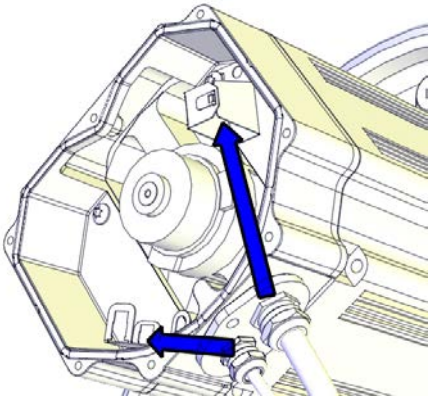
4.7.4 Replacing the axis-4 motor

Continued

Connecting the motor cables

	Action	Note
1	Push the motor cables through the cable gland opening.	 xx1300000738
2	Refit the cable gland cover. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001067
3	Connect the motor cables. Connect in accordance with the markings on the connectors.	 xx1200001066

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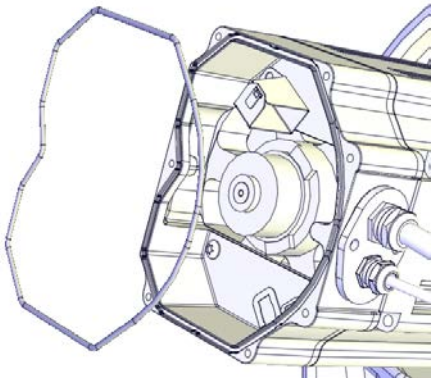
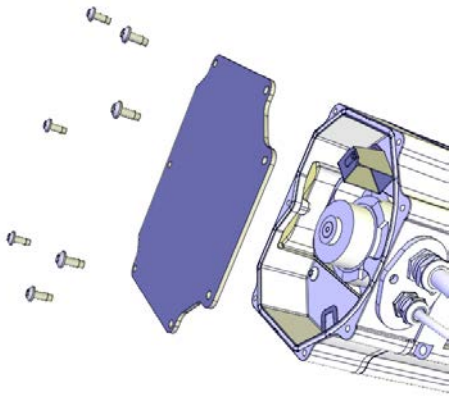
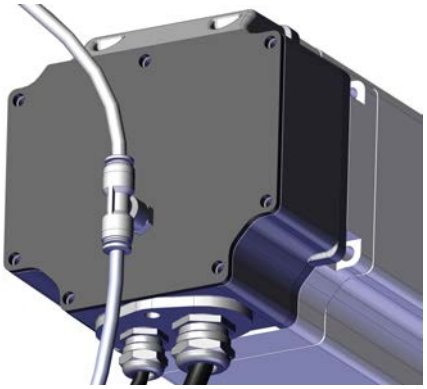
	Action	Note
4	Inspect the o-ring. **Note** Replace if damaged.	O-ring, axis-1: 3HAC067762-001 O-ring, axis-2: 3HAC067762-001 O-ring, axis-3: 3HAC067762-001 O-ring, axis-4: 3HAC067744-001  xx1200001070
5	Wipe clean o-ring and o-ring groove.	
6	Refit the o-ring. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	
7	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	

Continues on next page

4.7.4 Replacing the axis-4 motor

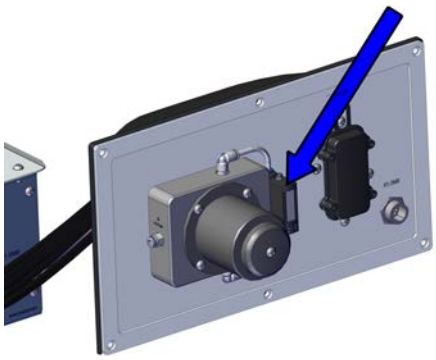
Continued

	Action	Note
8	Refit the motor cover with it's attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Attachment screws: M5x12 Stainless steel A2-70 (7 pcs) (9ADA619-44) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001135
9	Make sure that the covers are tightly sealed.	
10	Connect air hose to air fitting on motor. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000568

Concluding procedure

	Action	Note
1	Refill the gearbox with oil, if gearbox has been drained.	See *Filling oil into the axis-4 gearbox on page 162*.
2	Connect the air hose to the nipple on the connection box.	
3	Turn on the air pressure supply to the overpressure system.	

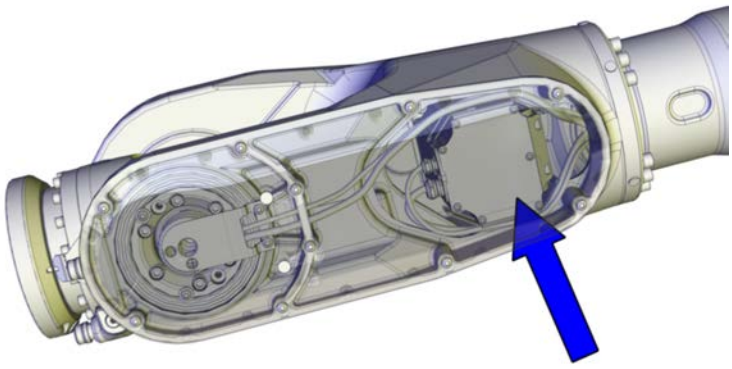
Continues on next page

	Action	Note
4	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
5	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.
6	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.7.5 Replacing the axis-5 motor

Location of the axis-5 motor

The axis-5 motor is located inside the wrist, as shown in the figure.



xx1500001899

Spare part

Spare part	Spare part number	Note
Axis-5 motor	See *Product manual, spare parts - IRB 6790*	

Consumables

Equipment, etc.	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.
O-ring	3HAC067744-001	D=119x3 Used on motor cover.
O-ring	3HAB3772-107	D=102x3 Used on motor flange.
Activator	3HAC074342-001	Loctite 7091
Flange sealant	-	Loctite 574 (or equivalent)

Required tools

Equipment, etc.	Article number	Note
Removal tool motor M12	3HAC14631-1	Used to push out the motor, if necessary. Always use removal tools in pairs.
Long AllenKeySocketIN19L 6-140	-	Length: 140 mm.
Guide pin, M8x100	3HAC15520-1	Always use guide pins in pairs.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
24 VDC power supply	-	Used to release the motor brakes.

Continues on next page

Equipment, etc.	Article number	Note
Leak-down tester	-	
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 651*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the axis-5 motor

Use these procedures to remove the motor.

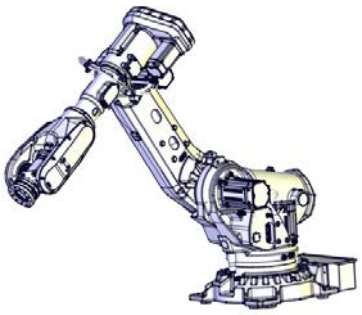
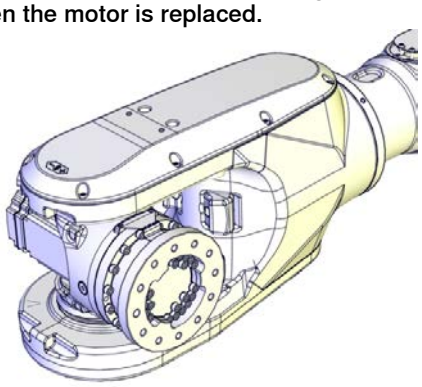
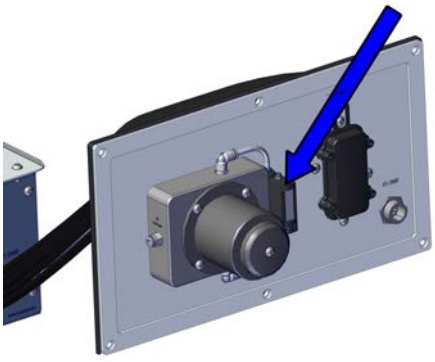
Preparations before removing the axis-5 motor

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

Continues on next page

4.7.5 Replacing the axis-5 motor

Continued

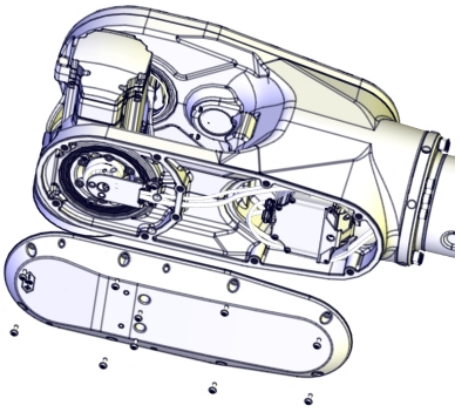
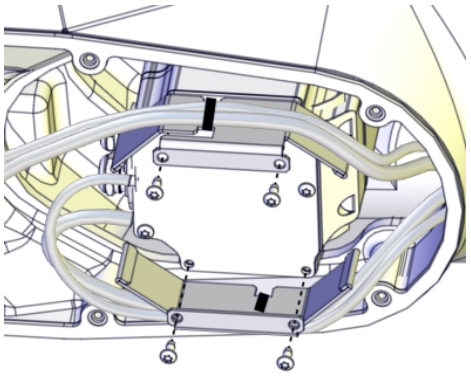
	Action	Note
2	Jog the robot to this position: • Axis 2: +25° • Axis 3: +35°	 xx1200001005
3	Jog axis 4 to this position: • Axis 4: +90°	With the robot in this position, there is no need to drain oil from the axis-5 gearbox when the motor is replaced.  xx1400000719
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
5	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593

Continues on next page

	Action	Note
6	**CAUTION** Turn off the air pressure supply.	

Retrieving access to the wrist cabling

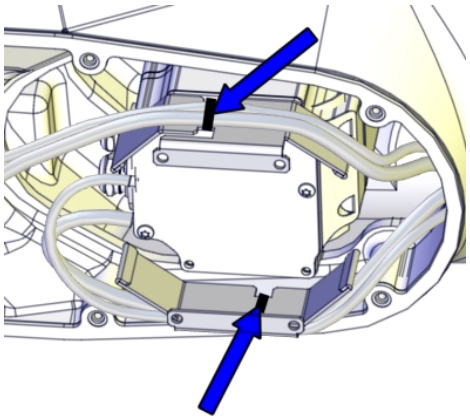
Use this procedure to remove the wrist cover to retrieve access to the axis-5 and axis-6 motor cables.

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Remove the wrist cover.	 xx1300002247
3	Remove the heat protection plates from the motor with the cabling still attached to the plate.	 xx1500001030

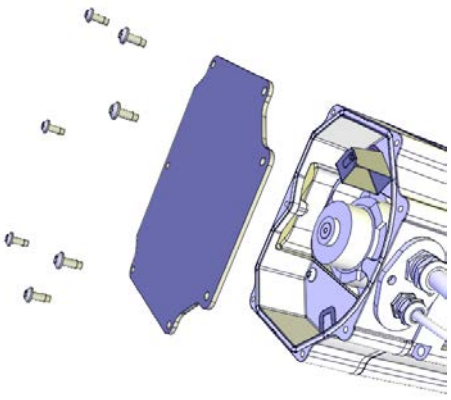
Continues on next page

4.7.5 Replacing the axis-5 motor

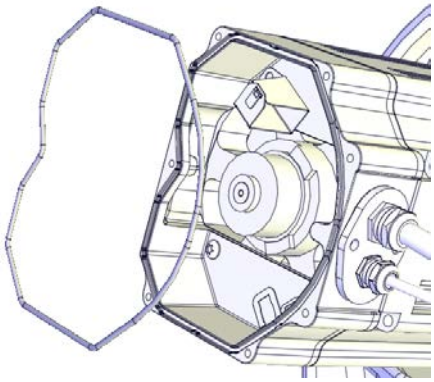
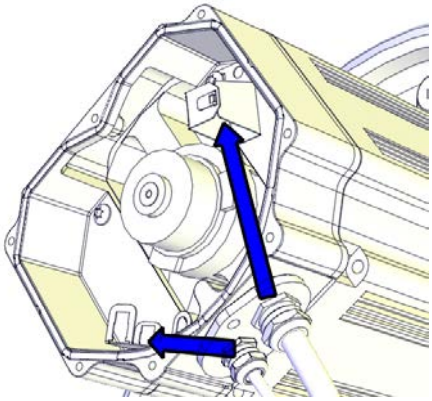
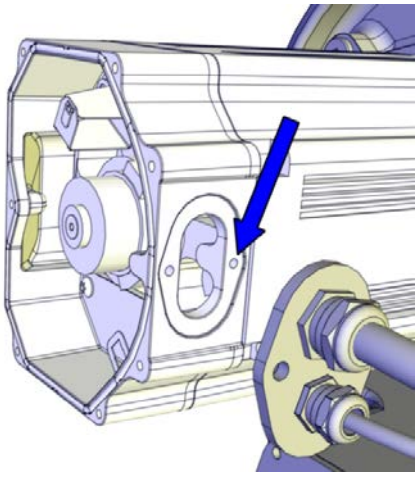
Continued

	Action	Note
4	Cut the cable ties that hold the cable harness to the plate. **Note** Keep the heat protection plate until refitting. **Tip** If removing the plate only for replacing the motor, the cabling does not need to be loosened from the plate.	 xx1500001029

Disconnecting the motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Unscrew the attachment screws and washers and remove the motor cover.	 xx1200001135

Continues on next page

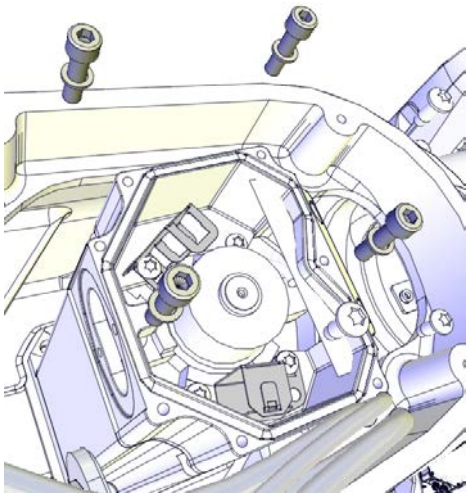
	Action	Note
3	Make sure the o-ring is present.	 xx1200001070
4	Disconnect the motor cables.	 xx1200001066
5	Remove the cable gland cover by performing the following steps: 1 Open the inner screw a little (the one the arrow is pointing at). No need to remove this screw from the motor. 2 Remove the outer screw. 3 Slide the cable gland cover away from the inner screw. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable exit hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1300000656
6	Use caution and pull out the motor cables.	

Continues on next page

4.7.5 Replacing the axis-5 motor

Continued

Removing the axis-5 motor

	Action	Note
1	Unscrew the attachment screws that secure the motor, using a bits extender.	Bits extender: 3HAC12342-1  xx1200001017
2	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
3	If needed, fit removal tools in opposite holes.	Removal tool motor M12: 3HAC14631-1 Always use removal tools in pairs.
4	**CAUTION** The motor weighs 12 kg. All lifting accessories used must be sized accordingly.	

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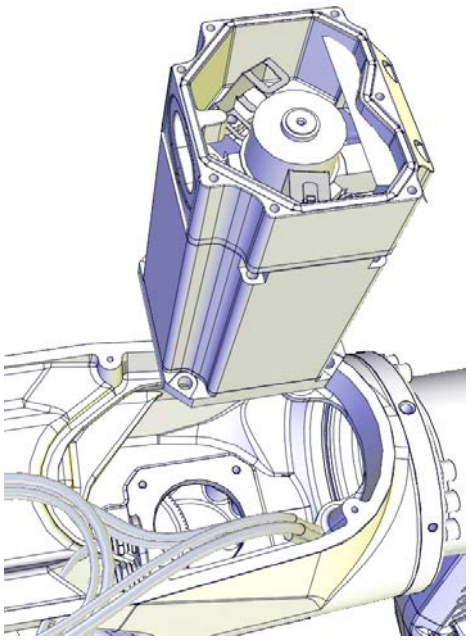
	Action	Note
5	Use caution and lift the motor out. Be careful not to damage the pinion.	 xx1200001018

Refitting the axis-5 motor

The procedures describe how to refit the motor.

Preparations before refitting the axis-5 motor

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

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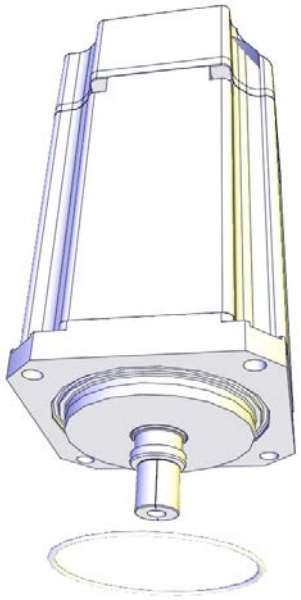
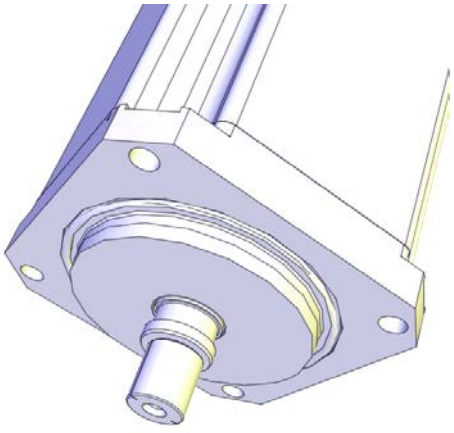
4.7.5 Replacing the axis-5 motor

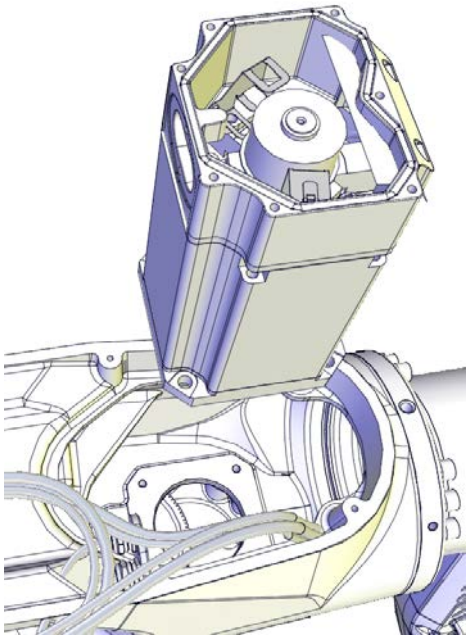
Continued

	Action	Note
2	Wipe clean the contact surfaces from any contamination. Also wipe clean the o-ring groove.	 xx1200001019
3	Check the o-ring. Replace if damaged.	O-ring, 3HAB3772-107
4	Lubricate the o-ring with some grease.	
5	Make sure the o-ring is seated in the groove.	 xx1200001020
6	Apply two guide pins in opposite holes.	Guide pin, M8x100: 3HAC15520-1

Securing the axis-5 motor

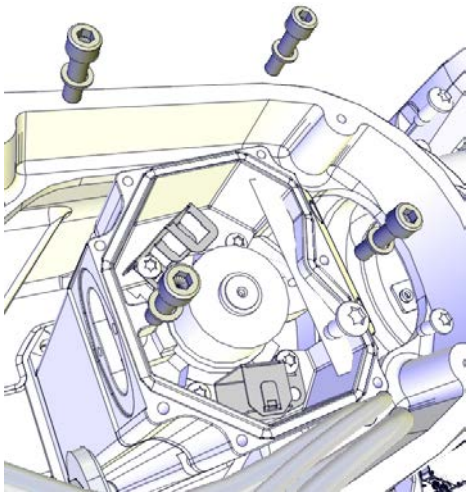
	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

Continues on next page

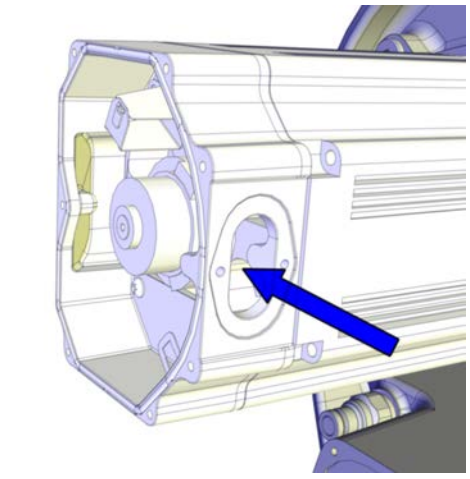
	Action	Note
2	Apply the rotation tool and use it to rotate the pinion when mating it into the gear.	Rotation tool: 3HAB7887-1
3	To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP5: • + = pin 2 • - = pin 5	24 VDC power supply
4	**CAUTION** The motor weighs 12 kg. All lifting accessories used must be sized accordingly.	
5	Use caution and lower the motor into position on the guide pins, while at the same time rotating the motor pinion slightly. Make sure that: • the motor pinion is properly mated to the gear of the gearbox. • the motor pinion does not get damaged. • the direction of the cable exit is facing the same way as before removal.	Rotation tool, 3HAB7887-1  xx1200001018
6	Remove the guide pins.	

Continues on next page

4.7.5 Replacing the axis-5 motor
Continued

	Action	Note
7	Secure the motor with its attachment screws and washers.	Tightening torque: 24 Nm. Screw dimension: M8x30 quality 12.9 Gleitmo(4 pcs)  xx1200001017
8	Perform a leak-down test.	See *Performing a leak-down test on page 184*.
9	Disconnect the 24 VDC power supply.	

Connecting the motor cables

	Action	Note
1	Push the motor cables in through the cable gland opening.	 xx1300000738

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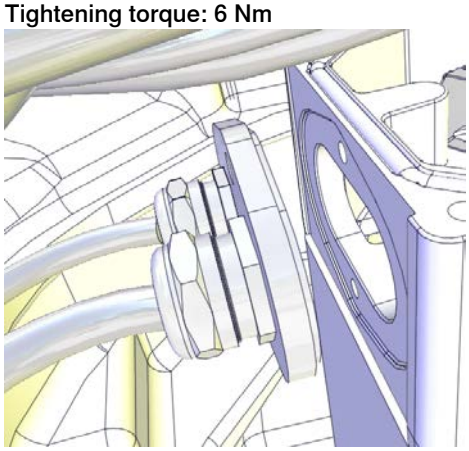
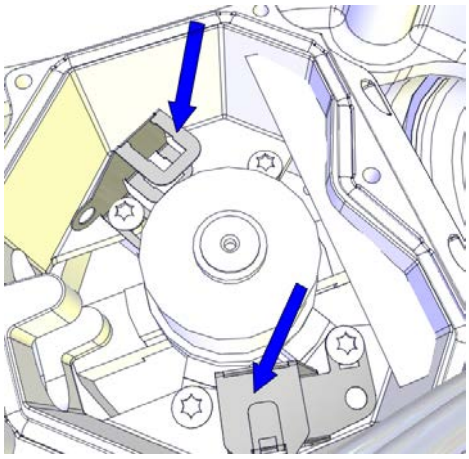
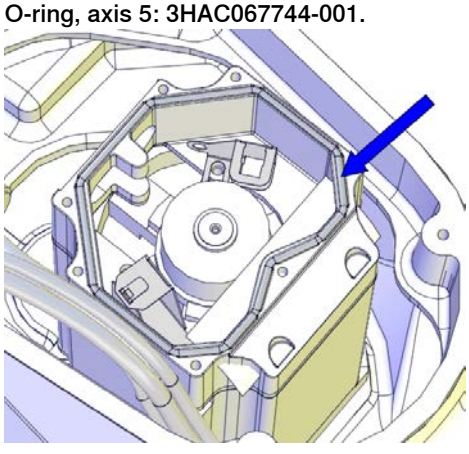
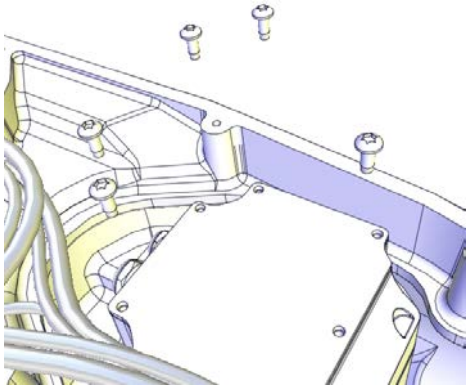
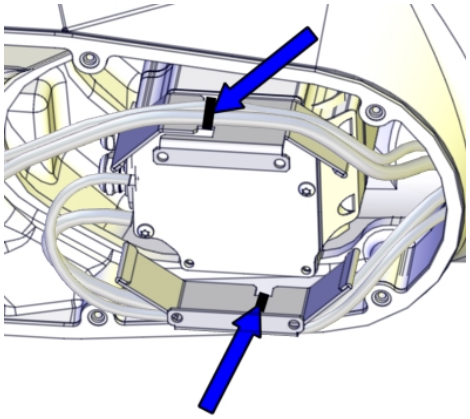
	Action	Note
2	Refit the cable gland cover by performing the following steps: • Slide the cable gland cover onto the inner screw. • Refit and tighten the outer screw. • Tighten the inner screw. Make sure that the gasket is not damaged. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001016
3	Connect the connectors. Connect in accordance with the markings on the connectors.	 xx1200001015
4	Make sure the o-ring on the motor is undamaged. Replace if damaged.	O-ring, axis 5: 3HAC067744-001.  xx1200001021
5	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	

Continues on next page

4.7.5 Replacing the axis-5 motor

Continued

	Action	Note
6	Refit the motor cover with its attachment screws. **Note** Do not refit the screws that will hold the heat protection plate at this point. **Note** Do not reuse the self-threading attachment screws, it will damage the threads. Replace with standard attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Screws: M5x12. Tightening torque: 10 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001013
7	Secure the cable harness with cable straps to the heat protection plate.	 xx1500001029

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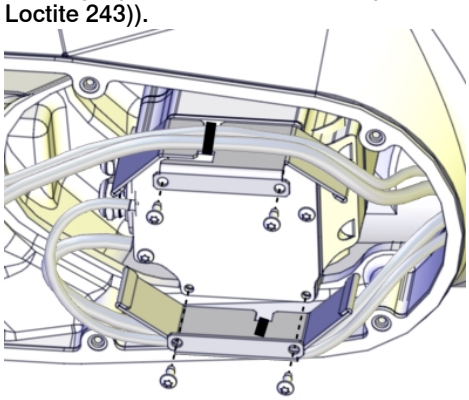
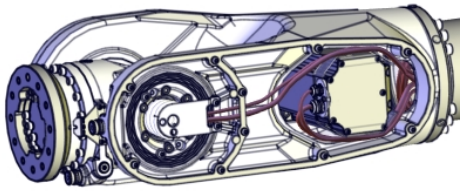
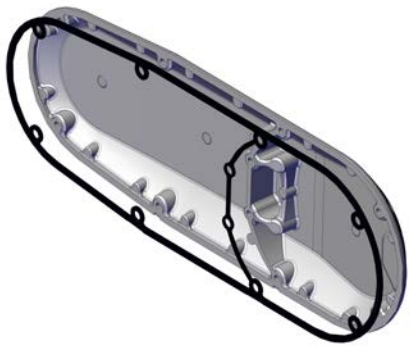
	Action	Note
8	Fit the heat protection plate with the screws.	Screws: M5x12. Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1500001030

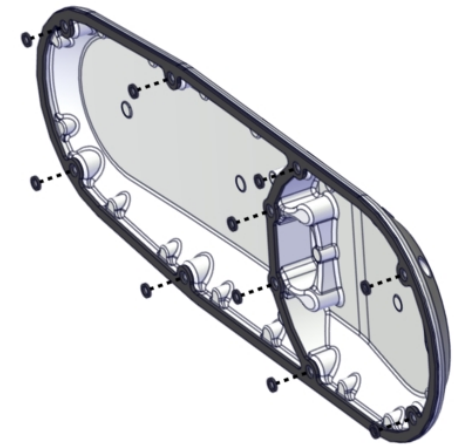
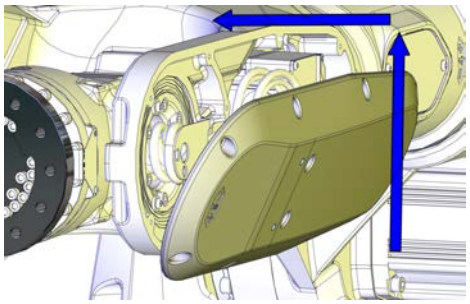
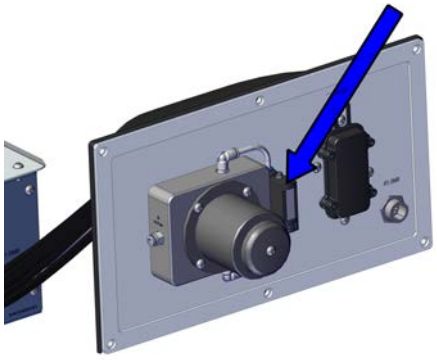
Concluding procedure

	Action	Note
1	Make sure that the cable harness is placed in a way that it will not be damaged when the wrist cover is fitted.	 xx1500001672
2	• Make sure that the gasket is undamaged on the cover. Replace gasket if damaged. • Clean the gasket from dirt and old grease residues. • Lubricate with grease between gasket and cover.	 xx2100000526 Grease: 3HAC042536-001 (Shell Gadus S2)

Continues on next page

4.7.5 Replacing the axis-5 motor

Continued

	Action	Note
3	Put washers in the holes of the gasket.	 xx1900002085
4	Refit the wrist cover. In order not to damage the cable harness when the wrist cover is refitted, use this method: 1 Hold the cover slightly tilted below the wrist. 2 Put the cable harness inside the cover. 3 Lift the cover, still tilted. 4 Move the upper part of the cover into position. 5 Secure the cover with its attachment screws.	 xx1300000772 Tightening torque: 10 Nm Torx pan head screw: 9ADA619-56 (M6x16 Stainless steel A2-70)
5	Turn on the air pressure supply to the overpressure system.	
6	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
7	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.

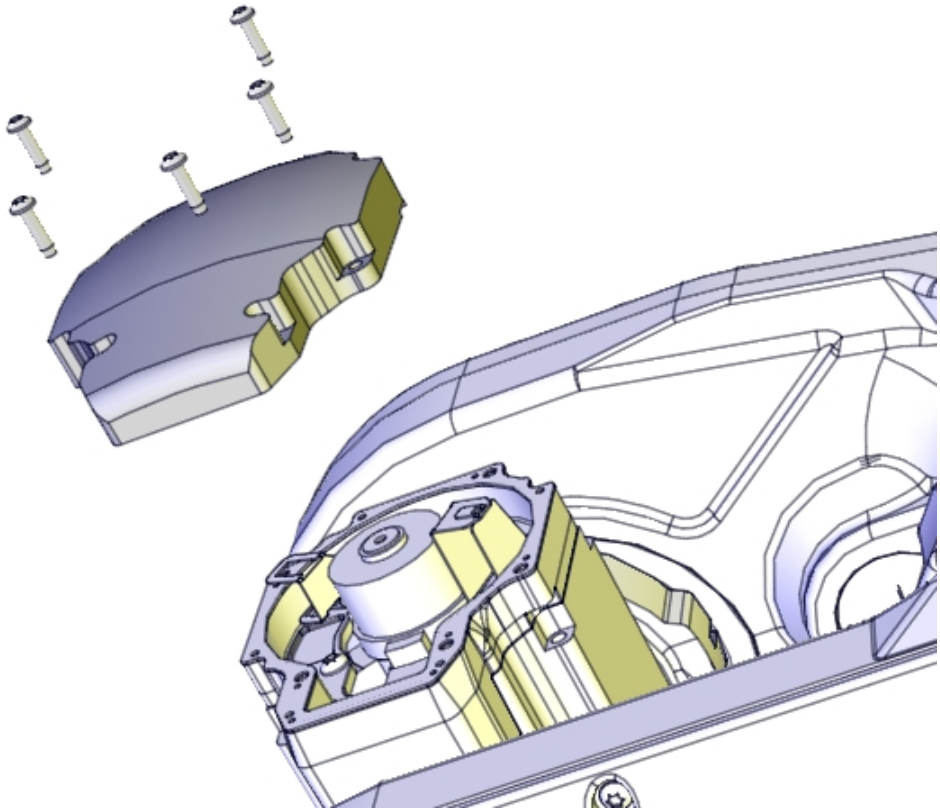
Continues on next page

	Action	Note
8	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.7.6 Replacing the axis-6 motor

Location of axis-6 motor

The axis-6 motor is located as shown in the figure.



xx1200001080

Spare part

Spare part	Spare part number	Note
Axis-6 motor	See *Product manual, spare parts - IRB 6790*	

Consumables

Equipment, etc.	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.
Gasket	3HAC033489-002	Used on motor cover.
O-ring	3HAB3772-107	D=102x3 Used on motor flange.
Activator	3HAC074342-001	Loctite 7091
Flange sealant	-	Loctite 574 (or equivalent)

Continues on next page

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Motor, axis-6	M8x25 stainless steel 3HAC060786-010	8.4x13x1.6 stainless steel 3HAC060866-001	4 pcs
Motor cover	M5x16 Stainless steel A2-70 9ADA619-45	-	5 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Removal tool motor M12	3HAC14631-1	Used to push out the motor, if necessary. Always use removal tools in pairs.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
24 VDC power supply	-	Used to release the motor brakes.
Leak-down tester	-	
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 651*.

Continues on next page

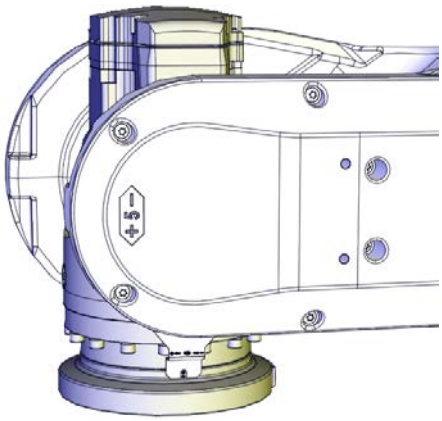
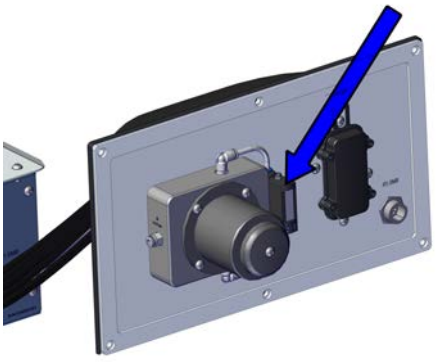
4.7.6 Replacing the axis-6 motor
Continued

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

Removing the axis-6 motor

Use these procedures to remove the 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 the robot to a position where axis 5 can be positioned with the motor pointing straight up at an acceptable working position. With axis 5 in this position it is possible to replace the motor without draining the oil from the axis-6 gearbox.	 xx1200001081
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
4	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593

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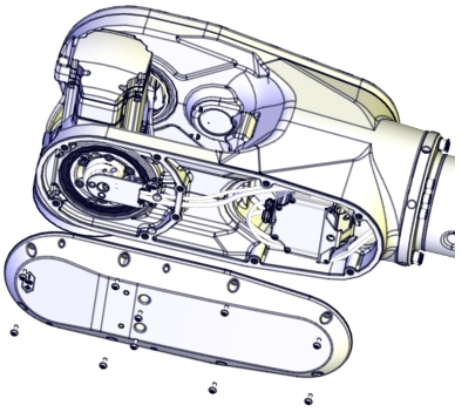
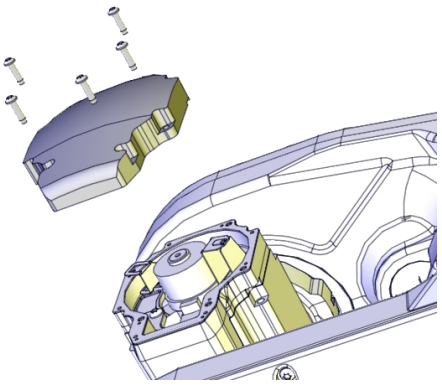
	Action	Note
5	**CAUTION** Turn off the air pressure supply.	
6	Remove the wrist cover.	 xx1300002247

Disconnecting the axis-6 motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Unscrew the attachment screws and remove the motor cover.	 xx1200001080

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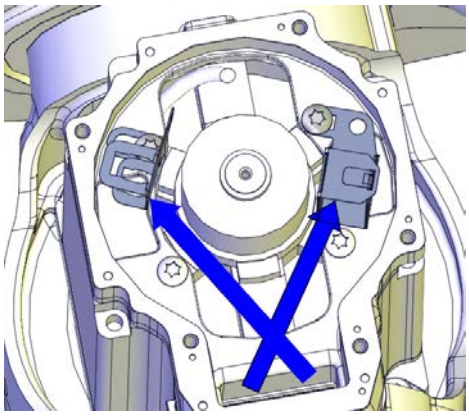
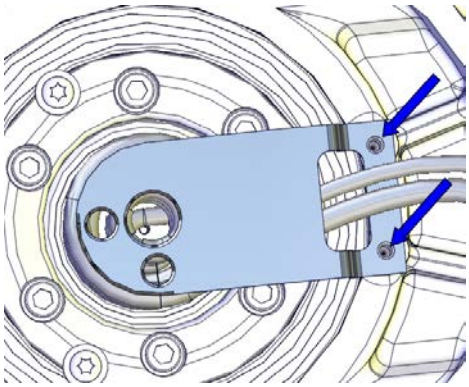
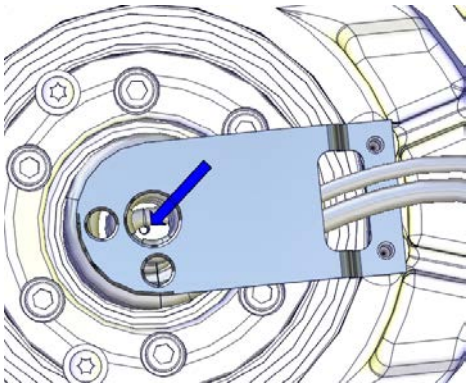
4.7.6 Replacing the axis-6 motor

Continued

	Action	Note
3	Disconnect the motor cables.	 xx1300000488
4	Unscrew the attachment screws that hold the cable bracket.	 xx1300000484
5	Unscrew the M4 screw that holds the carrier. **Note** The screw is located at the bottom of the carrier. **Note** The parts are sealed with flange sealant Loctite 5400 (or equivalent Loctite 577). Remove the part carefully.	 xx1300000485

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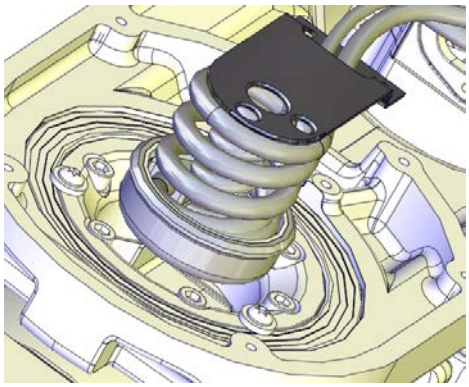
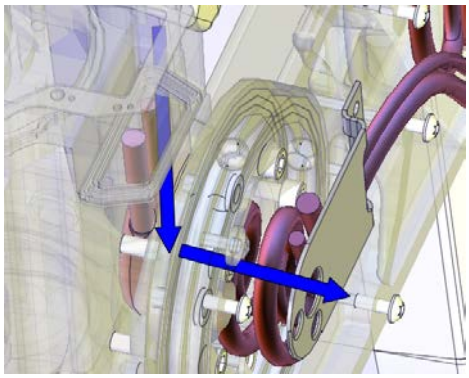
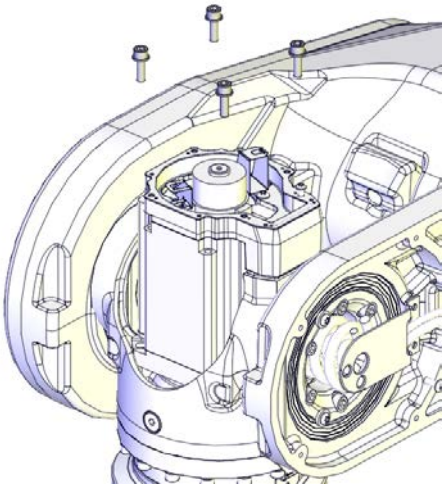
	Action	Note
6	Pull out the carrier from its position.	 xx1300001113
7	Pull out the axis-6 motor cables by holding the cables with one hand at the motor and the other at the carrier.	 xx1300000666

Removing the axis-6 motor

	Action	Note
1	To release the brakes, connect the 24 VDC power supply. Connect to R2.MP6-connector: • + = pin 2 • - = pin 5	24 VDC power supply
2	Unscrew the motor attachment screws.	 xx1200001090

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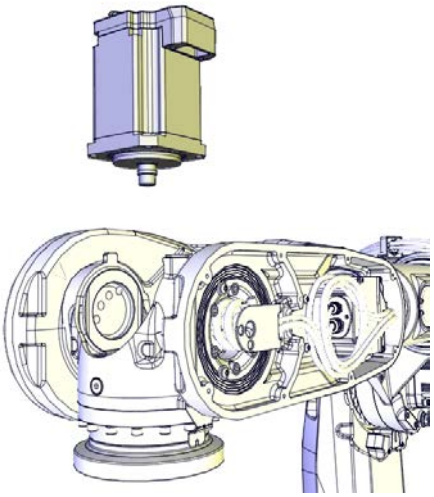
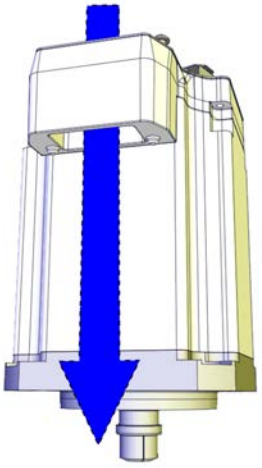
4.7.6 Replacing the axis-6 motor

Continued

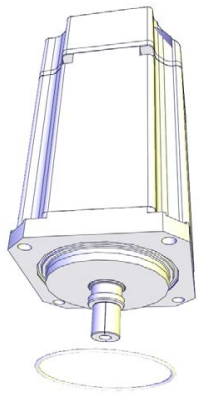
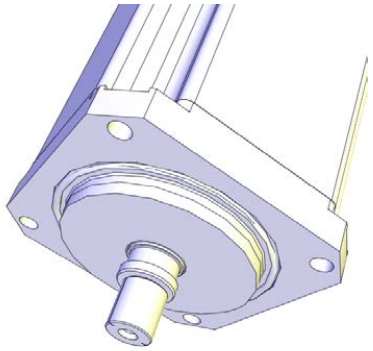
	Action	Note
3	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
4	If required, press the motor out of position by fitting the removal tool, motor to the attachment holes of the motor.	Removal tool motor M12: 3HAC14631-1 Always use removal tools in pairs.
5	**CAUTION** The motor weighs 9 kg. All lifting accessories used must be sized accordingly.	
6	Remove the motor by lifting it straight up from the gear while at the same time picking out the motor cables from the motor. Make sure the motor pinion is not damaged!	 xx1200001091  xx1200001096
7	Disconnect the 24 VDC power supply.	

Continues on next page

Refitting the axis-6 motor

Use this procedure to refit the motor.

Preparations prior to refitting motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Remove any old paint residues or other contamination from the contact surfaces on both the motor and the mating parts. Wipe clean the contact surfaces and the o-ring groove.	
3	Fit a new o-ring.	 xx1200001019
4	Make sure the o-ring is seated in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	 xx1200001020

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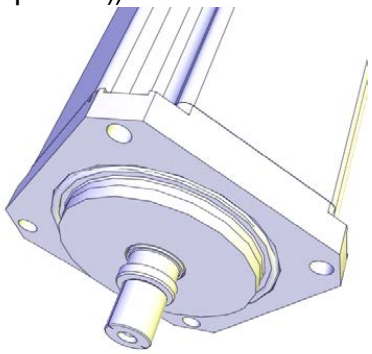
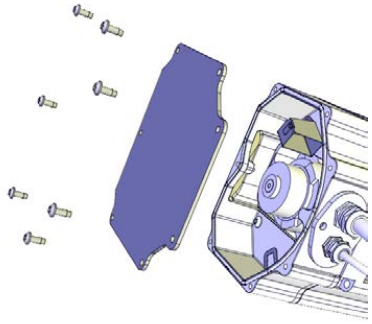
4.7.6 Replacing the axis-6 motor

Continued

	Action	Note
5	Apply locking liquid with activator on the motor flange.	Activator (Loctite 7091). Flange sealant (Loctite 574 (or equivalent)).  xx1200001020
6	If the motor is a new spare part, remove the cover.	 xx1200001135

Securing the axis-6 motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP6: • + = pin 2 • - = pin 5	
3	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	

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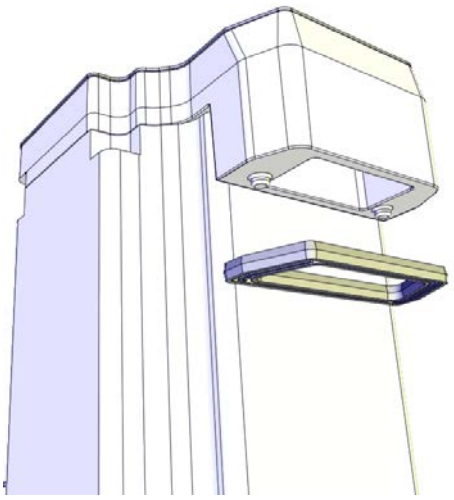
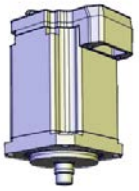
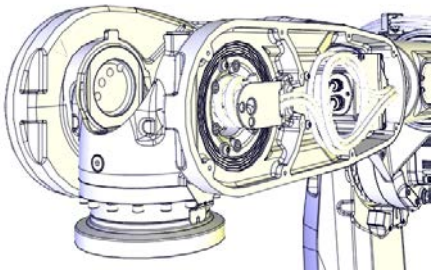
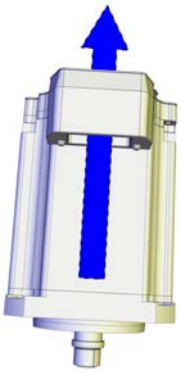
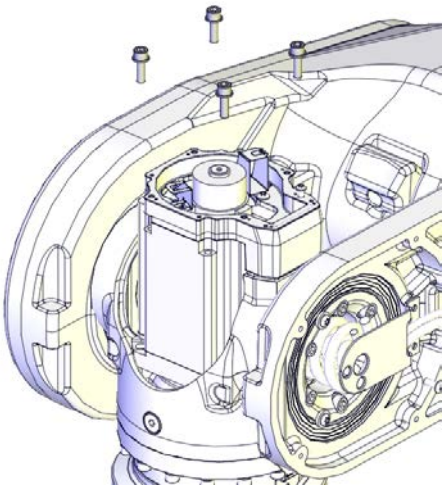
	Action	Note
4	Check the gasket. Replace if damaged.	 xx1200001094
5	**CAUTION** The motor weighs 9 kg. All lifting accessories used must be sized accordingly.	

Continues on next page

4.7.6 Replacing the axis-6 motor

Continued

	Action	Note
6	Fit the motor while, at the same, time pushing the motor cables in through the cable gland. Make sure the motor pinion is properly mated with the gear of the axis-6 gearbox. Make sure the motor pinion is not damaged!	  xx1200001091  xx1200001097
7	Check that the gasket is fitted correctly. Secure the motor with its attachment screws.	Screws: M8x25 stainless steel (3HAC060786-010) (4 pcs) Washers: 8.4x13x1.6 stainless steel (3HAC060866-001) (4 pcs) Tightening torque: 24 Nm  xx1200001090

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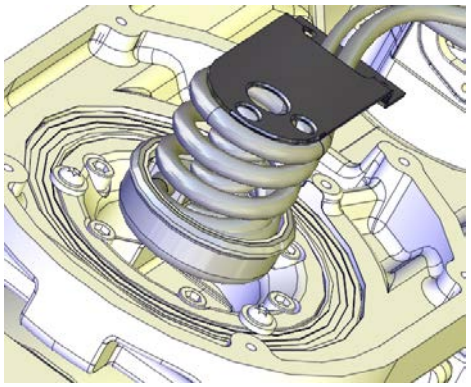
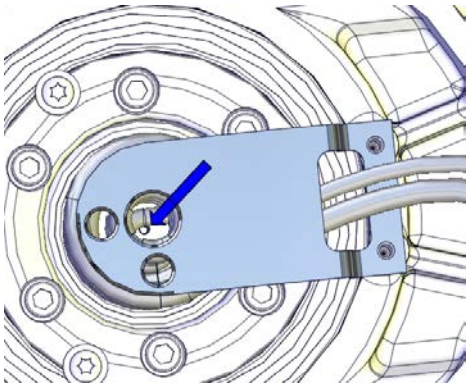
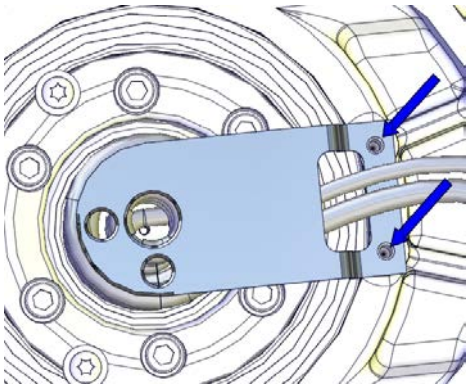
	Action	Note
8	Refit the axis-6 motor cables by carefully pushing them and the carrier into position.	 xx1300001113
9	Tighten the M4 screw that holds the carrier. Seal the screw with Loctite 5400 (or equivalent Loctite 577). **Note** The screw is located at the bottom of the carrier.	 xx1300000485
10	Refit the cable bracket.	 xx1300000484
11	Perform a leak-down test.	See *Performing a leak-down test on page 184*.
12	Disconnect the 24 V DC power supply.	

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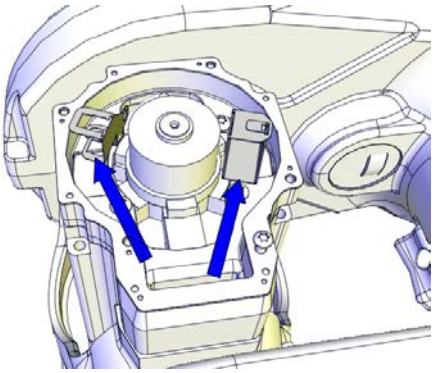
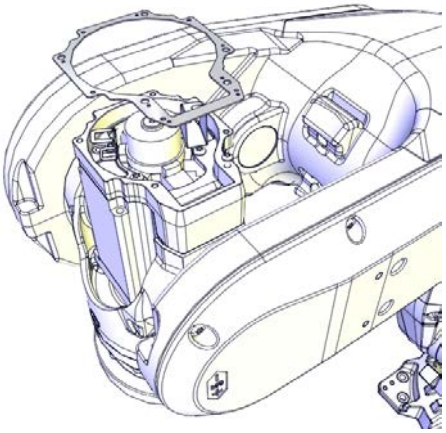
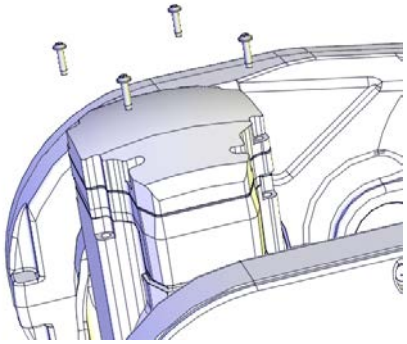
4.7.6 Replacing the axis-6 motor

Continued

	Action	Note
13	Reconnect the connectors.	 xx1200001084
14	Check the gasket. Replace if damaged.	Gasket: 3HAC033489-002  xx1200001095
15	Refit the motor cover.	Attachment screws: M5x16 Stainless steel A2-70 (5 pcs) (9ADA619-45) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001082

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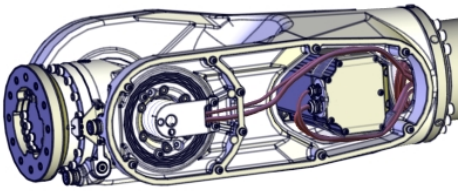
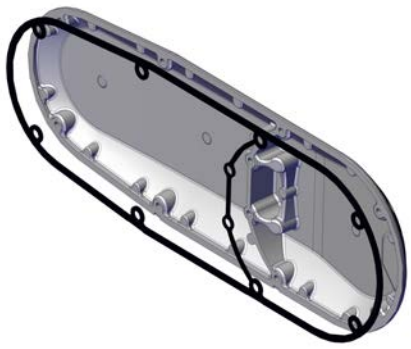
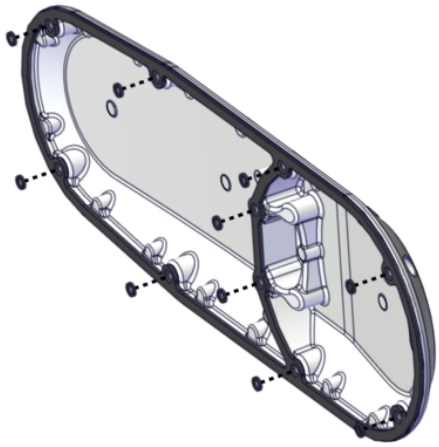
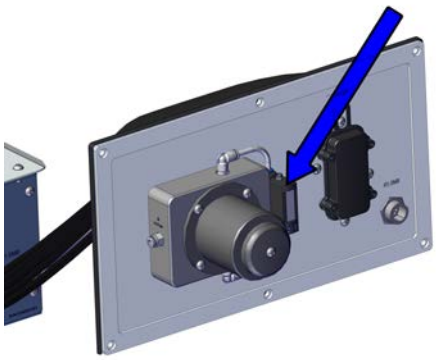
Concluding procedure

	Action	Note
1	Make sure that the cable harness is placed in a way that it will not be damaged when the wrist cover is fitted.	 xx1500001672
2	• Make sure that the gasket is undamaged on the cover. Replace gasket if damaged. • Clean the gasket from dirt and old grease residues. • Lubricate with grease between gasket and cover.	 xx2100000526 Grease: 3HAC042536-001 (Shell Gadus S2)
3	Put washers in the holes of the gasket.	 xx1900002085
4	Turn on the air pressure supply to the overpressure system.	

Continues on next page

4.7.6 Replacing the axis-6 motor

Continued

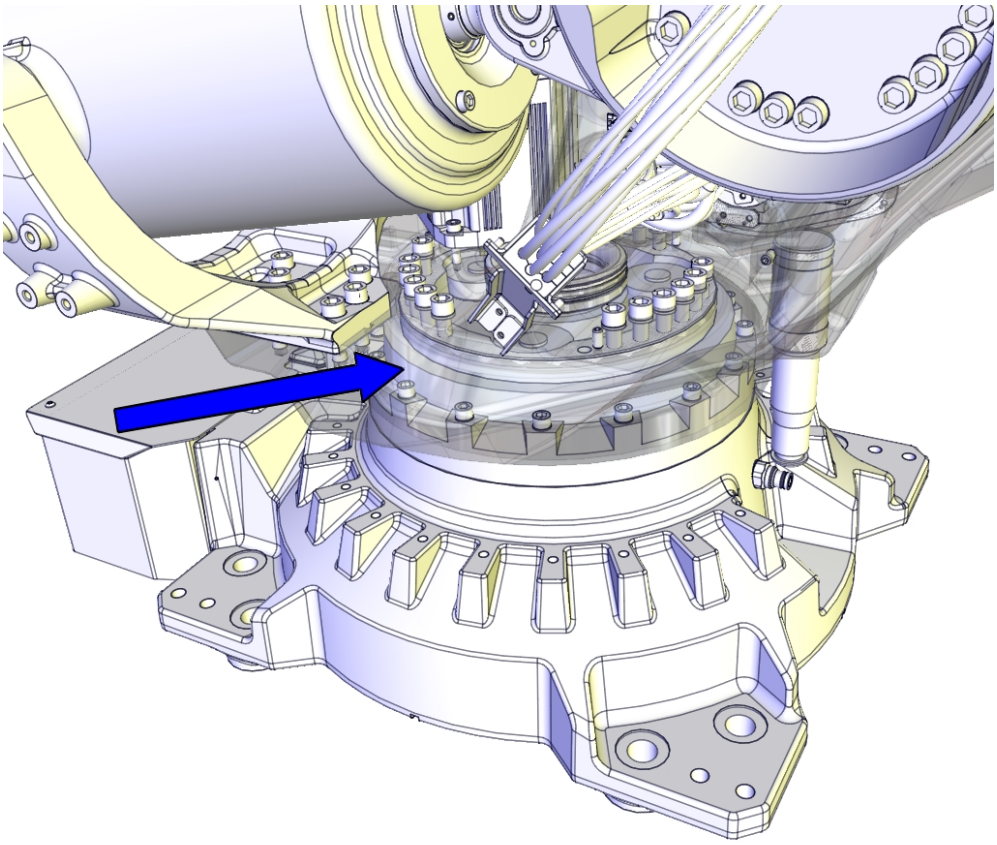
	Action	Note
5	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
6	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.
7	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.8 Gearboxes

4.8.1 Replacing the axis-1 gearbox

Location of the axis-1 gearbox

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



xx1200001183

Summary of the replacement procedure

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

1. Drain the axis-1 gearbox.
2. Remove the cabling from the base.
3. Remove the axis-1 motor.
4. Remove the complete arm system (including frame and balancing device) as a package.
5. Replace the axis-1 gearbox.
6. Refit in reverse order.

Continues on next page

4.8.1 Replacing the axis-1 gearbox
Continued

Spare parts

Spare parts	Article number	Note
Axis-1 gearbox	See *Product manual, spare parts - IRB 6790*.	

Consumables

Equipment, etc.	Article number	Note
Locking liquid	-	Loctite 2400 (or equivalent Loctite 243)
Flange sealant	-	Loctite 574 (or equivalent)
Activator	3HAC074342-001	Loctite 7091
Grease	3HAC042536-001	Shell Gadus S2
Flange sealant for conical fittings	-	Loctite 5400 (or equivalent Loctite 577)
Rust preventive	3HAC034903-001	Mercasol 3110 Waxcoat. Recommended drying time is 24h.
O-ring	3HAB3772-58	
O-ring	3HAC061327-002	
O-ring	3HAC054692-002	
O-ring	3HAB3772-107	
O-ring	3HAB3772-164	
Cable straps	-	
Cable ties	-	
Sealing ring	-	

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Gearbox	M12x90 stainless steel 3HAC060786-036	13x19x2 coated stainless steel 3HAC060866-004	16 pcs
Frame	M16x50 stainless steel 3HAC060786-041	17x25x3 coated stainless steel HV200 (3HAC060866-005)	16 pcs
Motor, axis-1	M10x30 stainless steel 3HAC060786-020	13x17x2 stainless steel 3HAC060866-003	4 pcs
Mechanical stop	M10x20 Stainless Steel 9ADJ400914P1259	-	1 pcs

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Required tools and equipment

Equipment, etc.	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 144*.
Removal tool motor M12	3HAC14631-1	Used to push out the motor, if necessary. Always use removal tools in pairs.
Bits extender	3HAC12342-1	300 mm, bits 1/2"
Fender washer	-	Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.
Lifting accessory, motor	3HAC14459-1	
Lifting eye	3HAC16131-1	M12
Lifting eye	3HAC16131-1	M12
Lifting eye	3HAC14457-4	M16
Lifting shackle	-	SA-10-8-NA1
Roundsling, 1.5 m	-	Length: 1.5 m. Lifting capacity: 2,000 kg.
Roundsling, 1 m	-	Length: 1 m, lifting capacity: 1,000 kg.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
Aligning tool	3HAC046645-003	Used for aligning the gearbox against the frame, so that the play in the motor does not need to be adjusted.
24 VDC power supply	-	Used to release the motor brakes.
Guide for reduction gear	3HAC043870-009	Used to guide axis-1 gear and frame during refitting.
Guide pin, M10x150	3HAC15521-2	Always use guide pins in pairs.
Guide pin, M12x150	3HAC13056-2	Always use guide pins in pairs.
Guide pin, M16x150	3HAC13120-2	Always use guide pins in pairs.
Guide pin, M16x200	3HAC13120-3	Always use guide pins in pairs.
Leak-down tester	-	
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Continues on next page

4.8.1 Replacing the axis-1 gearbox
Continued

Required documents

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

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 651*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the axis-1 gearbox

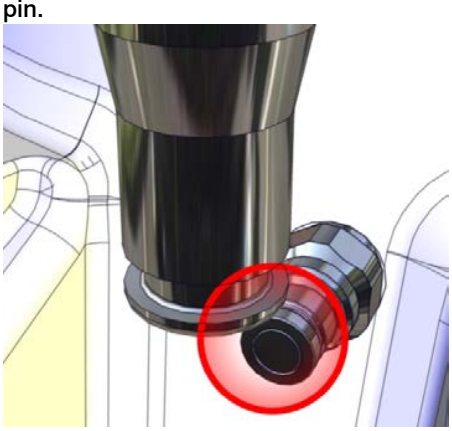
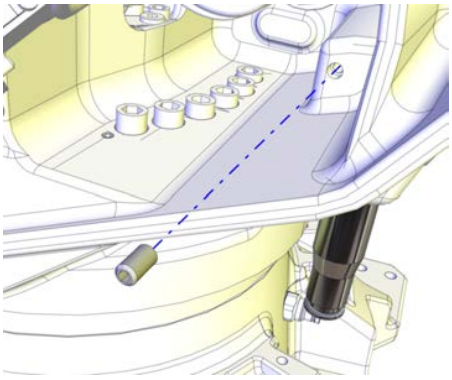
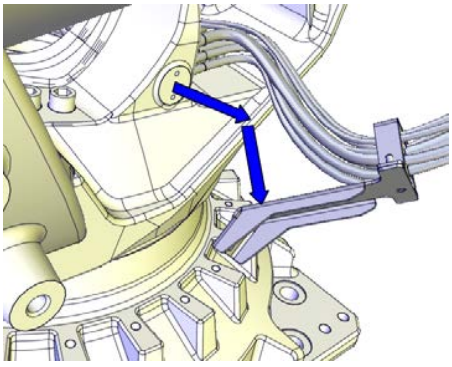
These procedures describe how to remove the gearbox.

Preparations before removing the axis-1 gearbox

Use this procedure to do the necessary 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	Remove tools and other equipment fitted on the turning disc.	This is done to achieve the best stability of the complete arm system when it is resting by itself, after it has been removed.
3	Begin draining the axis-1 gearbox.	See *Draining the axis-1 gearbox on page 146*.

Continues on next page

	Action	Note
4	Jog the robot into position: • axis 1 = -5° • axis 2 = 0°	The specified position of axis-1 is required for removal of the mechanical stop pin.  xx1300000478
5	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
6	Hold the mechanical stop pin in a firm grip, and remove it by unscrewing the set screw. **CAUTION** The mechanical stop pin weighs 5 kg and may fall down when the set screw is removed.	 xx1300000476
7	Unscrew the attachment screws that secure the cable bracket.	 xx1200001184

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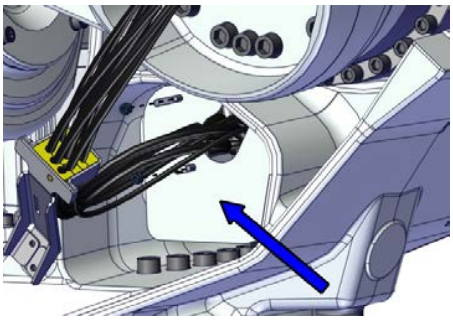
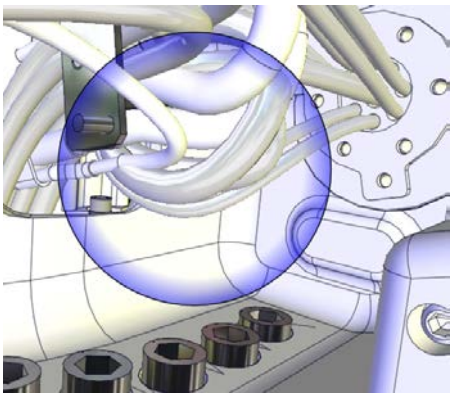
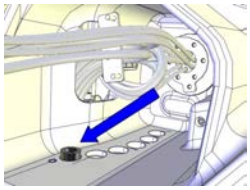
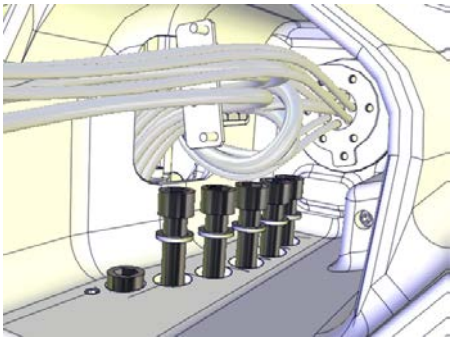
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
8	Remove the cable protection plate by removing the two nuts.	 xx1700001585
9	Lift up the part of the cable harness shown in the figure, and let it rest against the bracket. This is done to be able to reach all attachment screws inside the recess.	 xx1200001240
10	Unscrew five of the six attachment screws inside the frame recess, that secure the frame to the gearbox. **Note** Leave the outermost screw fitted as a safety precaution.  xx1200001185	 xx1200001189

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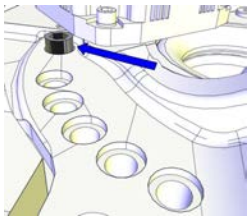
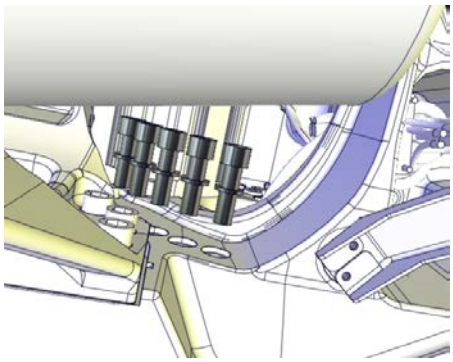
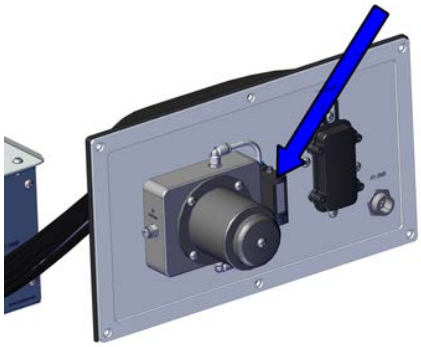
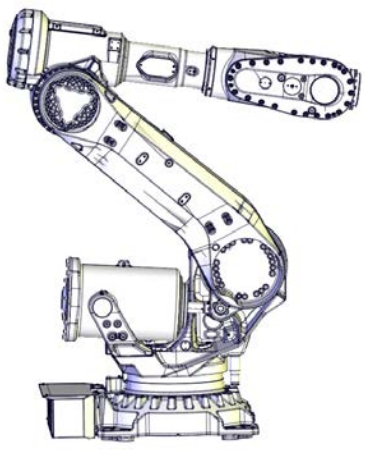
	Action	Note
11	Unscrew five of the six attachment screws under the balancing device. **Note** Leave the screw closest to the axis-1 motor fitted.  xx1200001239	 xx1200001238
12	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593
13	**CAUTION** Turn off the air pressure supply.	

Robot position

Use this procedure to jog the robot into position.

	Action	Note
1	Jog the robot into position: • Axis 1: no significance as long as the robot is secured to the foundation. • Axis 2: -40° • Axis 3: +65° (approximately) • Axis 4: calibration position (0°) • Axis 5. +90° • Axis 6: calibration position (0°)	 xx1200001132

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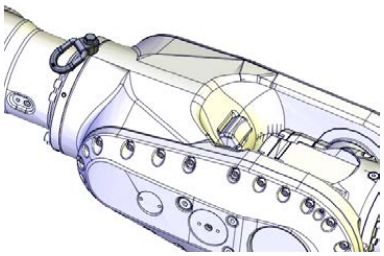
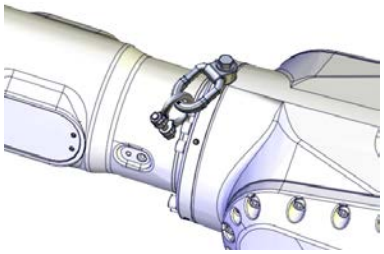
4.8.1 Replacing the axis-1 gearbox
Continued

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

Attaching the lifting accessories

Use this procedure to attach the lifting accessories.

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**CAUTION** The complete arm system weigh (according to variants) 1,100 kg. All lifting accessories used must be sized accordingly.	
3	Fit a lifting eye to the wrist. **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1  xx1200001133
4	Fit a lifting shackle in the wrist lifting eye.	Lifting shackle: SA-10-8-NA1  xx1200001234

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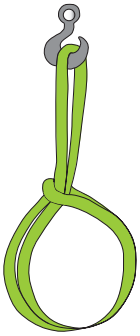
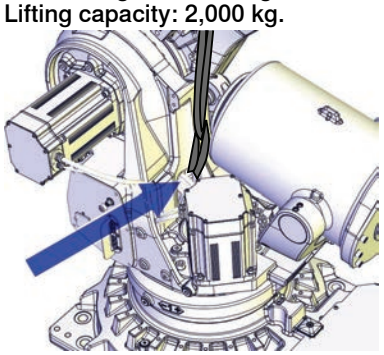
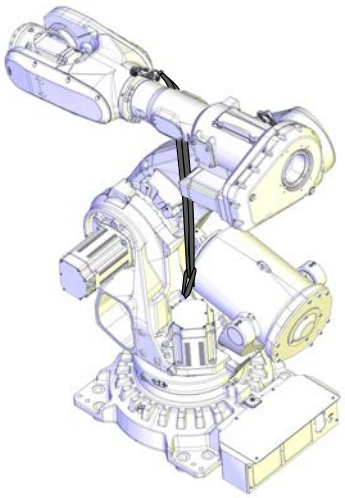
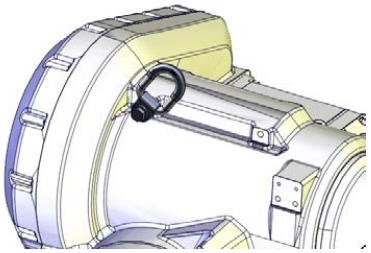
	Action	Note
5	Run a roundsling through the hole in the frame. Attach the roundsling choked. See figure!  xx1400000730	Roundsling, 1.5 m: Length: 1.5 m. Lifting capacity: 2,000 kg.  xx1200001209
6	Attach the roundsling to the shackle on the wrist.	 xx1200001235
7	Jog axis-3 slowly until the roundsling is stretched (approximately +58°), to carry the weight of the lower arm and frame. **WARNING** Without the roundsling the weight of the lower arm and frame is applied to the axis-3 gear during lifting, which risks to damage the gear.	
8	Fit a lifting eye in the arm house, with a fender washer underneath.  xx1400002196 Fender washer **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1 Fender washer. Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.  xx1200001134

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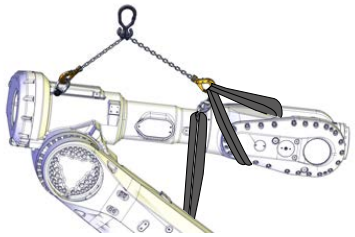
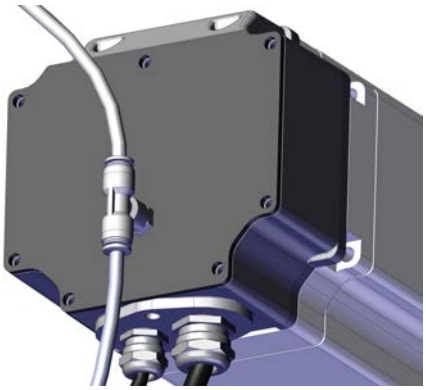
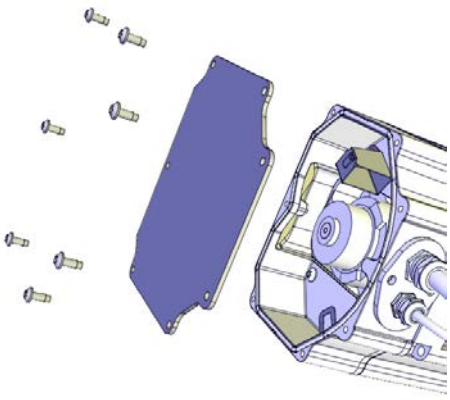
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
9	Attach the Lifting accessory (chain) to an overhead crane (or similar) and then to the lifting eye in the arm house and to a roundsling run through the wrist.	Lifting accessory (chain): 3HAC15556-1 Roundsling, 1 m: Length: 1 m, lifting capacity: 1,000 kg.  xx1200001236

Disconnecting the axis-1 motor cables

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Disconnect air hose from air fitting on motor cover.	 xx2100000568
3	Unscrew the attachment screws and washers and remove the motor cover. **Note** Axis 3 and 4 motors only: Be careful not to damage the air hose or air nipple.	 xx1200001135

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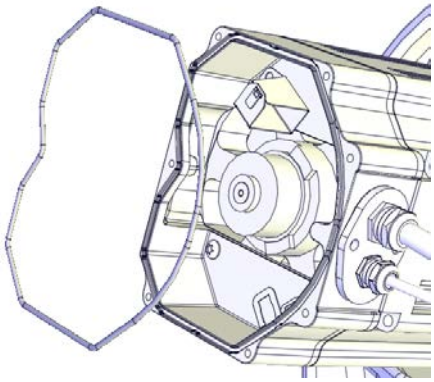
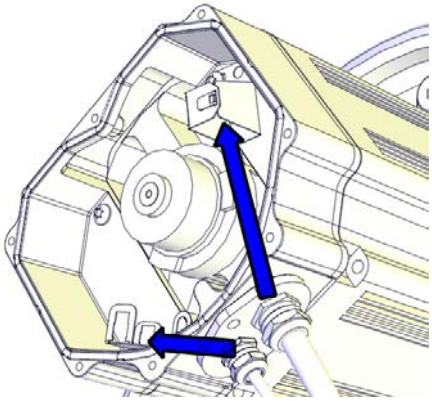
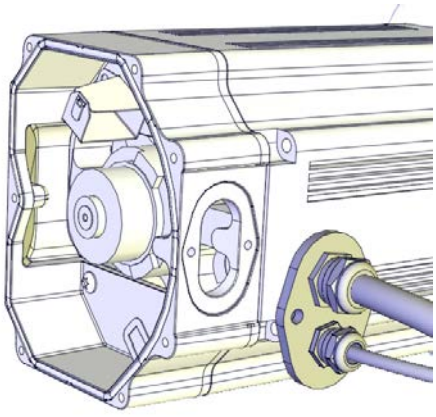
	Action	Note
4	Make sure the o-ring is present.	 xx1200001070
5	Disconnect the motor cables.	 xx1200001066
6	Remove the cable gland cover. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable gland hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1200001067
7	Use caution and pull out the motor cables.	

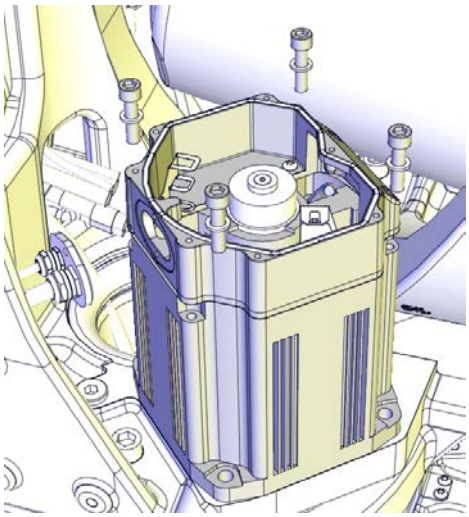
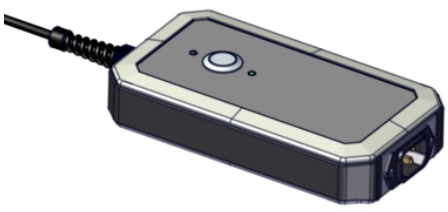
Removing the axis-1 motor

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

Continues on next page

4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
2	Unscrew the attachment screws and washers. Use a bits extender to reach the screws.	Bits extender: 3HAC12342-1  xx1200001071
3	Fit guide pins in opposite holes.	Guide pin, M12x150: 3HAC13056-2 Always use guide pins in pairs.
4	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
5	If needed, use removal tools to help loosen the motor.	Removal tool motor M12: 3HAC14631-1 Used to push out the motor, if necessary. Always use removal tools in pairs.
6	**CAUTION** The weight of the motor is 25 kg All lifting accessories used must be sized accordingly.	
7	Attach the lifting accessories.	Lifting accessory (chain): 3HAC15556-1 Lifting accessory, motor: 3HAC14459-1.
8	Release the brakes of the axis-1 motor with the brake release tool. 1 Turn off the brake release tool. 2 Connect the tool to the R2.MP1 connector. 3 Release the brakes by turning on the brake release tool and pressing the brake release button on the tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Brake release tool: 3HAC081310-001 User instructions are enclosed with the tool.  xx2100000666

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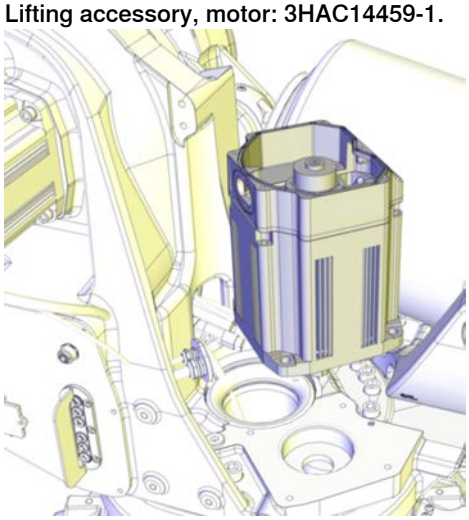
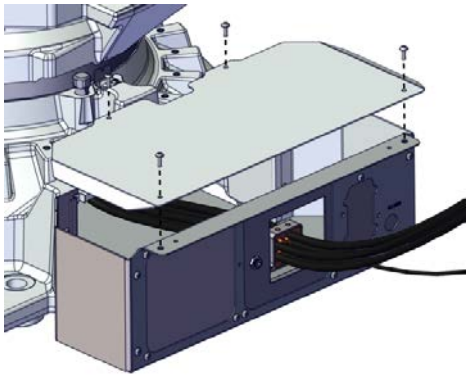
	Action	Note
9	Use caution and lift the motor straight up to get the pinion parted from the gear.	Lifting accessory (chain): 3HAC15556-1 Lifting accessory, motor: 3HAC14459-1.  xx1200001072
10	Disconnect the brake release tool / 24 VDC power supply.	

Preparations before removing the cable harness in the base

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**CAUTION** Turn off the air pressure supply.	
3	Remove the base cover.	 xx1700001580

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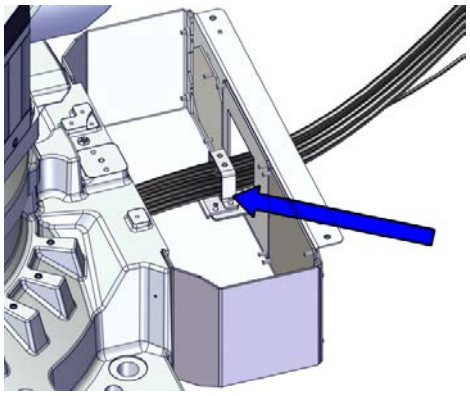
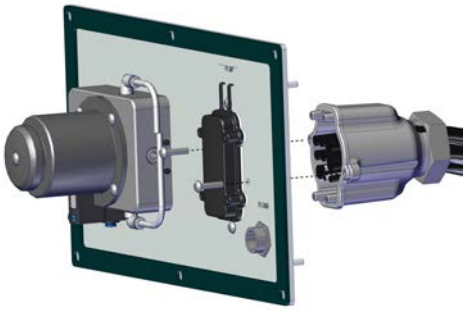
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
4	Remove the metal clamp inside the base.	 xx1700001584
5	Remove the cover that protects the R1.MP and R1.SMB connectors.	 xx1700001581
6	Disconnect connectors: • R1.MP • R1.SMB	 xx1700001582
7	Disconnect the earth cable.	Screw dimension : M6x16 Washer dimension : 6.4x17x3

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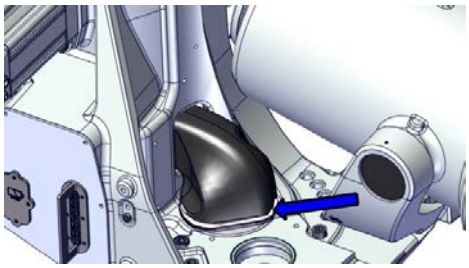
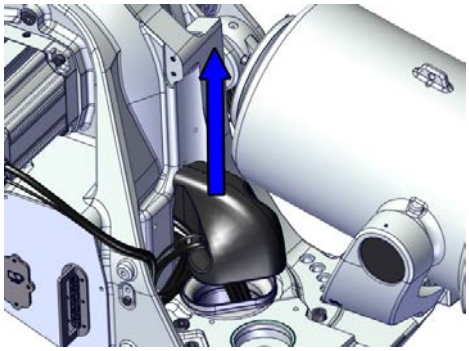
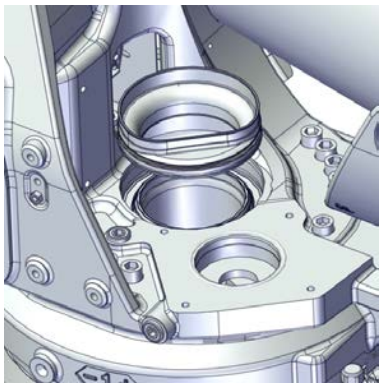
Removing the cable harness in the base

	Action	Note
1	Open the hose clamp on the black cable protection and loosen the protection from the frame.	 xx1700002036
2	Pull out the cable harness up from the base together with the black cable protection. **Tip** This step is best performed by two persons working together: • Person 1: Push the cable harness up through the robot base. • Person 2: Take a hold on the cable protection and cable harness at the frame and pull them upwards together. • Together: Move the cable harness out of the base and place it on, for example, the upper arm.	 xx1700001631

Removing the frame cable protection

	Action	Note
1	Cut the flange sealant and remove the protection ring.	 xx1700001633

Lifting away the complete arm system

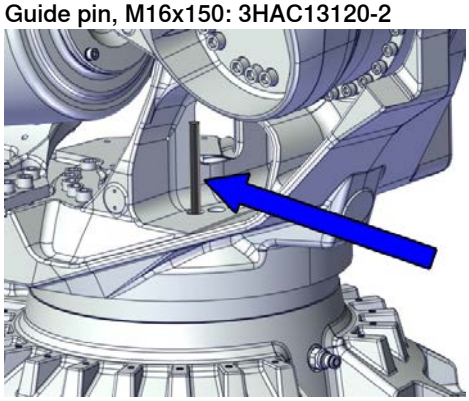
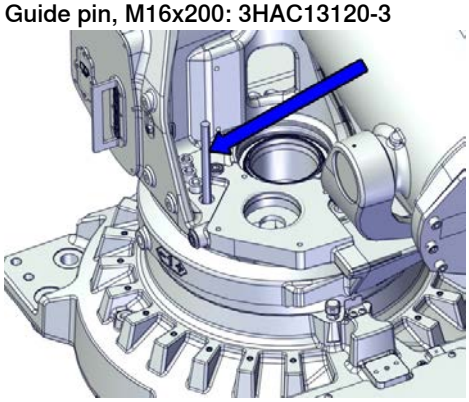
Use this procedure to lift away the complete arm system.

	Action	Note
1	Raise the overhead crane to stretch the chains and roundslings. Make sure that the roundsling between the wrist and the frame is stretched.	

Continues on next page

4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
2	Remove two attachment screws in opposite holes and replace them with guide pins. **Tip** Lubricate the guide pins with some grease to make the frame slide better.	Guide pin, M16x150: 3HAC13120-2  xx1700001635 Guide pin, M16x200: 3HAC13120-3  xx1700001636 Always use guide pins in pairs.
3	Remove the remaining attachment screws, that hold the frame to the axis-1 gearbox.	
4	**CAUTION** The complete arm system weighs: 1,100 kg. All lifting accessories used must be sized accordingly.	

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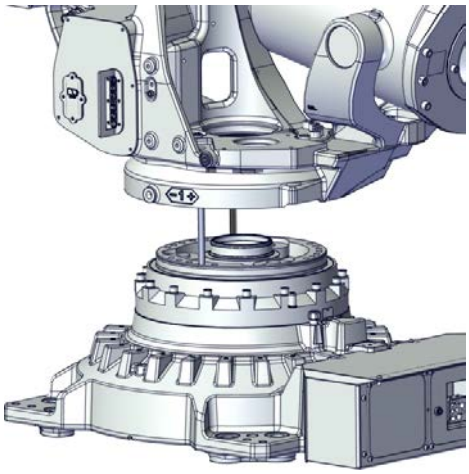
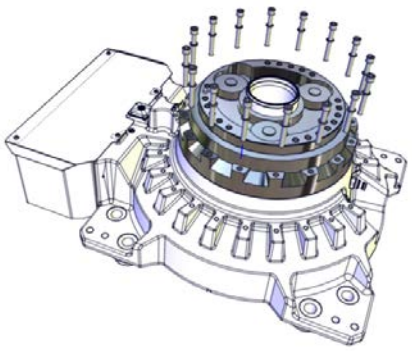
	Action	Note
5	Use caution and lift the complete arm system.	 xx1700001637
6	Move away the complete arm system.	
7	**DANGER** Make sure that the complete arm system is resting completely stable on the floor before removing the lifting accessories. Do not change the position of the axes from the position described earlier.	

Removing the gearbox

	Action	Note
1	Remove the attachment screws and washers that secure the gearbox to the base.	 xx1200001186

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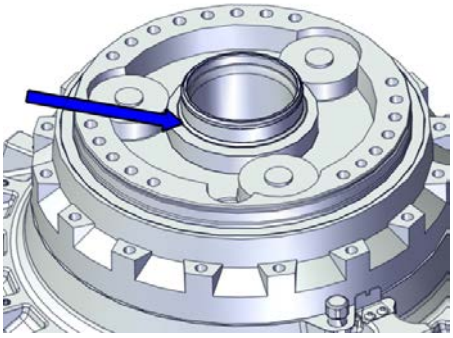
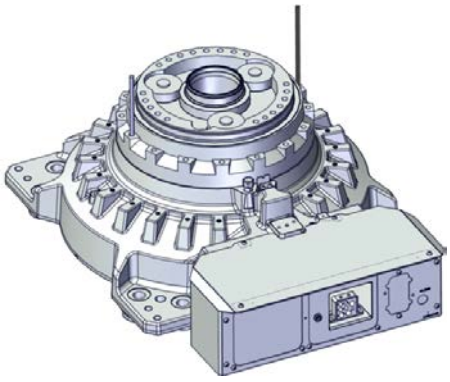
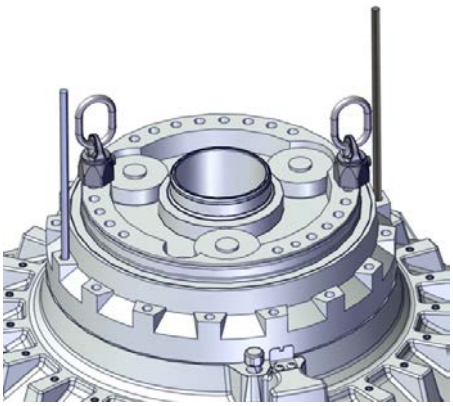
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
2	Rip off only the lip from the protection tube sleeve with pliers, along the perforation. Leave the rest of the sleeve on the protection tube. Remove old residues of flange sealant from the protection tube.	 xx1700001654
3	Fit two guide pins in opposite holes. **Tip** Lubricate the guide pins with some grease to make the gearbox slide better.	Guide pin, M12x150: 3HAC13056-2 Guide pin, M12x200: 3HAC13056-3  xx1700001653 Always use guide pins in pairs.
4	Fit two lifting eyes manually in opposite holes in the gearbox. **CAUTION** Leave a couple of millimeters of space between the lug and the surface of the gearbox. The surface of the gearbox is a sealing surface, not to be damaged.	Lifting eye: 3HAC14457-4  xx1700002193
5	**CAUTION** The weight of the gearbox is 92 kg All lifting accessories used must be sized accordingly.	

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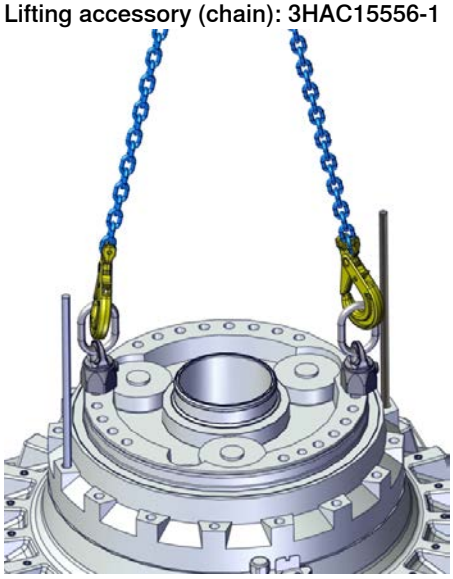
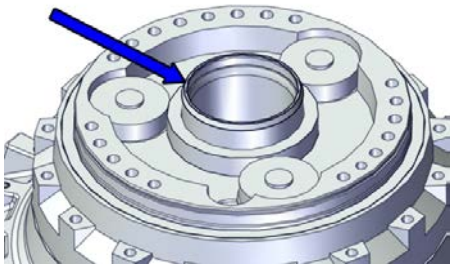
	Action	Note
6	Attach the lifting accessory (chain) to the gearbox.	Lifting accessory (chain): 3HAC15556-1  xx1700002194
7	Protect the sealing areas on top of the protection tube, to avoid damaging them.	 xx1700001655
8	Lift away the gearbox.	

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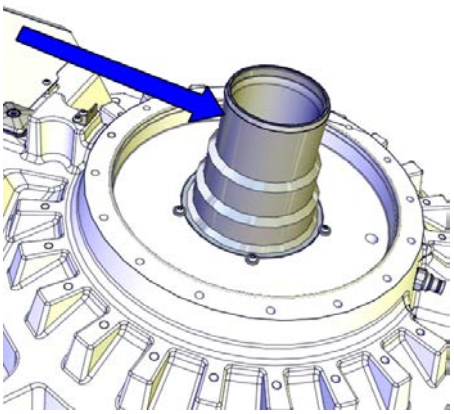
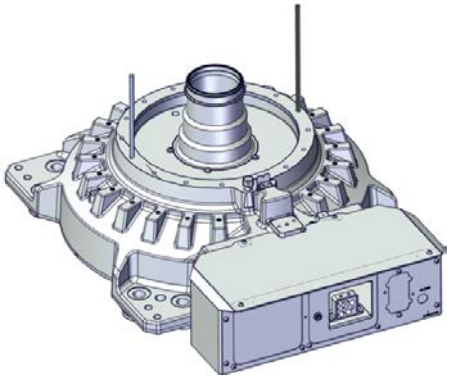
4.8.1 Replacing the axis-1 gearbox
Continued

Refitting the axis-1 gearbox

These procedures describe how to refit the axis-1 gearbox.

Preparations of robot base

Use this procedure to do the necessary preparations before refitting the gearbox.

	Action	Note
1	Check the protection tube for damages. Especially check the surface for the radial sealing. See figure! Replace if damaged. **Note** A sleeve is mounted on the protection tube to ensure that the radial sealing seals properly against the tube.	 xx1300000779
2	Fit guide pins in opposite holes in the base. **Tip** Lubricate the guide pins with some grease to make the gearbox slide better.	Guide pin, M12x150: 3HAC13056-2 Guide pin, M12x200: 3HAC13056-3 Always use guide pins in pairs.  xx1700001642
3	Wipe clean the contact surfaces on the base and the surfaces of the protection tube from any contamination.	
4	Put grease on the protection tube.	

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Preparations of gearbox

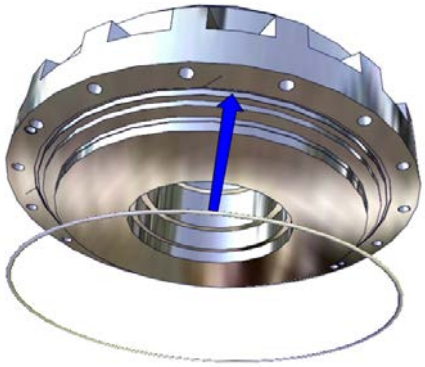
Use this procedure to do the necessary preparations before refitting the gearbox.

	Action	Note
1	Fit two lifting eyes manually in opposite holes in the gearbox. **CAUTION** Leave a couple of millimeters of space between the lug and the surface of the gearbox. The surface of the gearbox is a sealing surface, not to be damaged.	Lifting eye: 3HAC14457-4  xx1700002190
2	Attach the lifting accessory (chain).	Lifting accessory (chain): 3HAC15556-1  xx1700002191
3	**CAUTION** The weight of the gearbox is 92 kg All lifting accessories used must be sized accordingly.	
4	Wipe clean the contact surfaces from any contamination. Also wipe clean the o-ring groove.	 xx1200001245

Continues on next page

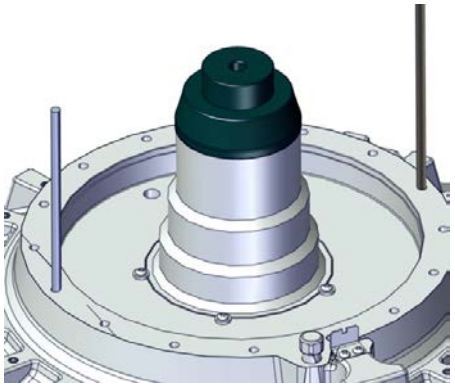
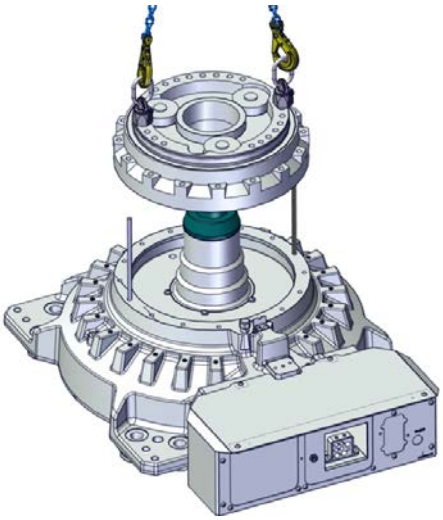
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
5	Wipe clean and put some grease on a new o-ring. **Note** Do not reuse an old o-ring!	O-ring: 3HAC061327-002.  xx1200001244
6	Fit the o-ring in the groove of the gearbox.	
7	Wipe clean the surfaces of the hole in axis-1 gearbox.	 xx1700002192

Continues on next page

Refitting the gearbox to the base

	Action	Note
1	Fit the guide for the gear on top of the protection tube. It protects the protection tube from getting damaged when the gearbox is being fitted.	Guide for reduction gear: 3HAC043870-009.  xx1700002037
2	Lower the gearbox very carefully onto the guide pins and onto the protection tube. **Note** Make sure that the o-ring is still fitted correctly when the gearbox is being fitted.	 xx1700001641
3	Remove the guide pins.	
4	Remove the lifting accessory and the lifting eyes.	

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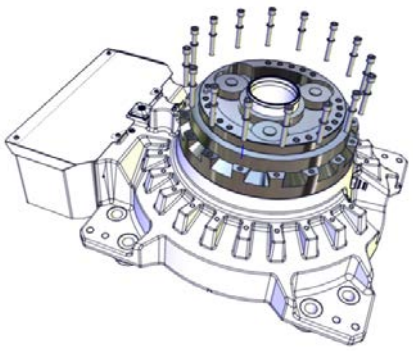
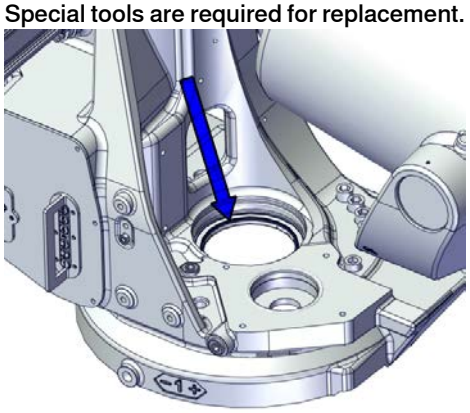
4.8.1 Replacing the axis-1 gearbox

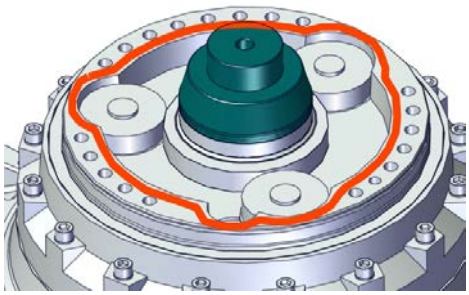
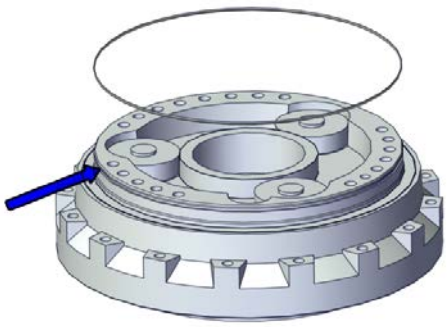
Continued

	Action	Note
5	Fit the attachment screws and washers. Tighten by hand.	 xx1200001186 Attachment screws: M12x90 stainless steel (3HAC060786-036) (16 pcs) Washers: 13x19x2 coated stainless steel (3HAC060866-004) (16 pcs)
6	Torque tighten all screws.	Tightening torque: 120 Nm.

Preparations before refitting the arm system

	Action	Note
1	Replace the radial sealing.	Special tools are required for replacement.  xx1700001639
2	Remove old residues of flange sealant and other contamination from the contact surfaces on the gearbox.	
3	Wipe clean the contact surfaces from any remaining contamination.	

Continues on next page

	Action	Note
4	Apply flange sealant on the contact surface of the gearbox. Apply an activator on the corresponding contact surface of the frame. **Note** The activator must be used to harden the flange sealant.	Flange sealant: - (Loctite 574 (or equivalent)) Activator: 3HAC074342-001 (Loctite 7091)  xx1700001657
5	Wipe clean the o-ring groove in the gearbox and the new o-ring.	Hex socket head cap screw: 3HAC060786-036. Grease: 3HAC042536-001.  xx1700001658
6	Lubricate the new o-ring with grease and fit it to the gearbox.	

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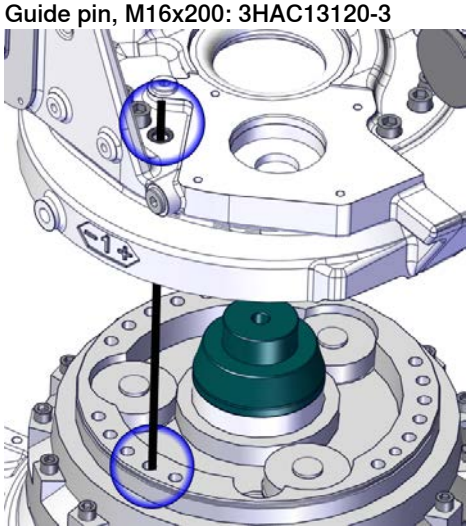
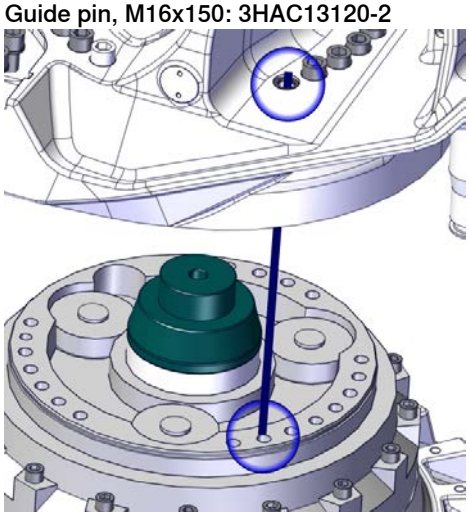
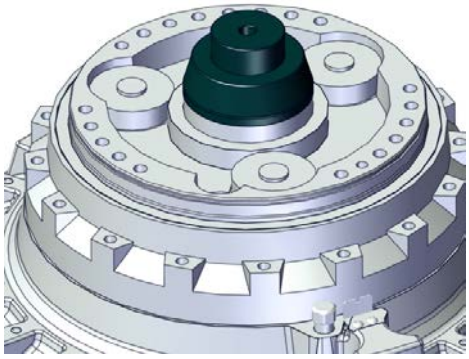
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
7	Apply guide pins in opposite holes in the gearbox. **Note** Make sure that the guide pins are fitted in the correct holes in the gearbox. See figures! **Tip** Lubricate the guide pins with some grease to make the frame slide better.	Guide pin, M16x200: 3HAC13120-3  xx1700002196 Guide pin, M16x150: 3HAC13120-2  xx1700002197 Always use guide pins in pairs.
8	Fit the guide for the gear on top of the protection tube. It protects the radial sealing from being damaged during refitting.	Guide for reduction gear: 3HAC043870-009.  xx1700002096

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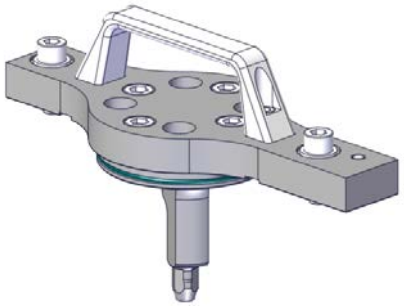
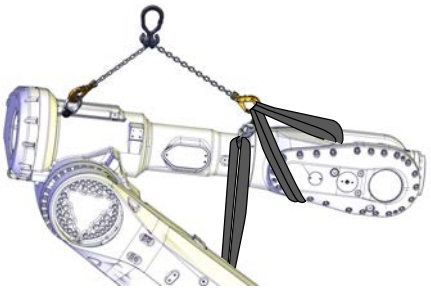
	Action	Note
9	Prepare the aligning tool. 1 Put some grease on the o-ring of the aligning tool. 2 Put some grease on the part of the aligning tool that will mate with the hole in the gearbox. 3 Also put some grease in the matching hole in the gearbox. The aligning tool is now prepared to be fitted. Wait until the arm system is lifted into position and the arm system orientation is verified visually before fitting the tool.	Aligning tool: 3HAC046645-003 Used for aligning the gearbox against the frame, so that the play in the motor does not need to be adjusted.  xx1700001659

Refitting the arm system

	Action	Note
1	**CAUTION** The arm system weighs 1,100 kg. All lifting accessories used must be sized accordingly.	
2	Make sure that all lifting accessories still is fitted correctly on the arm system.	
3	Attach the upper arm lifting accessory (chain) to an overhead crane (or similar) and then to the lifting eye in the arm house and to a roundsling run through the wrist.	For a more detailed description see *Attaching the lifting accessories on page 530*. Lifting accessory (chain): 3HAC15556-1 Roundsling, 1 m: Length: 1 m, lifting capacity: 1,000 kg.  xx1200001236
4	Lift the arm system up to reach the contact surfaces underneath the frame.	
5	Remove old residues of flange sealant from the contact surfaces.	
6	Wipe clean the contact surfaces from any remaining contamination. Also wipe clean the o-ring groove.	

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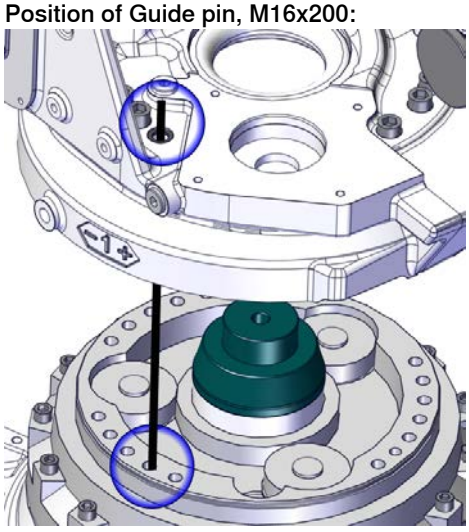
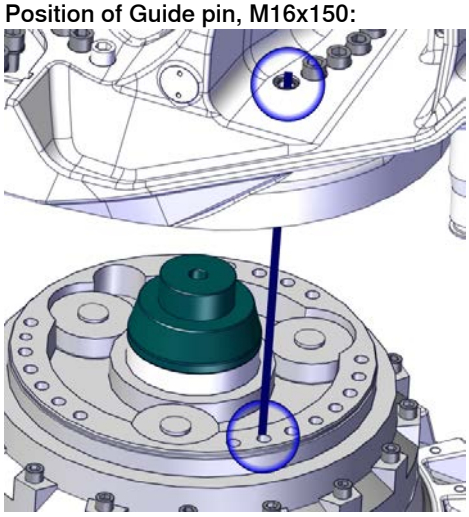
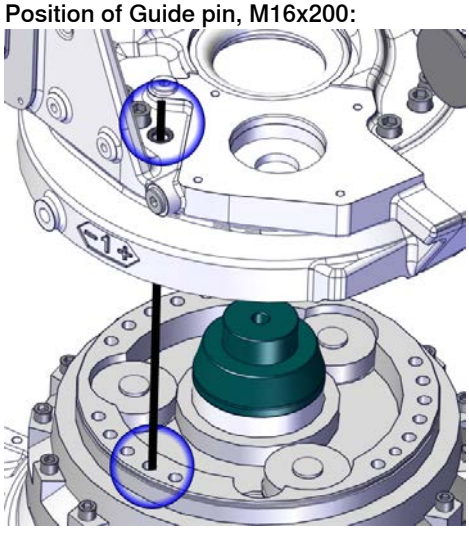
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
7	Lift the arm system to mounting position, and verify that the hole pattern match and that the guide pins will enter the correct holes in the frame. **Note** The amount of screw holes differ between the frame and the gearbox. See figures for correct entering holes for the guide pins.	Position of Guide pin, M16x200:  xx1700002196 Position of Guide pin, M16x150:  xx1700002197
8	Lower the arm system to align the longest guide pin into the hole. **Note** The outer screw hole in the gearbox (next to the motor pinion hole) is not used.	Position of Guide pin, M16x200:  xx1700002196

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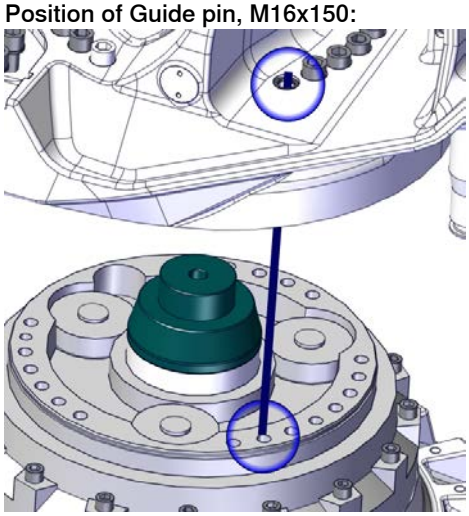
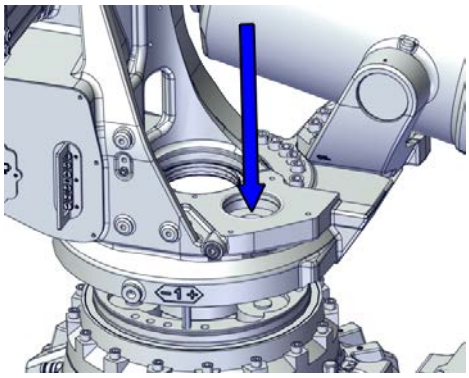
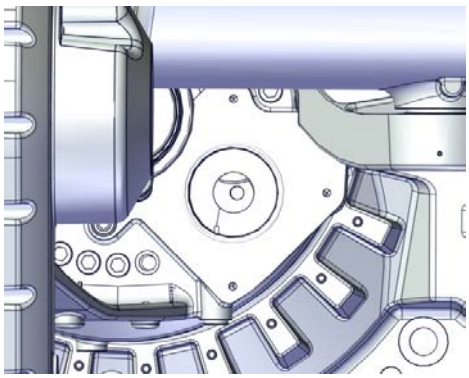
	Action	Note
9	Lower the arm system to align the other guide pin into the hole.	Position of Guide pin, M16x150:  xx1700002197
10	Visually verify through the axis-1 motor hole that the hole is aligned with the pinion hole in the gearbox.	 xx1700002040  xx1700002041

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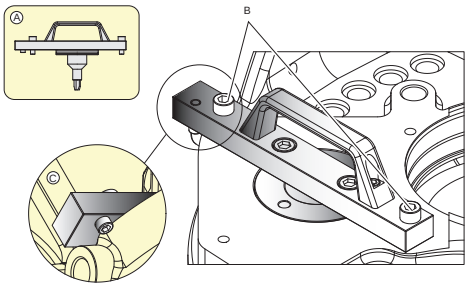
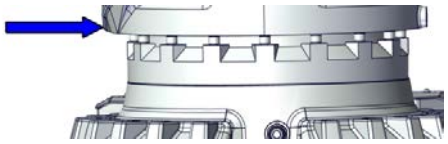
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
11	Fit the aligning tool according to figure.	 xx1300001118 A Aligning tool B Attachment screws (2 pcs) C Correct fitting of the aligning tool. Tightening torque: 24 Nm.
12	Lower the arm system slowly until the heads of the gearbox attachment screws are starting to disappear inside the frame edge. Verify visually from the side and from the front/back that the frame is coming down completely level against the gearbox. If the frame is somewhat tilted, adjust the lifting position with the overhead crane. **Note** While lowering the complete arm system, check that the cylindrical pin is fitted correctly.	 xx1700002042  xx1700002043
13	When the arm system is in position, fit the accessible attachment screws manually (no tools).	Attachment screws: M16x50 stainless steel (3HAC060786-041) (16 pcs) Washers: 17x25x3 coated stainless steel (HV200 (3HAC060866-005)) (16 pcs)
14	Use caution and lower the complete arm system into position on top of the gearbox.	
15	Secure the complete arm system to the axis-1 gearbox with its attachment screws.	Tightening torque: 300 Nm.
16	Remove the two guide pins and replace with attachment screws. Tighten the remaining, accessible attachment screws.	Tightening torque: 300 Nm.
17	Perform a leak-down test.	See *Performing a leak-down test on page 184*.
18	Remove the aligning tool, after the leak-down test is completed successfully.	

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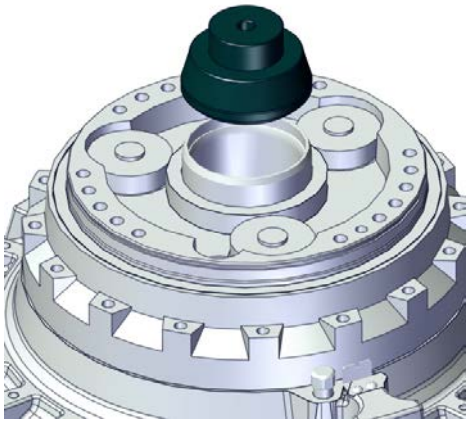
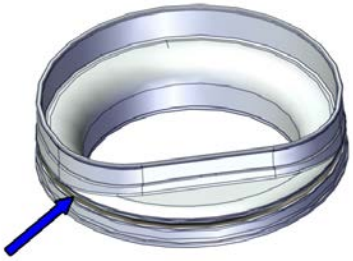
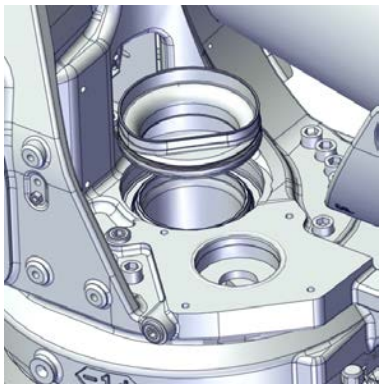
	Action	Note
19	Remove the guide for the reduction gear.	 xx1700002038
20	Remove the lifting accessories. Refit stop screws in the lifting accessory attachment holes.	

Refitting the frame cable protection

	Action	Note
1	Replace the o-ring on the protection ring.	O-ring: 3HAB3772-58.  xx1700001660
2	Refit the protection ring. Push it down until the groove in the protection ring goes in to the groove in the frame. This can be checked by rotating the ring. If it is easy to rotate, the grooves are aligned. **Note** Face the flat side against the axis-1 motor location.	 xx1700001633

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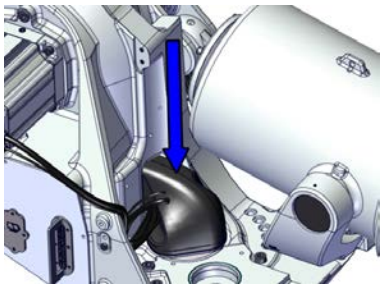
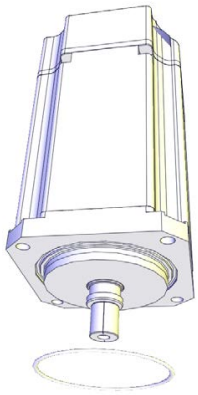
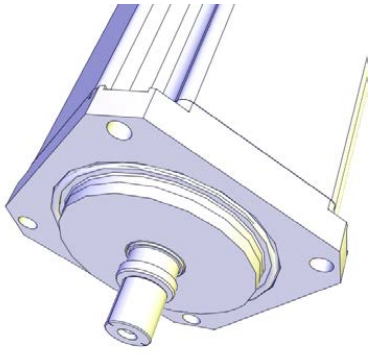
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
3	Insert the cabling into the base and refit the cable protection while pushing down the cabling. Fasten with the hose clamp around the protection ring.	 xx1700002095

Preparations prior to refitting motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Remove any old paint residues or other contamination from the contact surfaces on both the motor and the mating parts. Wipe clean the contact surfaces and the o-ring groove.	
3	Fit a new o-ring.	 xx1200001019
4	Make sure the o-ring is seated in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	 xx1200001020

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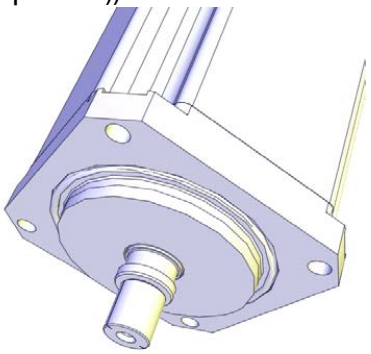
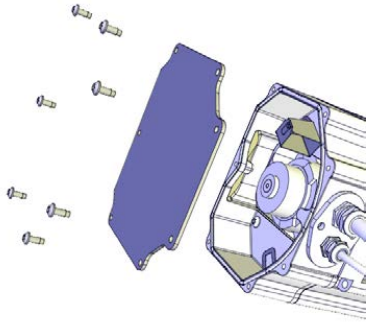
	Action	Note
5	Apply locking liquid with activator on the motor flange.	Activator (Loctite 7091). Flange sealant (Loctite 574 (or equivalent)).  xx1200001020
6	If the motor is a new spare part, remove the cover.	 xx1200001135

Securing the axis-1 motor

	Action	Note
1	Fit guide pins in opposite holes.	Guide pin, M12x150: 3HAC13056-2 Always use guide pins in pairs.
2	**CAUTION** The motor weighs 25 kg. All lifting accessories used must be sized accordingly.	
3	Apply the lifting accessory.	Lifting accessory, motor: 3HAC14459-1.
4	Fit the rotation tool.	Rotation tool: 3HAB7887-1

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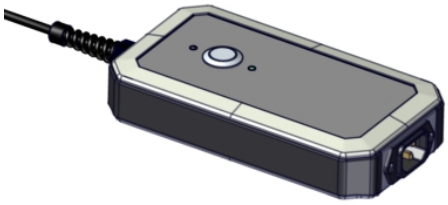
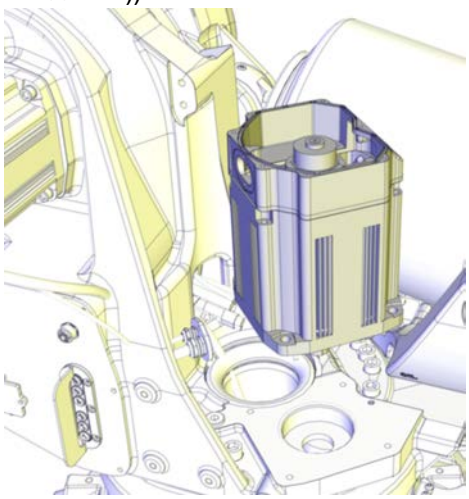
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
5	Release the brakes of the axis-1 motor with the brake release tool. 1 Turn off the brake release tool. 2 Connect the tool to the R2.MP1 connector. 3 Release the brakes by turning on the brake release tool and pressing the brake release button on the tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool. **Note** If a 24 VDC power supply is used instead of the brake release tool, connect it to connector R2.MP1: • pin 2 = 24V • pin 5 = 0V	Brake release tool: 3HAC081310-001 User instructions are enclosed with the tool.  xx2100000666
6	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
7	Lower the motor into position. • Make sure that the motor pinion is properly mated to the gear in the gearbox. • Make sure that the motor pinion does not get damaged. • Make sure that the direction of the cable gland exit is facing the correct way.	Lifting accessory (chain): 3HAC15556-1 Lifting accessory, motor: 3HAC14459-1. Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001072

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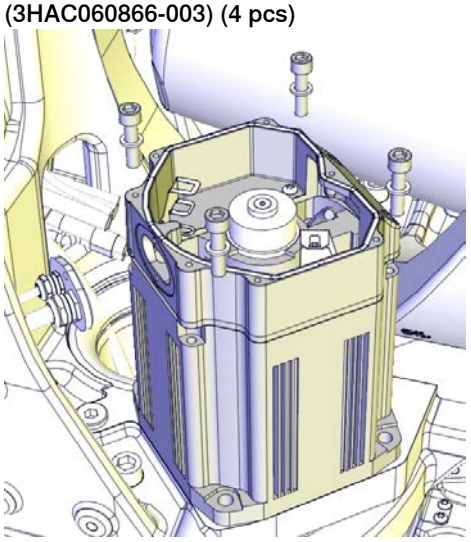
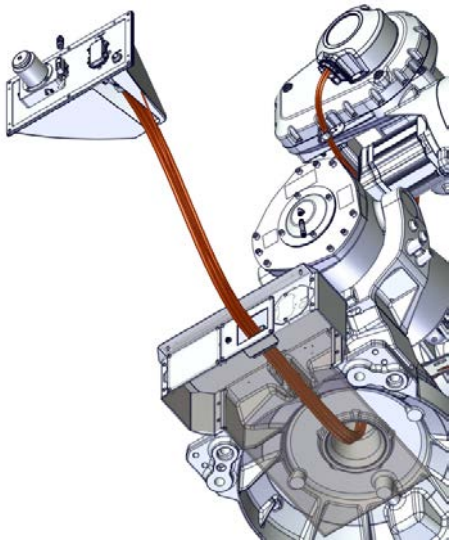
	Action	Note
8	Secure the motor with its attachment screws and washers. Use a bits extender to reach the screws.	Bits extender: 3HAC12342-1 Tightening torque: 50 Nm. Screws: M10x30 stainless steel (3HAC060786-020) (4 pcs) Washers: 13x17x2 stainless steel (3HAC060866-003) (4 pcs)  xx1200001071
9	Perform a leak-down test (if not already done).	See *Performing a leak-down test on page 184*.
10	Disconnect the brake release tool / 24 VDC power supply.	

Refitting the cable harness in the base

	Action	Note
1	Run the cables correctly aligned: • Make sure that the cables are not twisted. Each cable must be in line with its position on the base plate. • Make sure that the R1.SMB cable will run on the correct side of the R1.MP1, see the figure. **Note** Do not run the cables connected between the interface plate and the manipulator base submerged beneath detergent solution, since that kind of extensive exposure to fluids shortens the expected life of the cables significantly.	 xx1700001808

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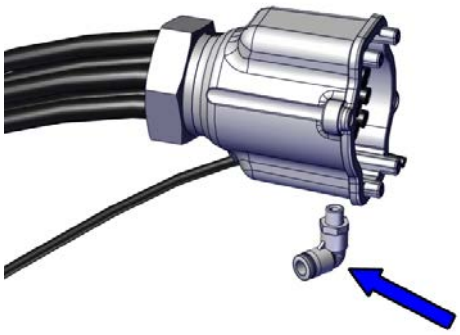
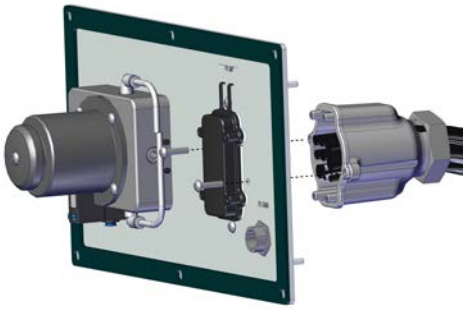
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
2	Seal and refit the air coupling to the connector R1.MP and reconnect the air pressure hose.	Tightening torque: 0.5 kg  xx1700001583
3	Connect connectors R1.MP and R1.SMB. Also connect the air hose that belongs to the balancing device. Check the adapter for dirt or wear. Clean or replace if needed.	Tightening torque for R1.SMB: 10 Nm. Adapter: 3HAC11774-3  xx1700001582
4	Refit the cover that protects the R1.MP and R1.SMB connectors.	Tightening torque: 6 Nm  xx1700001581
5	Connect the earth cable.	Screw dimension: M6x16. Washer dimension: 6.4x17x3.

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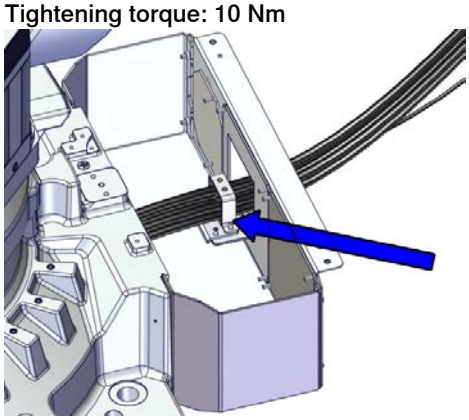
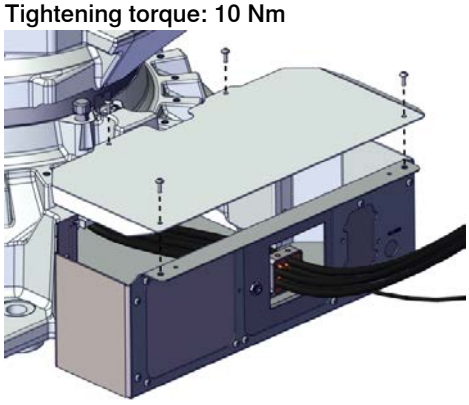
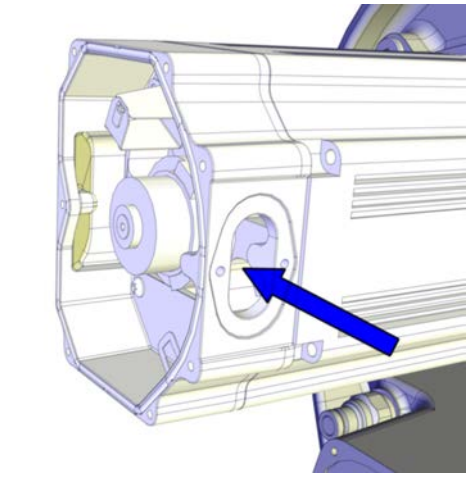
	Action	Note
6	Refit the metal clamp inside the base.	Tightening torque: 10 Nm  xx1700001584
7	Refit the base cover.	Tightening torque: 10 Nm  xx1700001580
8	Install the cabling between the base and the	

Connecting the axis-1 motor cables

	Action	Note
1	Push the motor cables through the cable gland opening.	 xx1300000738

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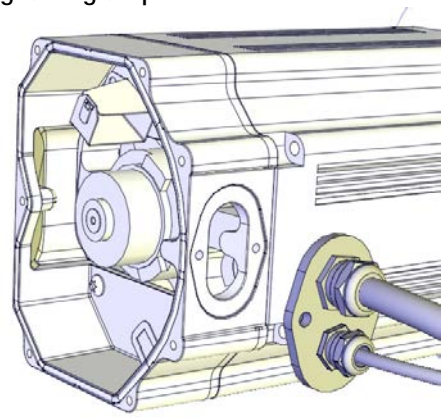
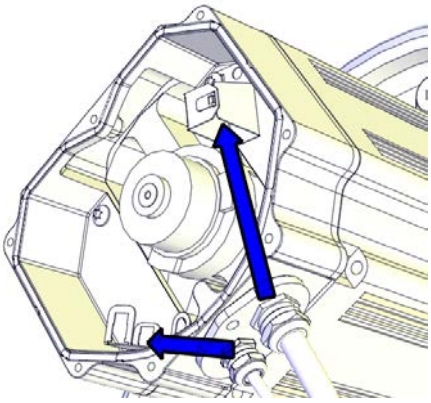
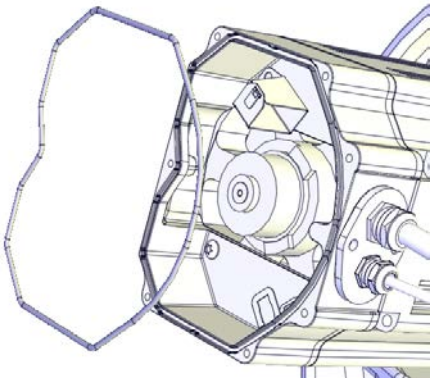
4.8.1 Replacing the axis-1 gearbox

Continued

	Action	Note
2	Refit the cable gland cover. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001067
3	Connect the motor cables. Connect in accordance with the markings on the connectors.	 xx1200001066
4	Inspect the o-ring. **Note** Replace if damaged.	O-ring, axis-1: 3HAC067762-001 O-ring, axis-2: 3HAC067762-001 O-ring, axis-3: 3HAC067762-001 O-ring, axis-4: 3HAC067744-001  xx1200001070
5	Wipe clean o-ring and o-ring groove.	

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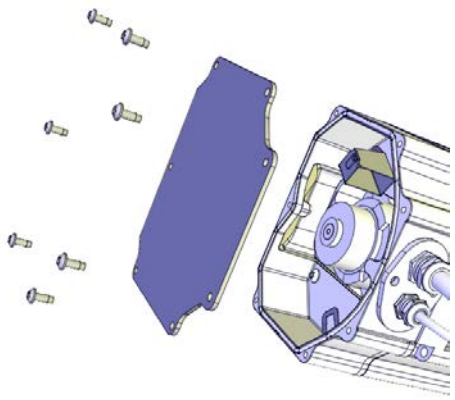
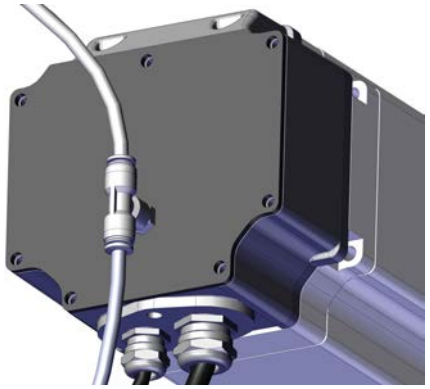
	Action	Note
6	Refit the o-ring. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	
7	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
8	Refit the motor cover with it's attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Attachment screws: M5x12 Stainless steel A2-70 (7 pcs) (9ADA619-44) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001135
9	Make sure that the covers are tightly sealed.	
10	Connect air hose to air fitting on motor. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000568

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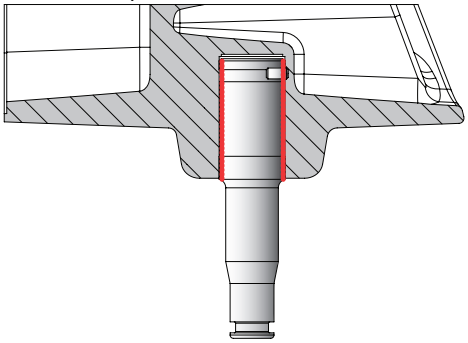
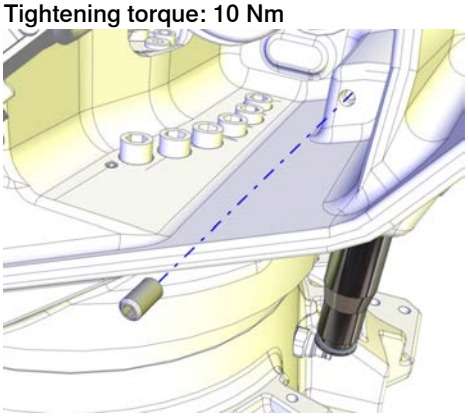
4.8.1 Replacing the axis-1 gearbox

Continued

Concluding procedure

	Action	Note
1	Remove the lifting accessory.	
2	Turn on the power to the robot and jog to: • axis 1 = -5° • axis 2 = +10°	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Secure the remaining attachment screws that previously were not accessible.	Tightening torque: 300 Nm.
5	Refill oil in the gearbox.	See *Filling oil into the axis-1 gearbox on page 147*.
6	Apply Mercasol on the surfaces shown in the figure, on stop pin and in the hole as shown in the figure.	Rust preventive: 3HAC034903-001 (Mercasol 3110 Waxcoat. Recommended drying time is 24h.).  xx1400000378
7	Refit the mechanical stop pin and secure it with the attachment screw. Apply locking liquid on the screw.	Screw: M10x20 Stainless Steel (9ADJ400914P1259) Locking liquid: Loctite 2400 (or equivalent Loctite 243) Tightening torque: 10 Nm  xx1300000476

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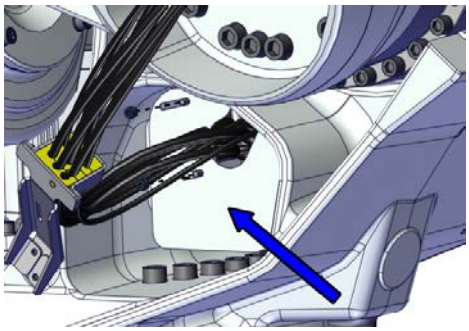
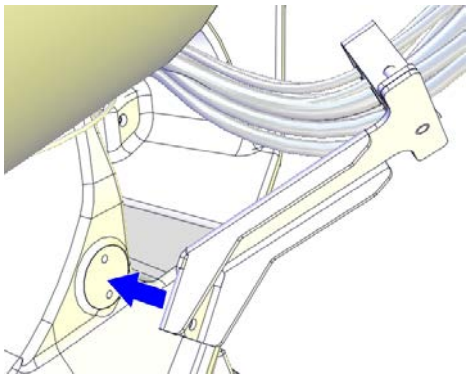
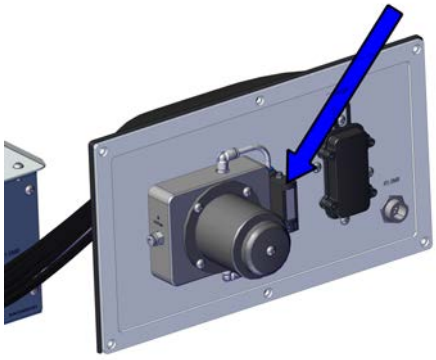
	Action	Note
8	Refit the cable protection plate with two nuts.	 xx1700001585
9	Refit the cable bracket on the frame.	 xx1200001246
10	Turn on the air pressure supply to the overpressure system.	
11	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
12	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.
13	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.8.2 Replacing the axis-2 gearbox

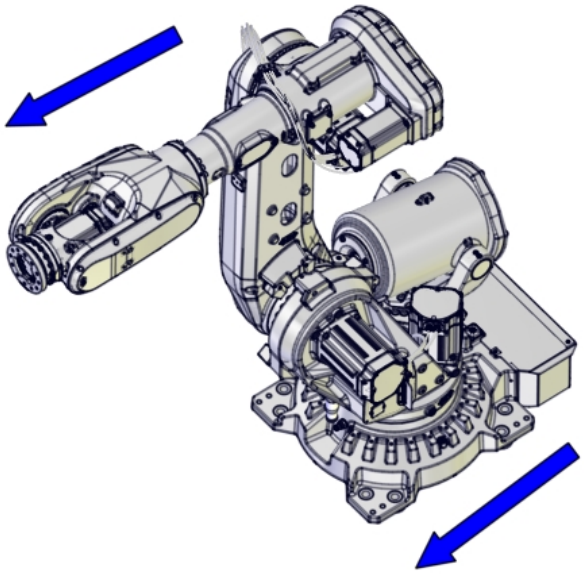
Space required beside

This section describes how to replace the gearbox without needing to remove the cable harness and DressPack cable package (if installed) from the robot.

The described procedure requires free space on the floor, in front of the frame (with axis-1 in calibration position). There should be enough space to place two pallets as shown in the figures in the procedures below.

DANGER

The base shall be fitted to the foundation when performing this procedure! Valid in both examples described below.



xx1300002303

Example 1: Position with space for pallets in front of the robot. Axis-1 in calibration position.

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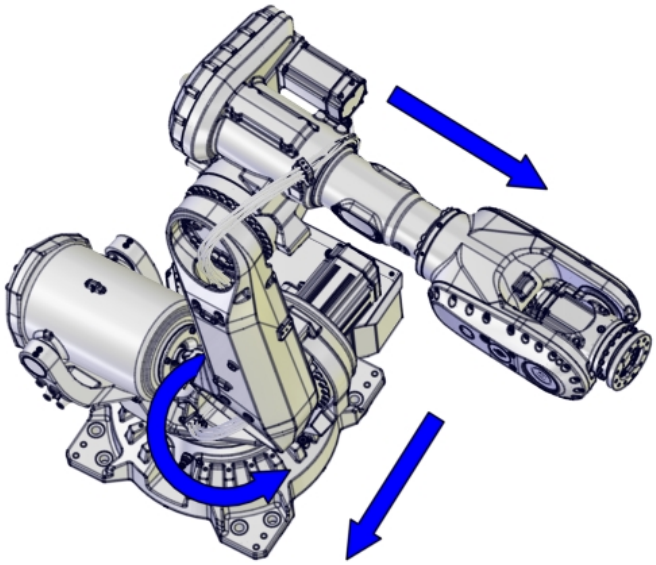
If needed, run axis-1 into a position that gives the required space. The figure shows an example.



xx1300002304

Example 2: Axis-1 jogged to a position where it is possible to find the required space in another position of axis-1 than calibration position.

Note

Using this method to replace the gearbox with cable harness and DressPack fitted, is only a recommendation. If it is not possible to put the arm system close enough to the robot and keep the cable harness partly fitted, it may by necessary to remove the cable harness and DressPack in base and frame first.

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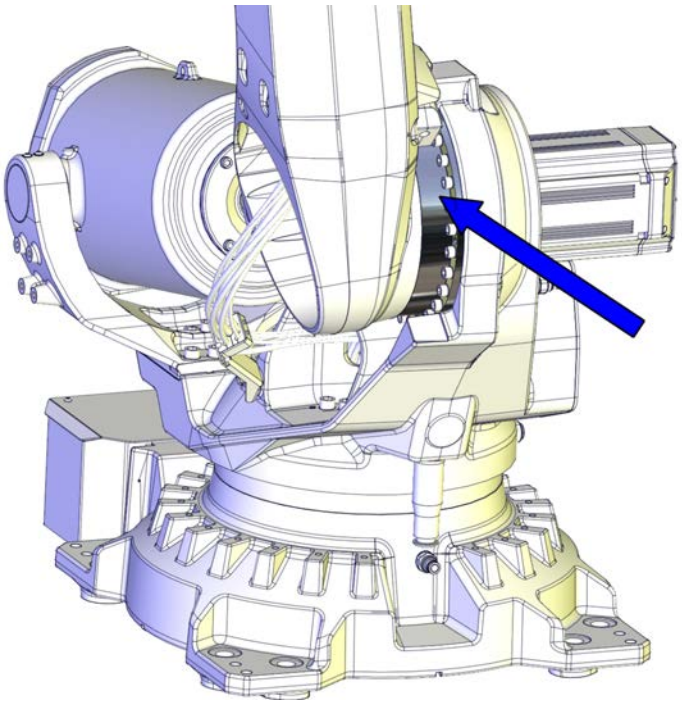
4.8.2 Replacing the axis-2 gearbox
Continued

Location of the axis-2 gearbox

The axis-2 gearbox is located as shown in the figure.



xx1200001276

Spare parts

Spare parts	Article number	Note
Axis-2 gearbox	See *Product manual, spare parts - IRB 6790*	

Consumables

Equipment, etc	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.
O-ring	3HAB3772-107	D=102x3 Used on motor flange.
O-ring	3HAC067762-001	D=169.5x3 Used on motor cover.
O-ring	3HAB3772-48	
VK cover	3HAA2166-28	VK 28x7
Locking liquid (Loctite 2701)	-	

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Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Gearbox	M12x90 stainless steel 3HAC060786-036	13x19x2 coated stainless steel 3HAC060866-004	30 pcs
Lower arm	M16x50 stainless steel 3HAC060786-041	17x25x3 coated stainless steel HV200 (3HAC060866-005)	21 pcs
Motor, axis-2	M10x30 stainless steel 3HAC060786-020	13x17x2 stainless steel 3HAC060866-003	4 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 144*.
Lifting eye	3HAC16131-1	M12
Lifting eye	3HAC14457-4	M16
Fender washer	-	Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.
Lifting shackle	-	SA-10-8-NA1
Roundsling, 1.5 m	-	Length: 1.5 m. Lifting capacity: 2,000 kg.
Roundsling, 1 m	-	Length: 1 m, lifting capacity: 1,000 kg.
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
24 VDC power supply	-	Used to release the motor brakes.
Removal tool motor M12	3HAC14631-1	Used to push out the motor, if necessary. Always use removal tools in pairs.
Pallet		Used for putting down removed parts from robot.
Guide pin, M16x150	3HAC13120-2	Always use guide pins in pairs.
Guide pin, M16x200	3HAC13120-3	Always use guide pins in pairs.
Guide pin, M12x150	3HAC13056-2	Always use guide pins in pairs.
Guide pin, M12x200	3HAC13056-3	Always use guide pins in pairs.

Continues on next page

Equipment, etc.	Article number	Note
Aligning tool	3HAC046645-003	Used for aligning the gearbox against the frame, so that the play in the motor does not need to be adjusted.
Guide pin, M10x150	3HAC15521-2	Always use guide pins in pairs.
Lifting accessory, gearbox	3HAC046128-001	
Hydraulic cylinder	3HAC11731-1	To be used with the press tool.
Hydraulic pump 70 MPa	3HAC13086-1	To be used with the hydraulic cylinder.
Leak-down tester	-	
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Required documents

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

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 651*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the axis-2 gearbox

Use these procedures to remove the gearbox.

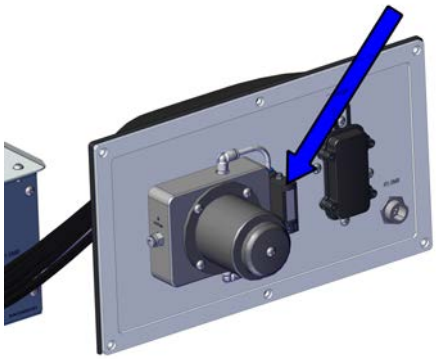
Continues on next page

Follow the order of the procedures according to the order they are presented.

CAUTION

When performing these procedures, the cable harness will still be fitted or partly fitted to the robot. Use extreme caution not to cause any damage to the cable harness.

Preparations before replacing the axis-2 gearbox

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
3	Begin draining the gearbox.	See *Draining the axis-2 gearbox on page 151*.
4	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593
5	**CAUTION** Turn off the air pressure supply.	

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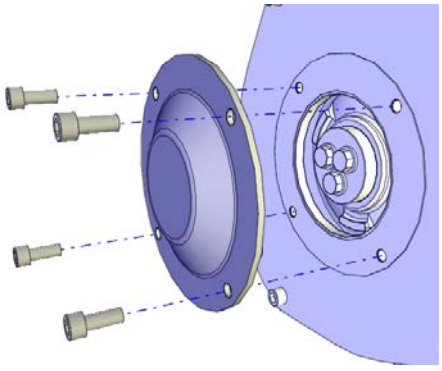
4.8.2 Replacing the axis-2 gearbox
Continued

Unloading the balancing device springs with the robot and locking position with the Distance tool

Use this procedure to unload the balancing device with the help of the robot, and lock the balancing device springs in a compressed position, using the Distance tool (3HAC030662-001).

	Action	Note
1	**DANGER** Do not use the Distance tool (3HAC030662-001) to unload or restore the pressure of the balancing device springs! This tool is only used to lock the spring unit in a compressed position, after axis-2 has been jogged to -30° or +30°. Fitting and removal of the tool shall only be done with axis-2 in this position! To unload or restore a new balancing device or if the spring unit of the balancing device cannot be compressed by jogging the robot, only use the Hydraulic press tool, balancing device (3HAC074411-001).	
2	Jog axis-2 to: • -30° or +30°	This is done in order to compress the balancing device springs inside the balancing device before fitting the Distance tool.
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Remove the cover plate on the back of the balancing device. **DANGER** DO NOT remove any other screws than the rear cover attachment screws.	 xx1300000554

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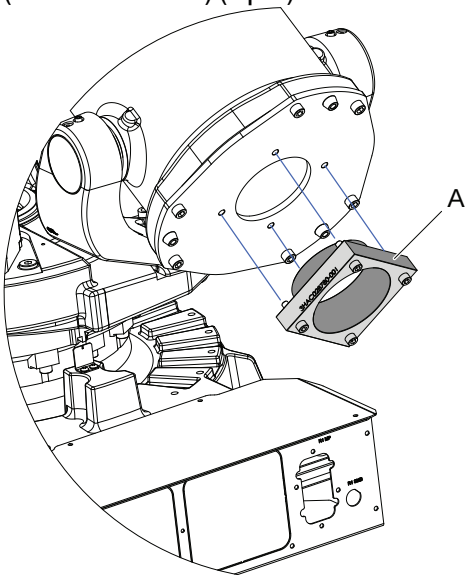
	Action	Note
5	Fit the Distance tool on the back of the balancing device using the four screws. **DANGER** Use caution when tightening the screws. The threads in the cover can be damaged if more tightening torque than 45 Nm is used, risking that the Distance tool is not properly fitted.	Tightening torque: 45 Nm Attachment screws: M10x30 stainless steel (3HAC060786-020) (4 pcs)  xx0800000480 A Distance tool: 3HAC030662-001
6	Turn the power on temporary.	
7	Jog axis-2 to the calibration position. The balancing device is now unloaded.	This is done to compress the balancing device springs, making it possible to remove the front shaft of the balancing device.
8	Let the Distance tool stay fitted during the continued procedure.	
9	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	

Attaching lifting accessory to the balancing device

	Action	Note
1	**CAUTION** The weight of the balancing device (excluding cradle) is 140 kg All lifting accessories used must be sized accordingly.	

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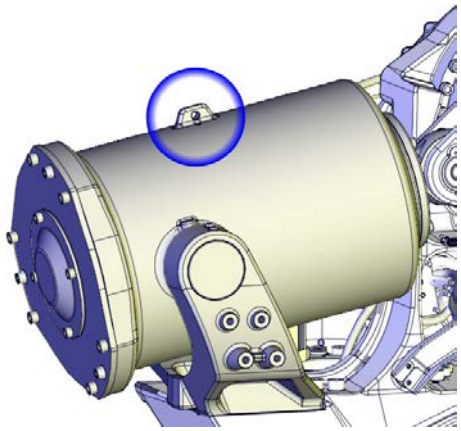
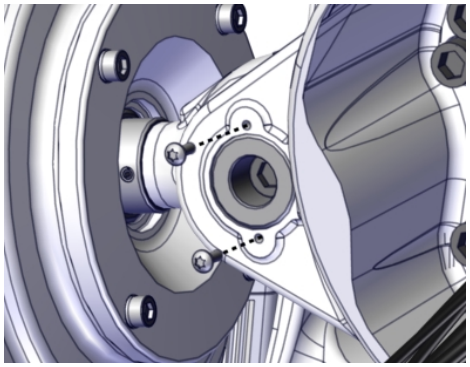
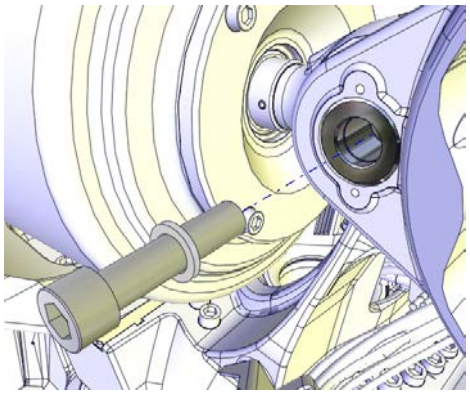
4.8.2 Replacing the axis-2 gearbox

Continued

	Action	Note
2	Fit a lifting shackle to the balancing device.	Lifting shackle: SA-10-8-NA1  xx1300000661
3	Fit the lifting accessory to the shackle and raise to unload the weight.	Lifting accessory (chain): 3HAC15556-1

Removing the shaft in the front (link ear)

	Action	Note
1	Remove the two screws.	 xx1900002146
2	Unscrew the attachment screw and washer.	 xx1200001279 • M16x70, stainless steel

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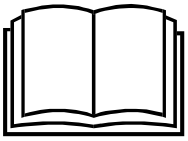
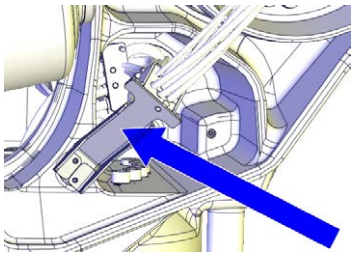
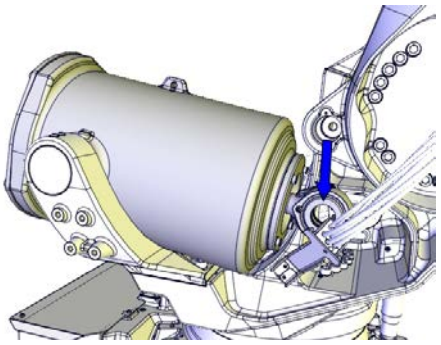
	Action	Note
3	Pull the shaft out using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.
4	Remove the attachment screws of the cable bracket on the frame and let it hang loose.	 xx1200001283
5	Put down the balancing device and let it rest on the frame.	 xx1200001281

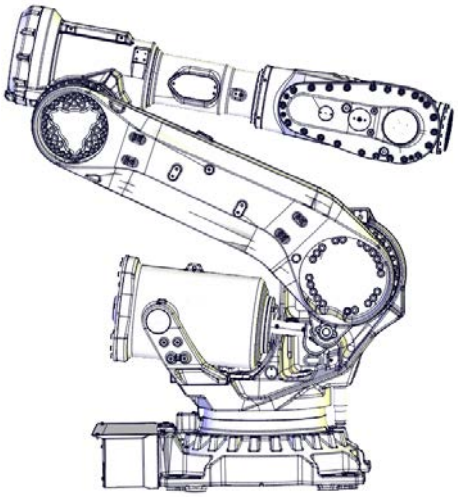
Robot position

Use this procedure to jog the robot into position.

	Action	Note
1	**Note** When jogging the axis-2 into position check that the balancing device ear and the ear on the lower arm is not colliding!	

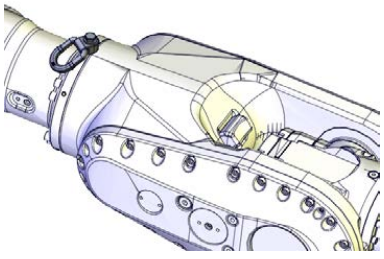
Continues on next page

4.8.2 Replacing the axis-2 gearbox
Continued

	Action	Note
2	Jog the robot into position: • Axis-1: no significance as long as the robot is secured to the foundation • Axis-2: -45° • Axis-3: +65° (approximately) • Axis-4: 0° • Axis-5: 0° • Axis-6: 0°.	 xx1200001250
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	

Attaching lifting accessories to the lower and upper arm

Use this procedure to attach the lifting accessories.

	Action	Note
1	**CAUTION** The lower and upper arms together weigh (according to variants) 510 kg. All lifting accessories used must be sized accordingly!	
2	Fit a lifting eye to the wrist. **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1  xx1200001133

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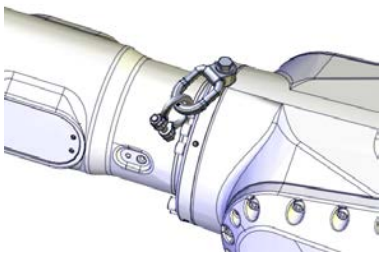
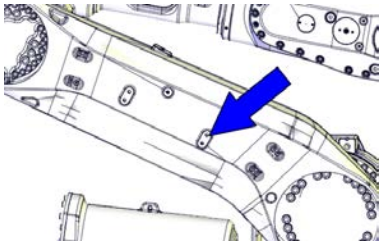
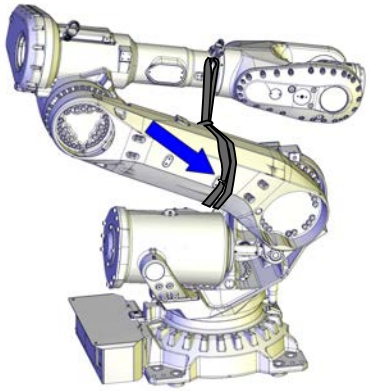
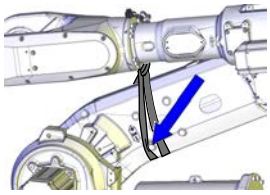
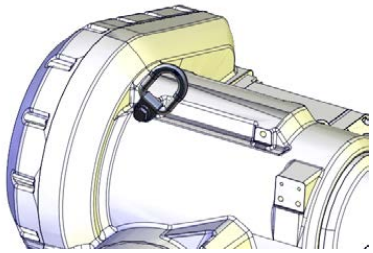
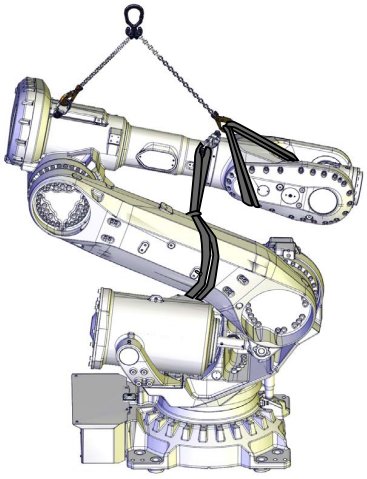
	Action	Note
3	Fit a lifting shackle in the wrist lifting eye.	Lifting shackle: SA-10-8-NA1  xx1200001234
4	Insert a M8x50 securing screw, not more than 10-15 mm, into the screw hole shown in the figure. This is done to secure the roundsling from gliding when lifting. **Note** Save the stop screw installed, to refit after the lifting eye is removed.	 xx1200001251
5	Run a roundsling around the lower arm, beneath the securing screw.	Roundsling, 1.5 m: Length: 1.5 m. Lifting capacity: 2,000 kg.  xx1200001252
6	Adjust the roundsling on the other side of the lower arm, so that the roundsling runs on the left side of the most lower of the four bosses. This will prevent the roundsling from gliding.	 xx1200001253
7	Attach the roundsling to the shackle on the wrist.	
8	Stretch the roundsling between the wrist and the lower arm by slowly jogging the axis-3. **Note** Make sure the roundsling is stretched, in order to carry the weight of the lower arm.	

Continues on next page

4.8.2 Replacing the axis-2 gearbox

Continued

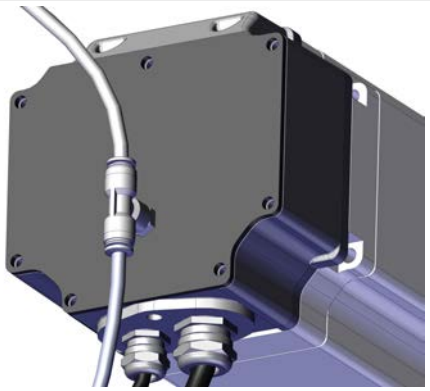
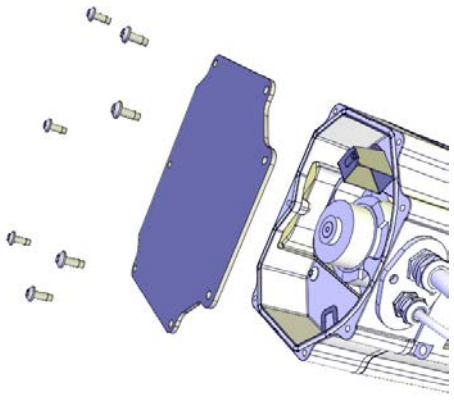
	Action	Note
9	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
10	Fit a lifting eye in the arm house, with a fender washer underneath.  xx1400002196 **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1 Fender washer: Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.  xx1200001134
11	Attach the Lifting accessory (chain) to an overhead crane (or similar), then to the lifting eye in the arm house and to a roundsling run through the wrist.	Lifting accessory (chain): 3HAC15556-1 Roundsling, 1 m: Length: 1 m, lifting capacity: 1,000 kg.  xx1200001254
12	Raise the overhead crane to stretch the chains and roundslings. Verify that the roundsling between the wrist and the lower arm is stretched.	

Continues on next page

	Action	Note
13	To release the brake, connect the 24 VDC power supply. Connect to connector R2.MP2, axis-2 motor: • + = pin 2 • - = pin 5	

Disconnecting the axis-2 motor cables

Use this procedure to disconnect the motor cables.

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Disconnect air hose from air fitting on motor cover.	 xx2100000568
3	Unscrew the attachment screws and washers and remove the motor cover. **Note** Axis 3 and 4 motors only: Be careful not to damage the air hose or air nipple.	 xx1200001135

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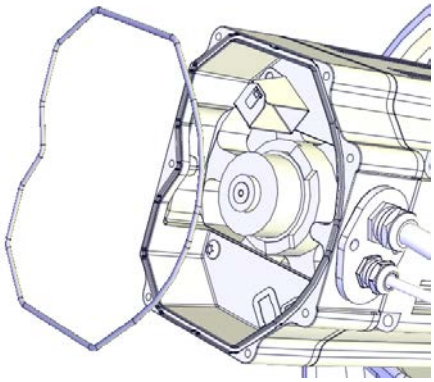
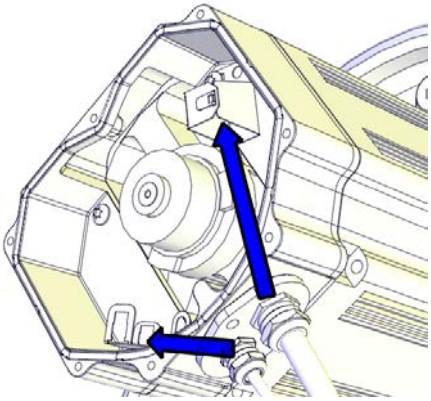
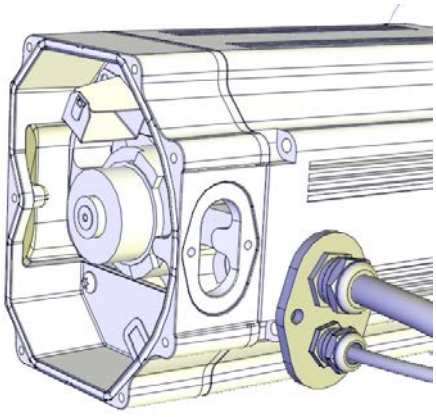
4.8.2 Replacing the axis-2 gearbox

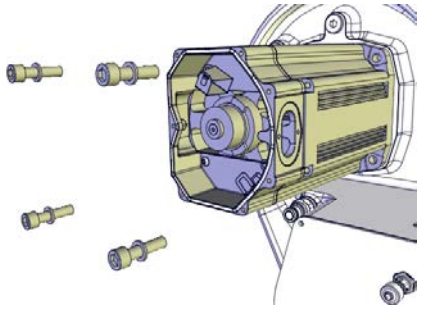
Continued

	Action	Note
4	Make sure the o-ring is present.	 xx1200001070
5	Disconnect the motor cables.	 xx1200001066
6	Remove the cable gland cover. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable gland hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1200001067
7	Use caution and pull out the motor cables.	

Removing the axis-2 motor

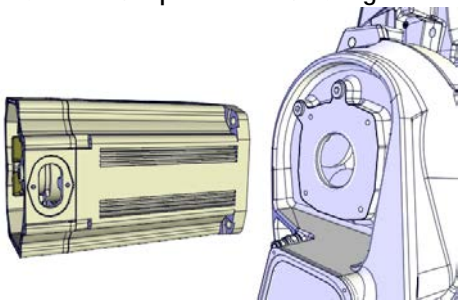
	Action	Note
1	Before removing the motor, make sure that the axis-2 gearbox is completely drained.	

Continues on next page

	Action	Note
2	**DANGER** When releasing the holding brakes of the motor, the lower arm will be movable and may fall down if not secured. Verify that the lower arm is secured as previously described, before continuing.	
3	To release the brake, connect the 24 VDC power supply. Connect to connector R2.MP2, axis-2 motor: • + = pin 2 • - = pin 5	
4	Remove the attachment screws. Use a bits extender in order to reach the screws.	Bits extender: 3HAC12342-1  xx1200001117
5	Fit guide pins in opposite holes. **Tip** Lubricate the guide pins with some grease to make the motor slide better.	Guide pin, M10x150: 3HAC15521-2 Always use guide pins in pairs.
6	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
7	If required, press the motor out of its position by using the removal tool in opposite holes of the motor.	Removal tool motor M12: 3HAC14631-1 Always use removal tools in pairs.
8	Disconnect the 24 VDC power supply.	
9	**CAUTION** The motor weighs 28 kg. All lifting accessories used must be sized accordingly.	
10	Carefully lift the motor out on the guide pins, in order to get the pinion away from the gear and let it rest on the guide pins.	

Continues on next page

4.8.2 Replacing the axis-2 gearbox
Continued

	Action	Note
11	Fasten the lifting accessory. Attach the lifting chain to the accessory and an overhead crane.	Lifting accessory, motor: 3HAC15534-1 Lifting accessory (chain): 3HAC15556-1
12	Remove the motor by sliding it out on the guide pins and lift it off.	Make sure the pinion is not damaged.  xx1200001118

Loosening the cable brackets

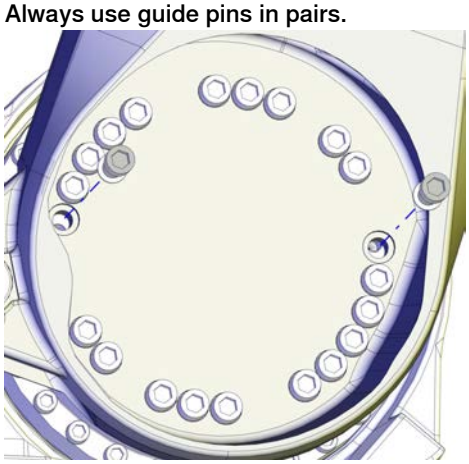
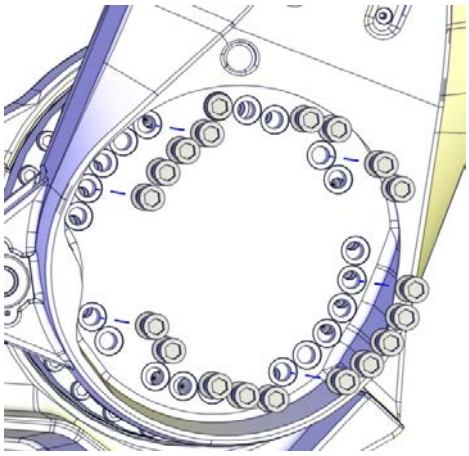
Use this procedure to lift the lower and upper arm un-separated.

	Action	Note
1	Unscrew the attachment screws that secure the axis-2 lower arm metal clamp and the axis-3 lower arm metal clamp located on the inside of the lower arm by removing the attachment screws. **Note** The screws are reached from outside the lower arm!	 xx1300000540

Continues on next page

Removing and lifting away the lower and upper arms un-separated (Step 1)

Use this procedure for the first step of removing and lifting away the lower and upper arm un-separated.

	Action	Note
1	Remove two attachment screws in opposite holes and replace them with guide pins. **Tip** Lubricate the guide pins with some grease to make the lower arm slide better.	Guide pin, M16x150: 3HAC13120-2 Guide pin, M16x200: 3HAC13120-3 Always use guide pins in pairs.  xx1300000788
2	Remove all but one of the remaining attachment screws that secure the lower arm to the axis-2 gearbox.	 xx1300000789

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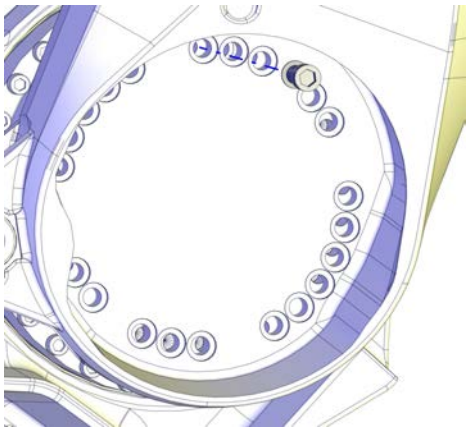
4.8.2 Replacing the axis-2 gearbox
Continued

Removing and lifting away the lower and upper arms un-separated (Step 2)

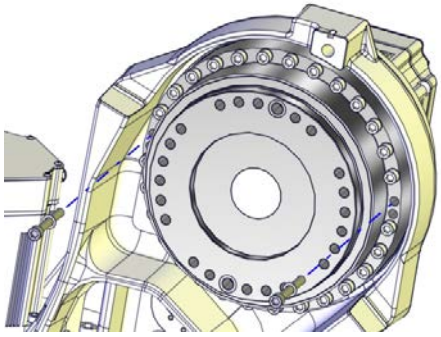
Use this procedure for the second step to remove and lift the lower and upper arm un-separated.

	Action	Note
1	Put two pallets on the floor, in front of the position of the mechanical stop. **Note** Using the method to replace the gearbox with cable harness and DressPack fitted, is only a recommendation. If it is not possible to put the arm system close enough to the robot and keep the cable harness partly fitted, it may by necessary to remove the cable harness and DressPack in base and frame first.	
2	**CAUTION** The lower and upper arms together weigh 510 kg. All lifting accessories used must be sized accordingly!	
3	Use caution and remove the remaining screw and slowly lift away the lower and upper arm together. Let the cabling run in the lower arm. Make sure not to stretch any cabling! **CAUTION** Use extreme caution when lifting the upper arm. The cable harness is still partly connected.	 xx1300000790
4	Use a piece of wood or similar as a support under the arm house when the arm system is put down on the pallets. This is done in order not to damage any parts of the cable harness and DressPack.	
5	Use caution and lift the arm system and lay it down safely on the pallets.	

Continues on next page

Removing the axis-2 gearbox

Use the procedure to remove gearbox.

	Action	Note
1	Remove two attachment screws in opposite holes and replace them with guide pins. **Tip** Lubricate the guide pins with some grease to make the gearbox slide better.	Guide pin, M12x150: 3HAC13056-2 Guide pin, M12x200: 3HAC13056-3 Always use guide pins in pairs.  xx1300002249
2	Leave one of the upper attachment screws and remove the rest. The remaining screw is used to prevent the gearbox from falling down.	
3	**CAUTION** The gearbox weighs 83 kg. All lifting accessories used must be sized accordingly.	
4	Remove the remaining screw left in the gearbox.	
5	Use two fully threaded attachment screws (M12) as removal tools to press the gearbox out of position.	
6	Attach the lifting accessory to the gearbox.	Lifting accessory, gearbox: 3HAC046128-001
7	Use caution and let the gearbox slide out on the guide pins.	
8	Remove the gearbox.	

Refitting the axis-2 gearbox

Use these procedures to refit the gearbox.

Follow the order of the procedures according to the order they are presented.

CAUTION

When performing these procedures, the cable harness will still be fitted or partly fitted to the robot. Use extreme caution not to cause any damage to the cable harness!

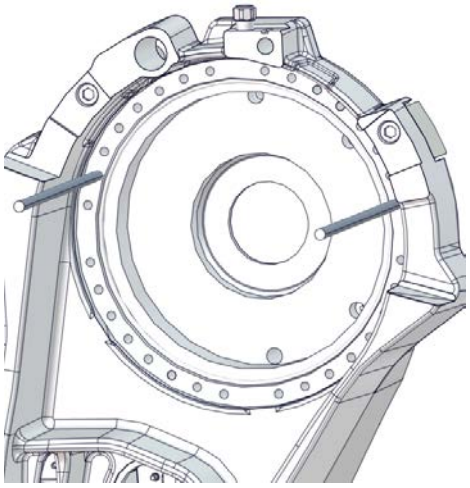
Continues on next page

4.8.2 Replacing the axis-2 gearbox

Continued

Refitting the gearbox

Use this procedure to refit the gearbox.

	Action	Note
1	**CAUTION** The gearbox weighs 83 kg. All lifting accessories used must be sized accordingly!	
2	Apply the lifting accessory to the gearbox.	Lifting accessory, gearbox: 3HAC046128-001
3	Use caution and lift the gearbox so that it rests on its side.	
4	Remove the o-ring and wipe it clean. **Note** This must also be done on a new spare part.	
5	Wipe clean the contact surfaces from any contamination. **Note** Also wipe clean the o-ring groove.	
6	Check the condition of the o-ring. Replace if damaged.	O-ring: 3HAB3772-48
7	Lubricate the o-ring with some grease, for a better fitting in the groove.	
8	Fit the o-ring in the groove.	
9	Fit two guide pins in opposite holes (M12). **Tip** Lubricate the guide pins with some grease to make the gearbox slide better.	Guide pin, M12x150: 3HAC13056-2 Guide pin, M12x200: 3HAC13056-3 Always use guide pins in pairs.  xx1700000445

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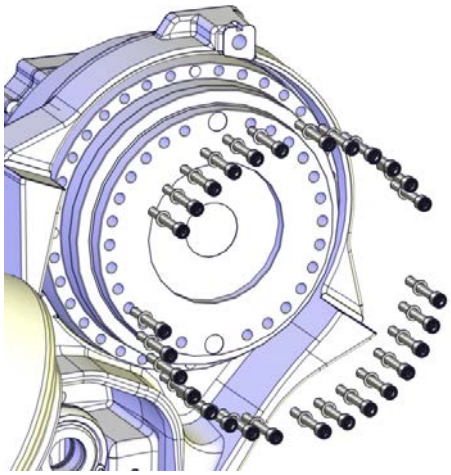
	Action	Note
10	Lift the gearbox and let it rest on the guide pins.	
11	Slide the gearbox into position.	
12	Fit the attachment screws and washers now accessible.	 xx1400002188 Attachment screws: M12x90 stainless steel (3HAC060786-036) (30 pcs). Washers: 13x19x2 coated stainless steel (3HAC060866-004) (30 pcs).
13	Remove the lifting accessory.	
14	Remove the guide pins and fit the remaining attachment screws and washers.	
15	Secure the gearbox with its attachment screws.	Tightening torque: 120 Nm.

Preparations prior to refitting motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Remove any old paint residues or other contamination from the contact surfaces on both the motor and the mating parts. Wipe clean the contact surfaces and the o-ring groove.	

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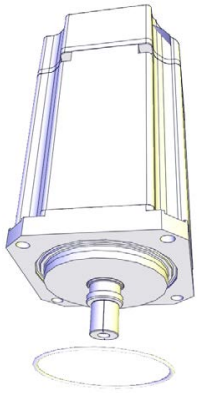
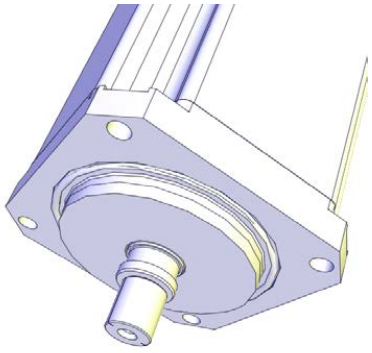
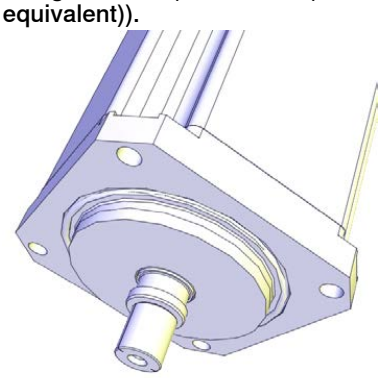
4.8.2 Replacing the axis-2 gearbox

Continued

	Action	Note
3	Fit a new o-ring.	 xx1200001019
4	Make sure the o-ring is seated in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	 xx1200001020
5	Apply locking liquid with activator on the motor flange.	Activator (Loctite 7091). Flange sealant (Loctite 574 (or equivalent)).  xx1200001020

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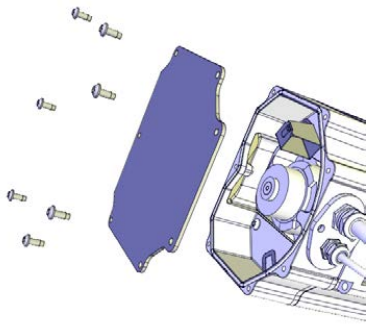
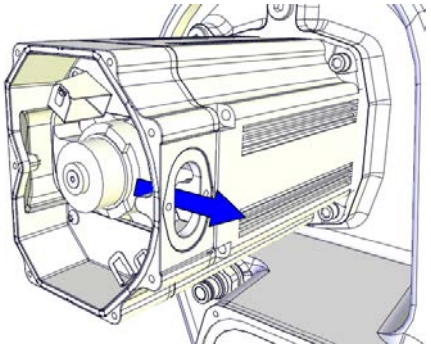
	Action	Note
6	If the motor is a new spare part, remove the cover.	 xx1200001135

Securing the axis-2 motor

	Action	Note
1	Fit guide pins in opposite holes.	Guide pin, M10x150: 3HAC15521-2 Always use guide pins in pairs.
2	**CAUTION** The motor weighs 28 kg. All lifting accessories used must be sized accordingly.	
3	Apply the lifting accessory.	Lifting accessory, motor: 3HAC15534-1 Lifting accessory (chain): 3HAC15556-1
4	**Note** Make sure the cable gland opening is turned the correct way.	 xx1200001120
5	Lift the motor and put it on the guide pins as close as possible to its final position without pushing the motor pinion into the gear.	
6	Remove the lifting accessory and allow the motor to rest on the guide pins.	
7	Apply the rotation tool and use it to rotate the pinion when mating it into the gear.	Rotation tool: 3HAB7887-1

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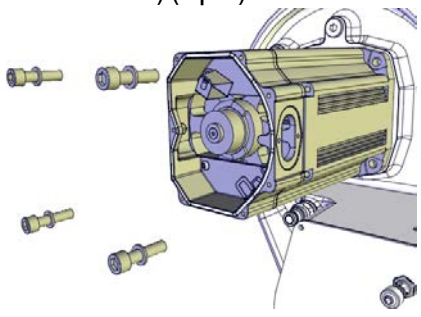
4.8.2 Replacing the axis-2 gearbox

Continued

	Action	Note
8	To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP2, axis-2 motor: • + = pin 2 • - = pin 5	
9	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
10	Use caution and fit the motor in its final position while at the same time rotating the motor pinion slightly using the rotation tool. • Make sure that the motor pinion is properly mated to the gear of the gearbox. • Make sure that the motor pinion does not get damaged. • Make sure that the direction of the cable exit is facing the correct way.	
11	Fit two of the attachment screws and washers.	Screws: M10x30 stainless steel (3HAC060786-020) Washers: 13x17x2 stainless steel (3HAC060866-003)
12	Remove the guide pins and replace with the remaining attachment screws.	
13	Secure the motor with its attachment screws and washers. Use a bits extender in order to reach the screws.	Bits extender: 3HAC12342-1 Tightening torque: 50 Nm. Screw dimension: M10x30 stainless steel (3HAC060786-020) (4 pcs) Washers: 13x17x2 stainless steel (3HAC060866-003) (4 pcs)  xx1200001117
14	Perform a leak-down test.	See *Performing a leak-down test on page 184*.

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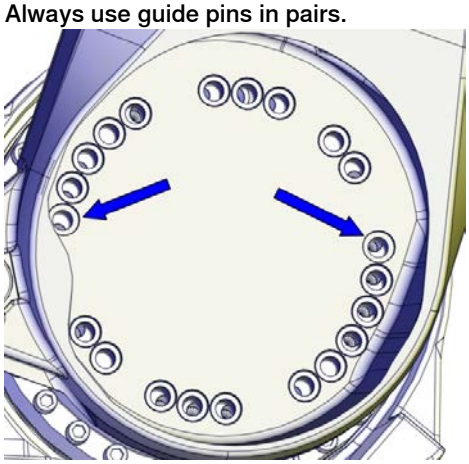
Lifting back and refitting the lower and upper arm

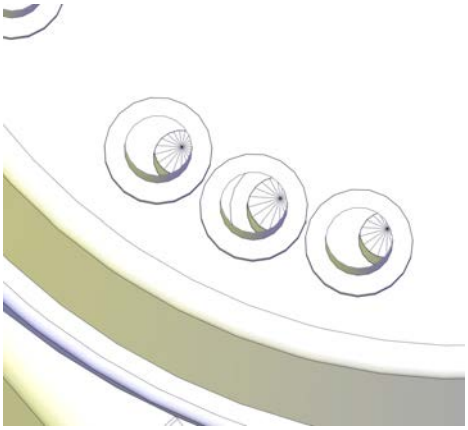
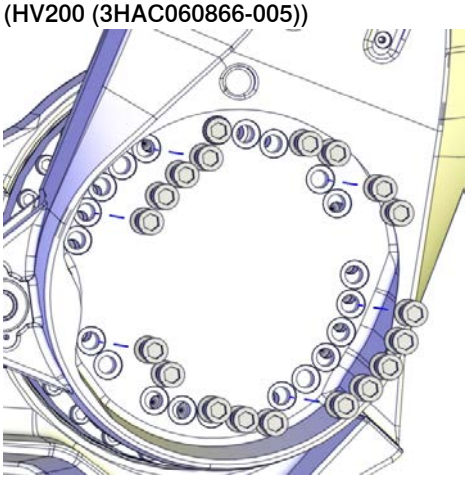
Use this procedure to lift back and refit the lower and upper arm un-separated.

	Action	Note
1	Connect the 24 VDC power supply to the axis-2 motor to release the brakes of the motor.	
2	Fit the rotation tool, if not already fitted.	Rotation tool: 3HAB7887-1
3	Fit two guide pins in opposite holes in the axis-2 gearbox. **Tip** Lubricate the guide pins with some grease to make the lower arm slide better.	Guide pin, M16x150: 3HAC13120-2 Always use guide pins in pairs.  xx1400000360
4	**CAUTION** The lower and upper arms together weigh 510 kg. All lifting accessories used must be sized accordingly!	
5	Attach the lifting accessories, if not already fitted.	
6	Clean all contact surfaces between lower arm and axis-2 gearbox.	Use: Cleaning agent. Isopropanol.
7	Use caution and slowly lift the lower and upper arm together. Make sure: • not to stretch any of the cables • that the arm package is level when lifted.	
8	Before putting the arms on the guide pins, make sure that the hole pattern is matched and in the correct position for all screws.	

Continues on next page

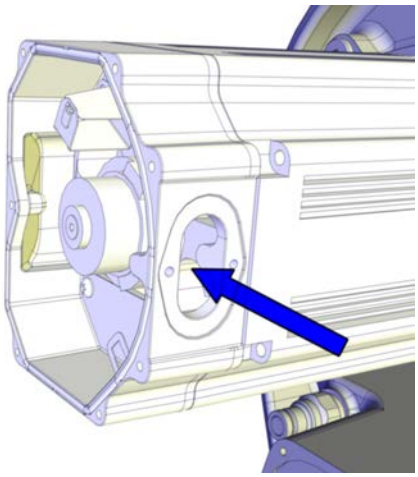
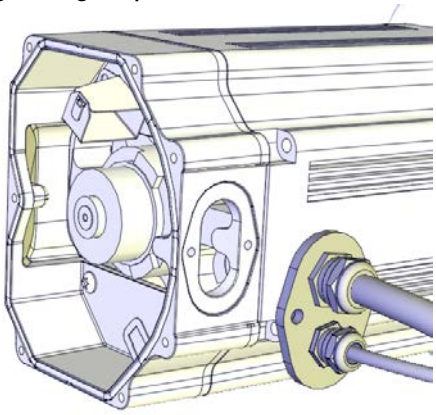
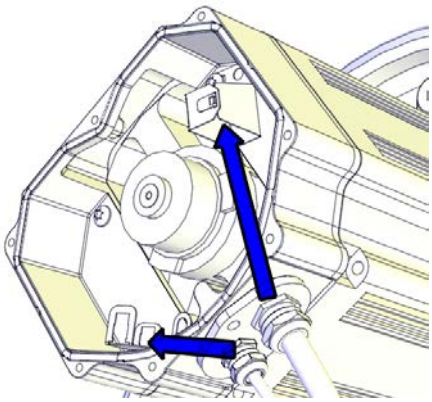
4.8.2 Replacing the axis-2 gearbox

Continued

	Action	Note
9	If the hole pattern is not matching, use the rotation tool and adjust.	Rotation tool: 3HAB7887-1  xx1300000819
10	Slide the lower arm on to the guide pins.	
11	Use caution and move the arms into position at the axis-2 gearbox on the guide pins.	
12	Fit all now accessible attachment screws and washers.	Screws: M16x50 stainless steel (3HAC060786-041) Washers: 17x25x3 coated stainless steel (HV200 (3HAC060866-005))  xx1300000789
13	Remove the two guide pins and replace with the remaining attachment screws and washers.	Screws: M16x50 stainless steel (3HAC060786-041) Washers: 17x25x3 coated stainless steel (HV200 (3HAC060866-005))
14	Secure the lower arm to the axis-2 gearbox with its attachment screws.	Tightening torque M16: 300 Nm
15	Disconnect the 24 VDC power supply.	
16	Remove the lifting accessories. Refit stop screws in the lifting accessory attachment holes.	

Continues on next page

Connecting the axis-2 motor cables

	Action	Note
1	Push the motor cables through the cable gland opening.	 xx1300000738
2	Refit the cable gland cover. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001067
3	Connect the motor cables. Connect in accordance with the markings on the connectors.	 xx1200001066

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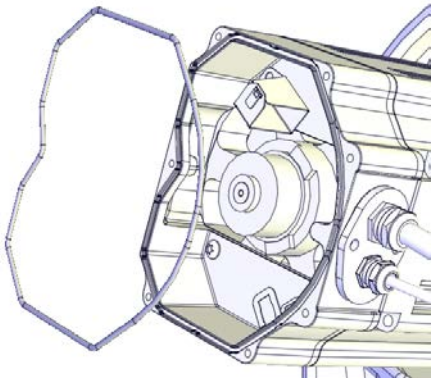
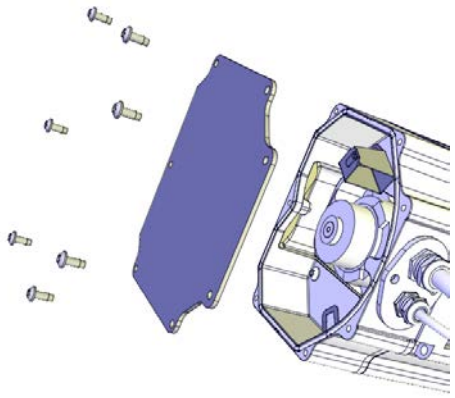
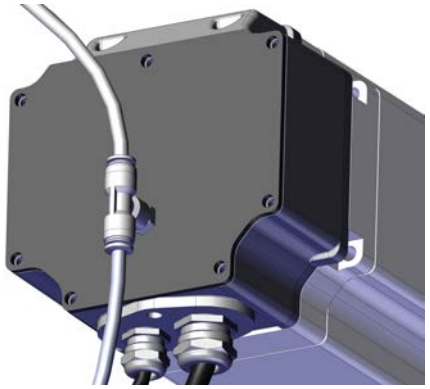
4.8.2 Replacing the axis-2 gearbox

Continued

	Action	Note
4	Inspect the o-ring. **Note** Replace if damaged.	O-ring, axis-1: 3HAC067762-001 O-ring, axis-2: 3HAC067762-001 O-ring, axis-3: 3HAC067762-001 O-ring, axis-4: 3HAC067744-001  xx1200001070
5	Wipe clean o-ring and o-ring groove.	
6	Refit the o-ring. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	
7	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	

Continues on next page

	Action	Note
8	Refit the motor cover with it's attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Attachment screws: M5x12 Stainless steel A2-70 (7 pcs) (9ADA619-44) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001135
9	Make sure that the covers are tightly sealed.	
10	Connect air hose to air fitting on motor. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000568

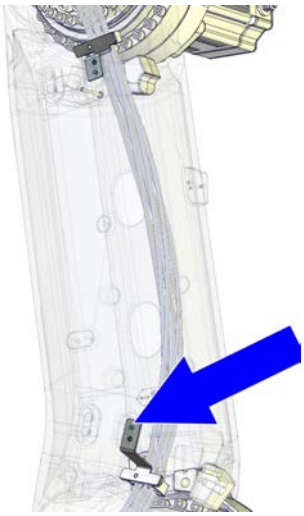
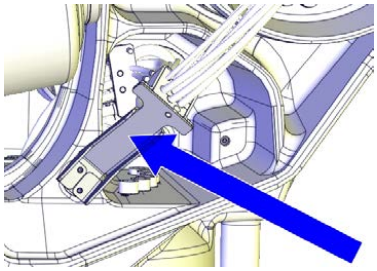
Refitting the cabling

Use this procedure to refit the cabling.

	Action	Note
1	Use caution and push the cable harness into the lower arm.	

Continues on next page

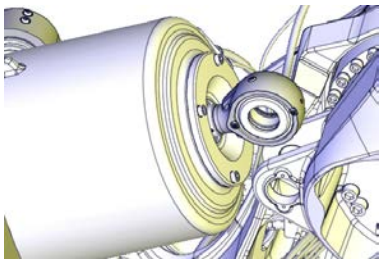
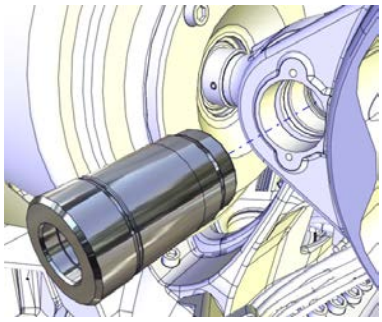
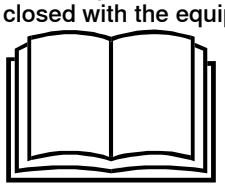
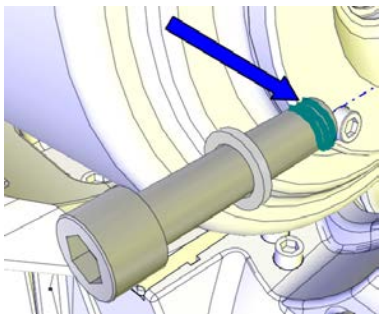
4.8.2 Replacing the axis-2 gearbox
Continued

	Action	Note
2	Refit the axis-2 lower arm metal clamp and the axis-3 lower arm metal clamp located on the inside of the lower arm. **Note** The screws are reached from the outside of the lower arm!	 xx1200001282
3	Refit the cable bracket on the frame.	 xx1200001283

Refitting the front shaft of the balancing device

	Action	Note
1	Turn the power to the robot on temporarily.	
2	Use caution and jog the robot to the calibration position (if not already done).	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Apply the lifting accessory to the balancing device (if not already done).	Lifting shackle: SA-10-8-NA1 Lifting accessory (chain): 3HAC15556-1
5	Remove all residue of Loctite in the screw hole of the shaft.	
6	Wipe all contact surfaces inside the recess clean from contamination.	

Continues on next page

	Action	Note
7	Align the balancing device link ear with the hole in the lower arm. **Note** Verify that the link ear is correctly turned.	 xx1300000784
8	Lubricate the shaft and place it to the front ear.	 xx1200001280
9	Press in the shaft using the dismantle and mounting tool, according to user instructions enclosed with the equipment.  xx0900000813 Go to the user instructions enclosed with the press tool. **DANGER** Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Dismantle and mounting tool: 3HAC028920-001 User instructions are enclosed with the tool.
10	Apply locking liquid (Loctite 2701) on the threads of the screw, first entering the threads in the frame.	 xx1300000782

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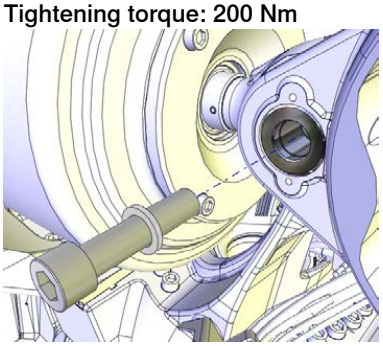
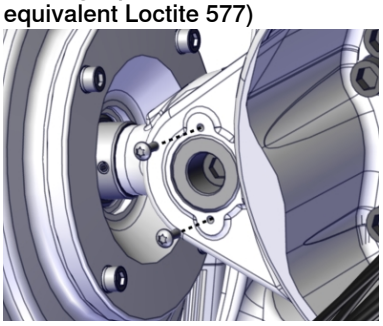
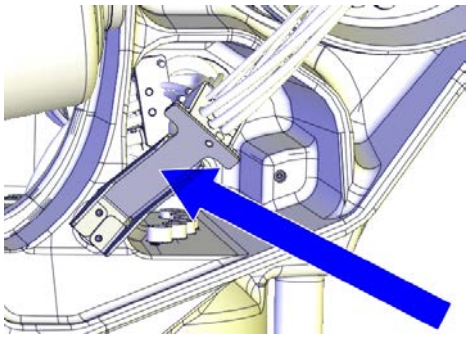
4.8.2 Replacing the axis-2 gearbox

Continued

	Action	Note
11	Secure the shaft with screw and washer.	Tightening torque: 200 Nm  xx1200001279
12	Refit the two screws and wipe clean from residual grease. Use locking liquid.	Tightening torque: 10 Nm Locking liquid: Loctite 5400 (or equivalent Loctite 577)  xx1900002146

Concluded refitting of the front shaft

	Action	Note
1	Remove the lifting accessory from the balancing device.	
2	Refit the cable bracket (if not already refitted).	 xx1200001283

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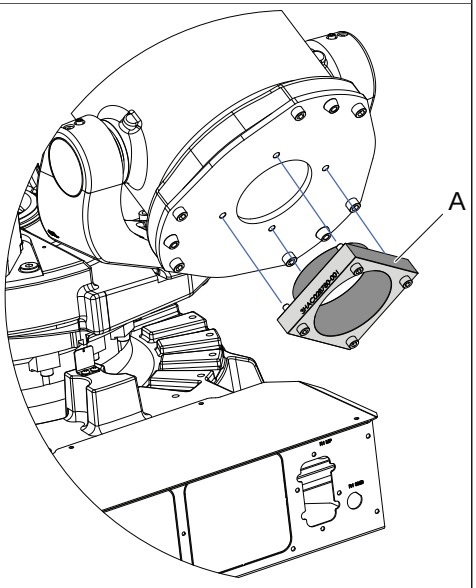
	Action	Note
3	**DANGER** Do not use the Distance tool: 3HAC030662-001 to unload or restore the pressure of the balancing device spring unit! This tool is only used to lock the spring unit in a compressed position, after axis-2 has been jogged to -20° or +20°. Fitting and removal of the tool shall only be done with axis-2 in this position! To unload or restore a new balancing device or if the spring unit of the balancing device cannot be compressed by jogging the robot, only use the hydraulic press tool Dismantle and mounting tool 3HAC028920-001.	
4	Jog axis-2 to: • -30° or +30°.	This is done in order to compress the spring unit inside the balancing device before refitting or removal of the distance tool.
5	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
6	Remove the distance tool.	 xx0800000480 A Distance tool: 3HAC030662-001

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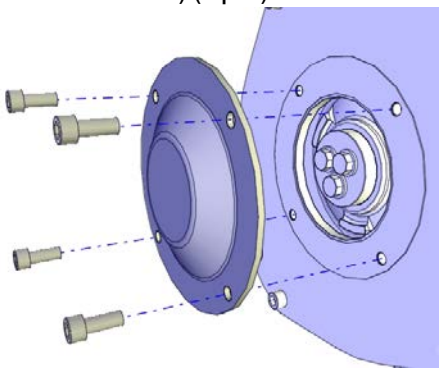
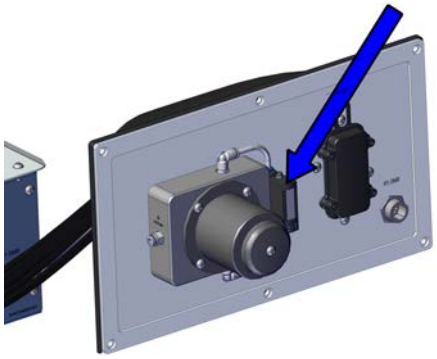
4.8.2 Replacing the axis-2 gearbox

Continued

	Action	Note
7	Refit the cover plate.	Attachment screws: M10x30 stainless steel (3HAC060786-020) (4 pcs)  xx1300000554

Concluding procedure

	Action	Note
1	Refill oil to the axis-2 gearbox.	See *Filling oil into the axis-2 gearbox on page 152*.
2	Turn on the air pressure supply to the overpressure system.	
3	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
4	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.
5	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.8.3 Replacing the axis-3 gearbox

Space required beside

This section describes how to replace the gearbox without needing to remove the cable harness and DressPack cable package (if installed) from the robot.

The described procedure requires free space on the floor, at the right-hand side of the balancing device (seen from behind). There should be enough space to place two pallets in a row.

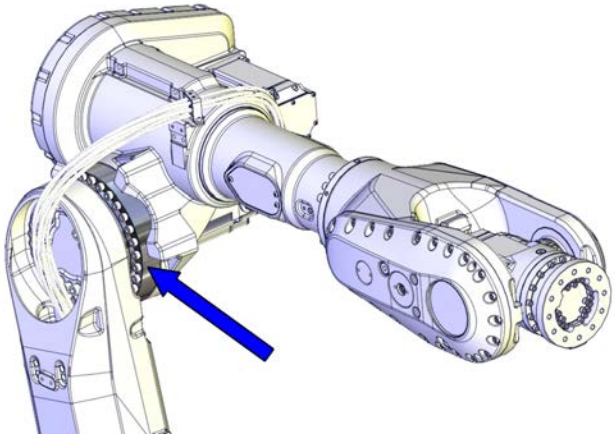
If needed, run axis 1 into a position that gives the required space at the right-hand side of the balancing device.

DANGER

Do not unscrew the attachment screws that secure the robot to the foundation! If unscrewed, the robot will be unstable.

Location of the axis-3 gearbox

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



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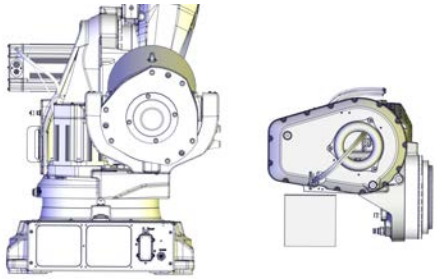
4.8.3 Replacing the axis-3 gearbox
Continued

Summary of the replacement procedure

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

1 Remove the upper arm from the robot and position it as shown in the figure, for easy removal of the axis-3 gearbox.



xx1300000553

When removing the upper arm, the cable harness can be kept fitted or partly fitted to the robot. Use caution not to cause any damage to the cable harness.

2 Replace the axis-3 gearbox.

Spare parts

Spare parts	Spare part number	Note
Axis-3 gearbox	See *Product manual, spare parts - IRB 6790*	

Consumables

Equipment, etc	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.
O-ring	3HAB3772-107	D=102x3 Used on motor flange.
O-ring	3HAC067762-001	D=169.5x3 Used on motor cover.
O-ring	3HAB3772-150	

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Gearbox	M12x70 stainless steel 3HAC060786-034	13x19x2 coated stainless steel 3HAC060866-004	31 pcs

Continues on next page

Equipment to be fastened	Screws	Washers	Quantity
Upper arm	M16x50 stainless steel 3HAC060786-041	17x25x3 coated stainless steel HV200 (3HAC060866-005)	9 pcs
	M12x40 stainless steel 3HAC060786-031	13x19x2 coated stainless steel 3HAC060866-004	27 pcs
Motor, axis-3	M10x30 stainless steel 3HAC060786-020	13x17x2 stainless steel 3HAC060866-003	4 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Oil collecting vessel	-	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	-	One example of oil dispenser can be found in section *Type of lubrication in gearboxes on page 144*.
Lifting eye	3HAC16131-1	M12
Lifting eye	3HAC14457-4	M16
Fender washer	-	Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.
Lifting accessory (chain)	3HAC15556-1	Lifting instruction 3HAC15880-2 enclosed.
Pallet		Used for putting down removed parts from robot.
Lifting accessory, gearbox	3HAC046128-001	
Removal tool motor M12	3HAC14631-1	Used to push out the motor, if necessary. Always use removal tools in pairs.
ScrewsM8x75, fully threaded	-	Used to push out the gearbox, if necessary.
Pallet		Used for putting down removed parts from robot.
Guide pin, M12x150	3HAC13056-2	Always use guide pins in pairs.
Guide pin, M16x200	3HAC13120-3	Always use guide pins in pairs.
Pinion	3HAC067546-001	Used for rotating the axis-3 gearbox when refitting upper arm.
24 VDC power supply	-	Used to release the motor brakes.
Leak-down tester	-	
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

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4.8.3 Replacing the axis-3 gearbox
Continued

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 651*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removing the axis-3 gearbox

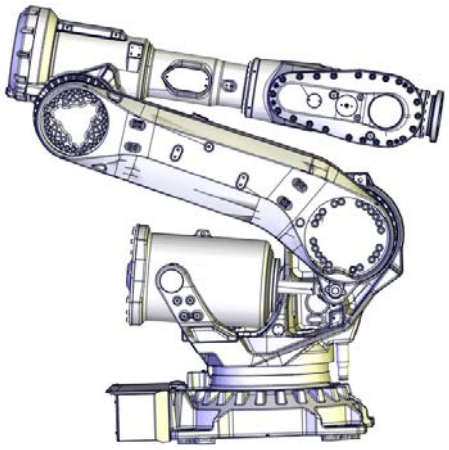
Use these procedures to remove the axis-3 gearbox.

Follow the order of the separate procedure according to the order they are presented.

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.	

Continues on next page

	Action	Note
2	Jog the robot to: • Axis 1 = No significance (as long as the robot is secured to the foundation). • Axis 2 = -65° • Axis 3 = maximum + position, upper arm resting against the mechanical stop (approximately +70°). • Axis 4 = 0° • Axis 5 = -90° • Axis 6 = 0°	If needed, run the axis-1 into a position that gives the required space (space to place two pallets in a row) at the right-hand side of the balancing device, as seen from behind.  xx1800000029
3	**DANGER** When releasing the holding brakes of the motor, the upper arm will be movable and may fall down if not secured. Verify that the upper arm is secured as previously described, before continuing.	
4	Release the holding brakes for the axis-3 motor to make the upper arm rest tightly against the mechanical stop.	
5	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
6	Begin draining the gearbox.	See *Draining the axis-3 gearbox on page 156*.
7	Put two pallets on the floor, at the right-hand side of the robot. **Note** This position is only a recommendation. If it is not possible to put the upper arm close enough to the robot and keep the cable harness partly fitted, it may be necessary to remove the cable harness and DressPack in the upper arm and wrist first.	

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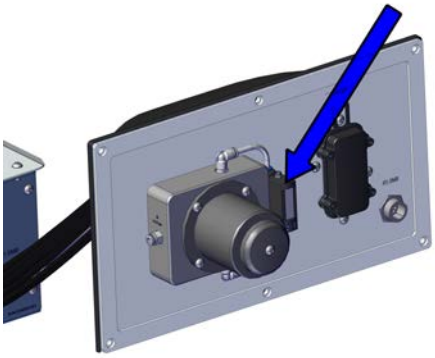
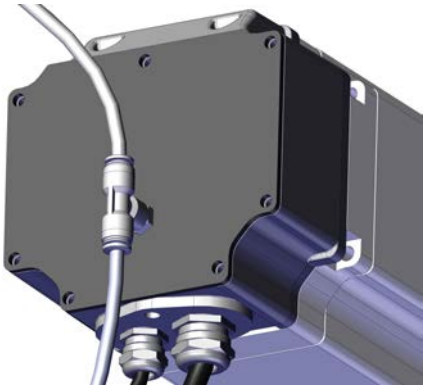
4.8.3 Replacing the axis-3 gearbox
Continued

	Action	Note
8	Check the leak flow value on the flow sensor. Note the value to be able to compare it when repair is completed.	 xx1700001593
9	**CAUTION** Turn off the air pressure supply.	

Disconnecting the axis-3 and axis-4 motor cables

Use this procedure to disconnect the motor cables on the axis-3 and axis-4 motors.

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Disconnect air hose from air fitting on motor cover.	 xx2100000568

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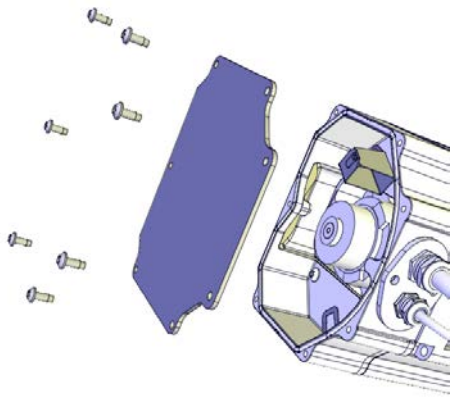
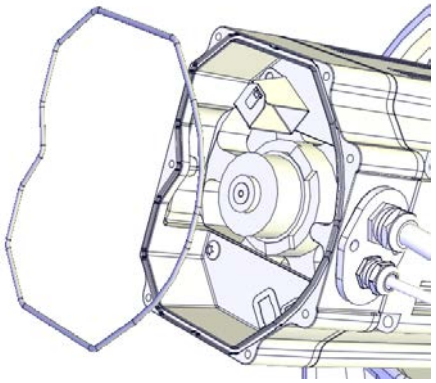
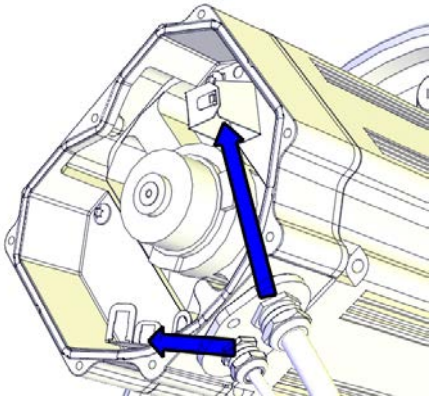
	Action	Note
3	Unscrew the attachment screws and washers and remove the motor cover. **Note** Axis 3 and 4 motors only: Be careful not to damage the air hose or air nipple.	 xx1200001135
4	Make sure the o-ring is present.	 xx1200001070
5	Disconnect the motor cables.	 xx1200001066

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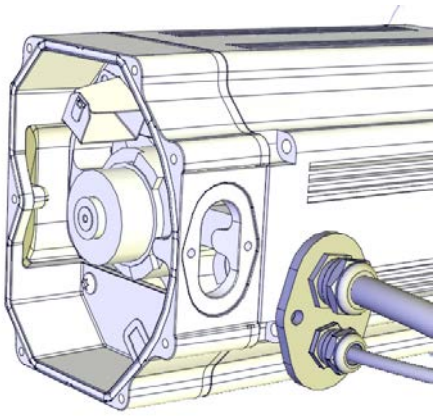
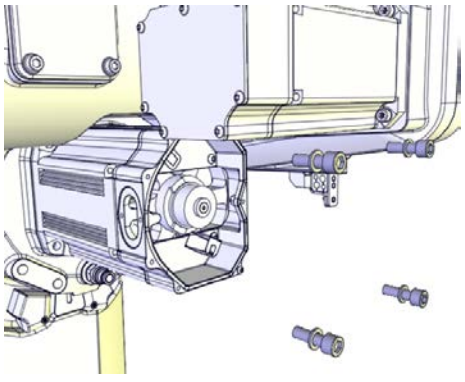
4.8.3 Replacing the axis-3 gearbox

Continued

	Action	Note
6	Remove the cable gland cover. Make sure the gasket is not damaged. **Tip** Make a note in which direction the cable gland hole is facing, if the motor will be removed too. The motor shall be refitted in the same position.	 xx1200001067
7	Use caution and pull out the motor cables.	

Removing the axis-3 motor

	Action	Note
1	Before removing the motor, make sure that the axis-3 gearbox is completely drained.	
2	**DANGER** When releasing the holding brakes of the motor, the upper arm will be movable and may fall down if not secured. Verify that the upper arm is secured as previously described, before continuing.	
3	To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP3: • + = pin 2 • - = pin 5	
4	Unscrew the attachment screws that hold the motor. Use a bits extender to reach the screws.	Bits extender: 3HAC12342-1  xx1200001126

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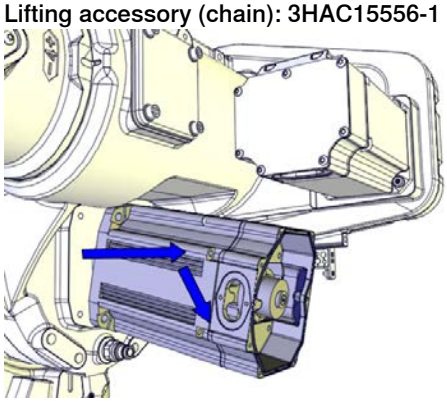
	Action	Note
5	Fit guide pins in opposite holes. **Tip** Lubricate the guide pins with some grease to make the motor slide better.	Guide pin, M10x150: 3HAC15521-2 Always use guide pins in pairs.
6	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
7	If required, press the motor out of position by using the removal tool in the remaining holes for the motor.	Removal tool motor M12: 3HAC14631-1 Always use removal tools in pairs.
8	Use caution and lift the motor out on the guide pins, in order to get the pinion away from the gear, and let the motor rest on the guide pins.	
9	**CAUTION** The motor weighs 26 kg. All lifting accessories used must be sized accordingly.	
10	Fasten the lifting accessory to the motor. Attach the lifting chain to the accessory and an overhead crane.	Lifting accessory, motor: 3HAC15534-1 Lifting accessory (chain): 3HAC15556-1
11	When the motor is hanging in the lifting accessory, and the pinion no longer is mated to the gear, let the outer end of the motor hang lower so that it will hang in an angle. This position makes it easier to remove the axis-3 motor with the axis-4 motor still fitted. **CAUTION** The pinion must have been parted from the gear before the motor is angled. If not there is a risk of damaging the pinion and gear.	 xx1200001125
12	Disconnect the 24 VDC power supply.	

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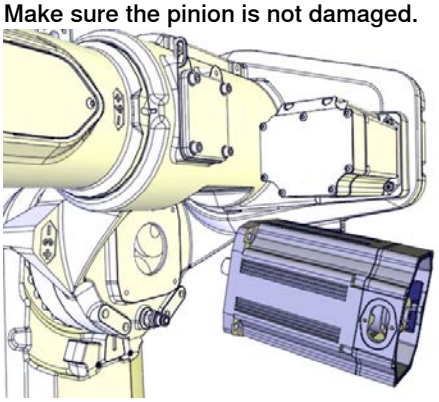
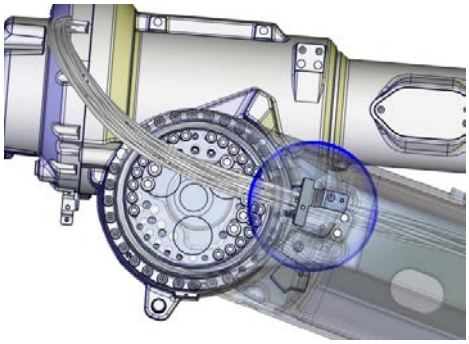
4.8.3 Replacing the axis-3 gearbox
Continued

	Action	Note
13	Remove the motor by lifting it straight out.	Make sure the pinion is not damaged.  xx1200001131

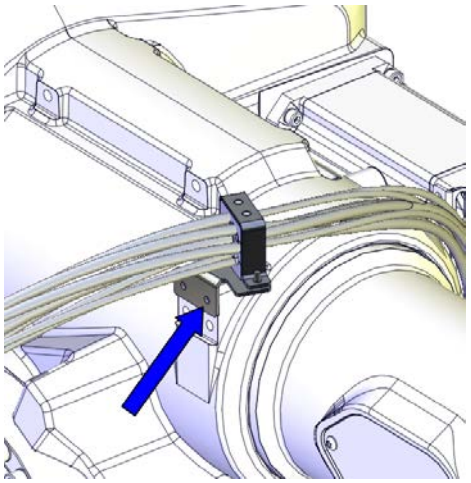
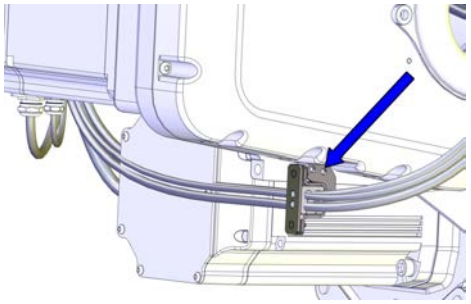
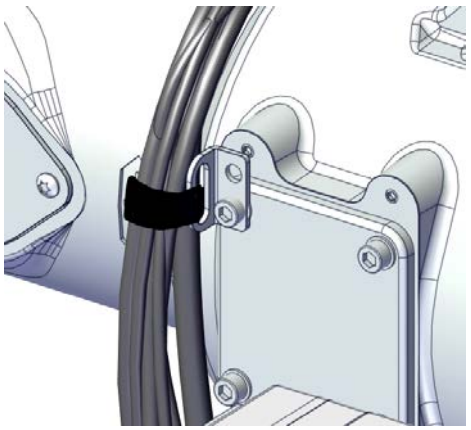
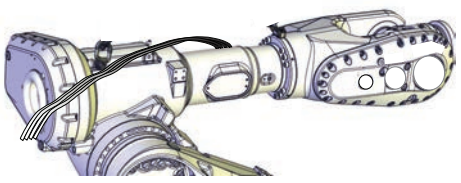
Keeping cabling installed in upper arm - loosening the cable brackets

This procedure is valid if wanting to keep the cabling installed in the upper arm, when removing the upper arm from the robot. If this is not possible due to lack of space where to put the upper arm, the cable harness must be removed from the upper arm, see *Removing the cable harness - upper arm and wrist on page 208*.

Use this procedure to loosen required cable brackets of the robot cable harness, in order to get the longest possible length of the cable harness between the lower and upper arm.

	Action	Note
1	Unscrew the attachment screws that hold the axis-3 lower arm metal clamp (the one closest to the axis-3 gearbox) located on the inside of the lower arm. **Note** The screw is reached from the outside of the lower arm!	 xx1800000042

Continues on next page

	Action	Note
2	Unscrew the attachment screws that hold the cable bracket on top of the arm house.	 xx1300000541
3	Unscrew the attachment screws that hold the cable bracket under the arm house.	 xx1300000543
4	Open the velcro strap at the cable fixing bracket.	 xx1700001810
5	In order not to damage the cable harness later, it shall be moved over to the other side of the arm house and be placed on the right side (as seen from behind) of the back lifting eye. See figure!	 xx1300000534

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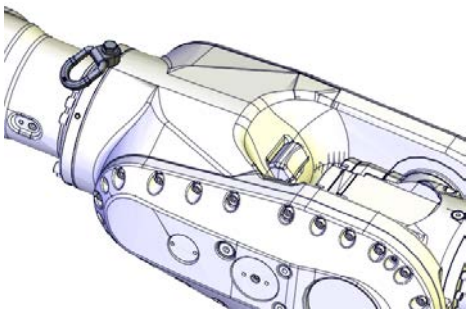
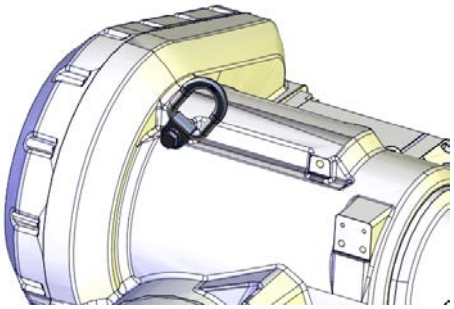
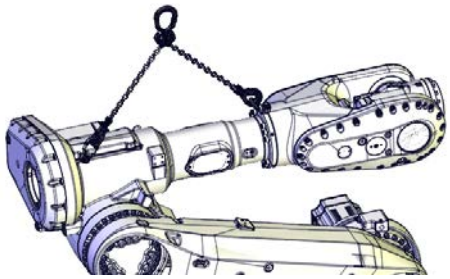
4.8.3 Replacing the axis-3 gearbox
Continued

Attaching the lifting accessories to the upper arm

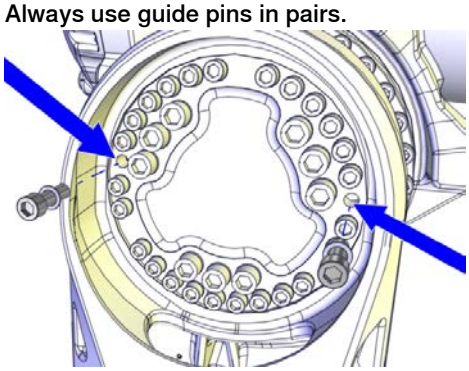
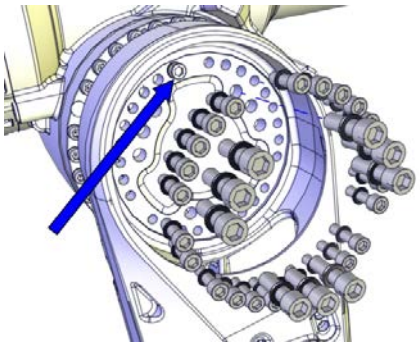
Use this procedure to attach the lifting accessories to the upper arm.

	Action	Note
1	**CAUTION** The weight of the complete upper arm (including the wrist) is 360 kg All lifting accessories used must be sized accordingly.	
2	Fit a lifting eye to the wrist. **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1  xx1200001133
3	Fit a lifting eye in the arm house, with a fender washer underneath.  xx1400002196 **Note** Save the stop screw installed, to refit after the lifting eye is removed.	Lifting eye: 3HAC16131-1 Fender washer: Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.  xx1200001134
4	Attach the upper arm lifting accessory (chain) to an overhead crane (or similar) and then to the lifting eye in the arm house and in the wrist.	Lifting accessory (chain): 3HAC15556-1  xx1200001308
5	Raise the lifting accessories to take the weight of the upper arm.	

Continues on next page

	Action	Note
6	In case of necessary adjustments, use the shortening loops on the lifting accessory (chain) to find the level position.	 xx1400002197

Preparations before removing the upper arm

	Action	Note
1	Remove two attachment screws (M12) in opposite holes and replace them with guide pins. **Note** Make sure that it is the screws that hold the lower arm to the axis-3 gearbox that are removed! **Tip** Lubricate the guide pins with some grease to make the upper arm slide better.	Guide pin, M12x150: 3HAC13056-2 Guide pin, M12x200: 3HAC13056-3 Always use guide pins in pairs.  xx1300000659
2	Leave one of the remaining attachment screws fitted, remove the other screws.	 xx1300000747

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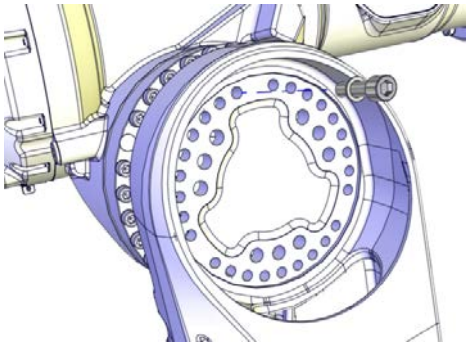
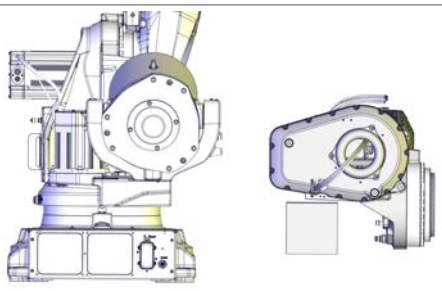
4.8.3 Replacing the axis-3 gearbox

Continued

Removing the upper arm

	Action	Note
1	**Note** Make sure the lift is done completely leveled! In case of necessary adjustments, use the shortening loops on the lifting accessory (chain), and make sure to place the chain the right way through the loops.	 xx1400002197
2	Remove the remaining attachment screw and let the upper arm slide out from the lower arm with support from the guide pins.	 xx1300001610
3	Lift the upper arm and place it on the prepared area. **CAUTION** *Only valid when the upper arm is removed due to replacement of the axis-3 gearbox:* If the cable harness is still fitted or partly fitted, use caution when lifting the upper arm over to the other side of the robot, in order not to cause any damage to the cable harness.	
4	*This step is only valid when the upper arm is removed due to replacement of the axis-3 gearbox:* Place pieces of wood (or similar) under arm house and wrist. Lower the upper arm, and let the upper arm rest as shown in the figure. This is done in order to keep the axis-3 gearbox in a vertical position and to get the best position to replace the axis-3 gearbox, if applicable.	 xx1300000553

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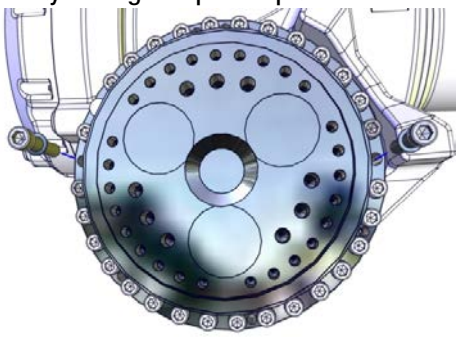
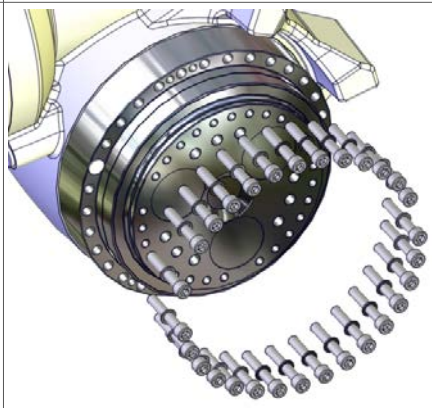
Removing the axis-3 gearbox

Use this procedure to remove the gearbox.

	Action	Note
1	Remove two attachment screws in opposite holes and replace them with guide pins. **Tip** Lubricate the guide pins with some grease to make the gearbox slide better.	Guide pin, M12x150: 3HAC13056-2 Always use guide pins in pairs.  xx1300001969
2	Remove all but one of the remaining attachment screws.	 xx1300001970
3	Fit two fully threaded screws and use them as removal tools.	Removal tool motor M10: Used to push out the motor, if necessary.
4	Remove the remaining attachment screw.	
5	Loosen the gearbox from its fitting position with the help of the removal tools, but only pull it out on the guide pins a little. **DANGER** There is a risk that the gearbox may glide out and fall down before the lifting accessory is applied, if pulled out to far.	
6	**CAUTION** The axis-3 gearbox weighs 56 kg. All lifting accessories used must be sized accordingly.	
7	Apply the lifting accessory to the gearbox.	Lifting accessory, gearbox: 3HAC046128-001

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4.8.3 Replacing the axis-3 gearbox
Continued

	Action	Note
8	**Note** There will be some oil spill when the gearbox is removed. Put some oil absorbent cloth or paper below the gearbox.	
9	With the gearbox attached to the lifting accessory, remove the gearbox by letting it slide out on the guide pins.	
10	Remove the gearbox.	

Refitting the axis-3 gearbox

Use these procedures to refit the axis-3 gearbox.

Follow the order of the separate procedures according to the order they are presented.

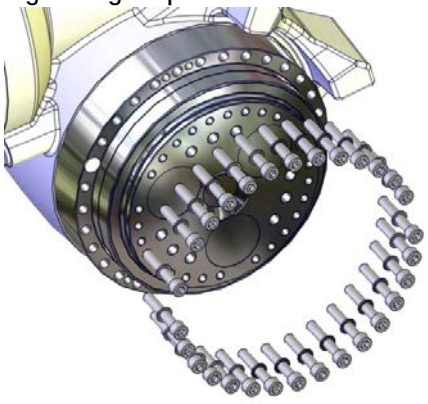
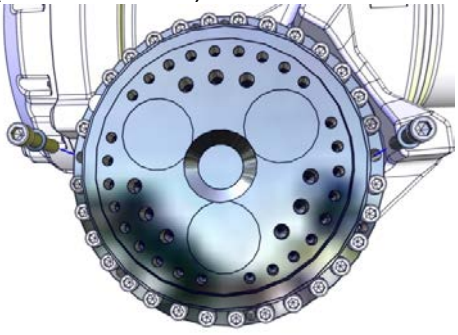
Preparations before refitting the axis-3 gearbox

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	**CAUTION** The axis-3 gearbox weighs 56 kg. All lifting accessories used must be sized accordingly.	
3	Apply the lifting accessory to the gearbox.	Lifting accessory, gearbox: 3HAC046128-001
4	Lift the gearbox so that it rests on the side.	
5	Remove the o-ring and wipe it clean. **Note** This shall also be done on a new spare part.	
6	Check the condition of the o-ring. Replace if damaged.	O-ring: 3HAB3772-150.
7	Wipe clean the contact surfaces, both on the gearbox and in the upper arm. Also wipe clean the o-ring groove.	
8	Lubricate the o-ring with some grease.	
9	Fit the o-ring in the groove.	

Continues on next page

	Action	Note
10	Fit two guide pins in opposite holes. **Tip** Lubricate the guide pins with some grease to make the gearbox slide better.	Guide pin, M12x150: 3HAC13056-2 Always use guide pins in pairs.
11	Lift the gearbox to the upper arm and let it rest on the guide pins.	

Securing the axis-3 gearbox

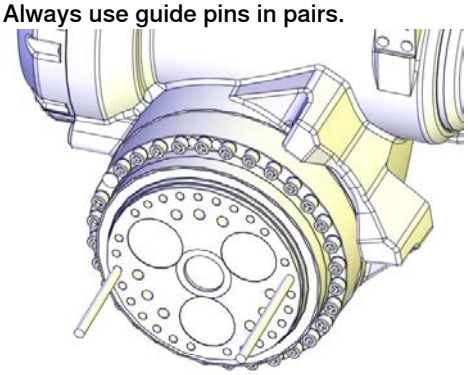
	Action	Note
1	Secure the gearbox with 29 of the 31 attachment screws and washers.	Screws: M12x70 stainless steel (3HAC060786-034) Washers: 13x19x2 coated stainless steel (3HAC060866-004) Tightening torque: 120 Nm  xx1300001970
2	Remove the guide pins and replace with the remaining attachment screws and washers.	Screws: M12x70 stainless steel (3HAC060786-034). Washers: 13x19x2 coated stainless steel (3HAC060866-004)  xx1300001969
3	Secure the remaining attachment screws.	Tightening torque: 120 Nm.
4	Remove the lifting accessory.	

Continues on next page

4.8.3 Replacing the axis-3 gearbox

Continued

Preparations before refitting the upper arm

	Action	Note
1	Wipe clean all contact surfaces.	
2	Fit two guide pins in opposite M12 holes in the axis-3 gearbox. **Tip** Lubricate the guide pins with some grease to make the upper arm slide better.	Guide pin, M12x150: 3HAC13056-2 Guide pin, M12x200: 3HAC13056-3 Always use guide pins in pairs.  xx1700000058

Securing the upper arm

	Action	Note
1	**CAUTION** The weight of the complete upper arm (including the wrist) is 360 kg All lifting accessories used must be sized accordingly.	
2	Attach the lifting accessories, if not already fitted.	See *Attaching lifting accessories to the upper arm on page 202*.
3	Lift the upper arm and put it on the guide pins.	
4	If the axis-3 motor is installed to the upper arm: In order to release the brakes, connect the 24 VDC power supply. Connect to R2.MP3-connector: • + = pin 2 • - = pin 5 Use the rotation tool and rotate the axis-3 motor to find the correct position for the guide pins in the lower arm.	24 VDC power supply Rotation tool
5	If the axis-3 motor is not installed to the upper arm: Use the pinion to rotate the axis-3 gearbox to find the correct position for the guide pins in the lower arm.	Pinion: 3HAC067546-001

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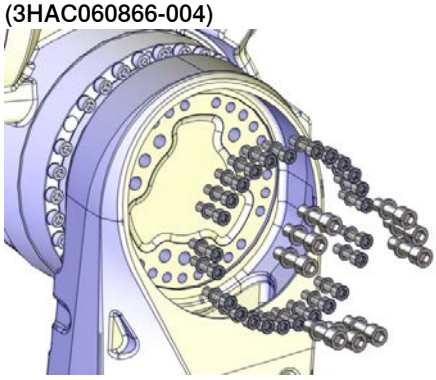
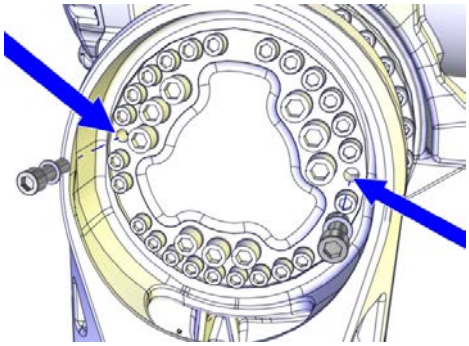
	Action	Note
6	Insert all nine M16 screws and 25 of the 27 M12 screws.	Screws: M16x50 stainless steel (3HAC060786-041) (9 pcs) M12x40 stainless steel (3HAC060786-031) (25 of 27 pcs) Washers: 17x25x3 coated stainless steel (HV200 (3HAC060866-005)) 13x19x2 coated stainless steel (3HAC060866-004)  xx1400000359
7	Remove the guide pins and fit the two remaining M12 screws.	 xx1300000659
8	Secure the upper arm by tightening the attachment screws.	Tightening torque depends on screw dimension. Tightening torque, M16: 300 Nm Tightening torque, M12: 120 Nm

Preparations prior to refitting motor

	Action	Note
1	**DANGER** Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
2	Remove any old paint residues or other contamination from the contact surfaces on both the motor and the mating parts. Wipe clean the contact surfaces and the o-ring groove.	

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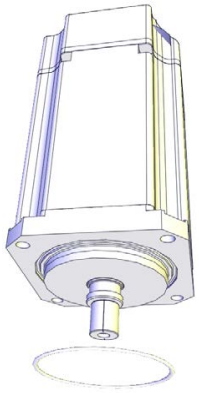
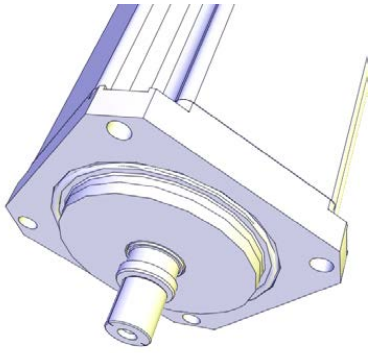
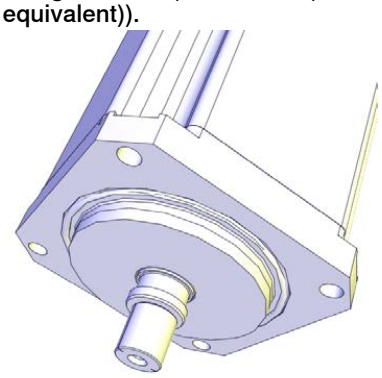
4.8.3 Replacing the axis-3 gearbox

Continued

	Action	Note
3	Fit a new o-ring.	 xx1200001019
4	Make sure the o-ring is seated in the groove. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	 xx1200001020
5	Apply locking liquid with activator on the motor flange.	Activator (Loctite 7091). Flange sealant (Loctite 574 (or equivalent)).  xx1200001020

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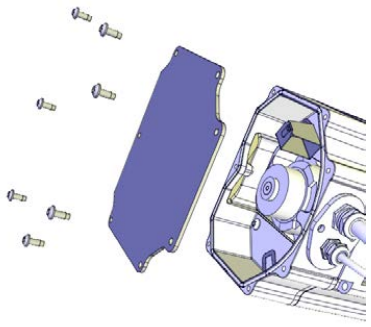
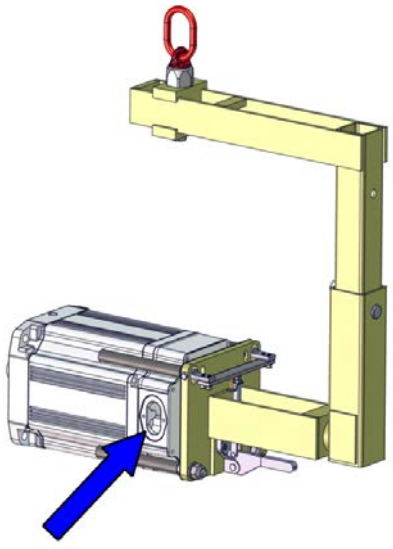
	Action	Note
6	If the motor is a new spare part, remove the cover.	 xx1200001135

Securing the axis-3 motor

Use this procedure to secure the motor.

	Action	Note
1	Fit guide pins in opposite holes.	Guide pin, M10x150: 3HAC15521-2 Always use guide pins in pairs.
2	**CAUTION** The motor weighs 26 kg. All lifting accessories used must be sized accordingly.	
3	Apply the lifting accessories to the motor. **Note** Make sure the cable gland exit is turned according to figure.	Lifting accessory, motor: 3HAC15534-1  xx1700000273

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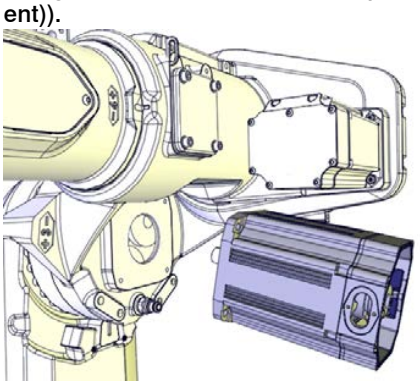
4.8.3 Replacing the axis-3 gearbox

Continued

	Action	Note
4	Lift the motor on to the guide pins and let it hang with the outer end a little lower when resting on the guide pins. Do not push the motor pinion into the gear yet. This is done in order to fit the motor with the axis-4 motor still fitted.	Activator (Loctite 7091). Flange sealant (Loctite 574 (or equivalent)).  xx1200001131
5	Remove the lifting accessory and allow the motor to rest on the guide pins.	
6	Apply the rotation tool and use it to rotate the pinion when mating it into the gear.	Rotation tool: 3HAB7887-1
7	To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP3: • + = pin 2 • - = pin 5	
8	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
9	Use caution and push the motor in position while at the same time the motor pinion is slightly rotated. Pay attention to following points: • Mate the motor pinion properly to the gear of the gearbox. • Do not damage the motor pinion.	
10	Fit two of the attachment screws and washers.	Screws: M10x30 stainless steel (3HAC060786-020) Washers: 13x17x2 stainless steel (3HAC060866-003)
11	Remove the guide pins.	
12	Fit the remaining attachment screws and washers.	Screws: M10x30 stainless steel (3HAC060786-020) Washers: 13x17x2 stainless steel (3HAC060866-003)
13	Tighten the screws.	Tightening torque: 50 Nm
14	Remove the rotation tool.	
15	Perform a leak-down test.	See *Performing a leak-down test on page 184*.

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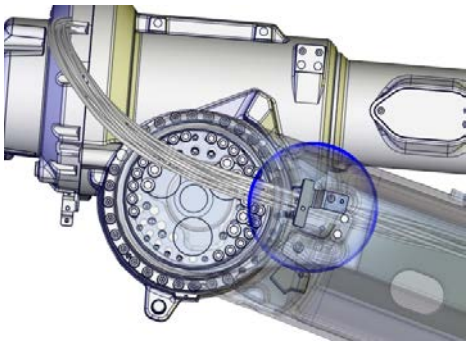
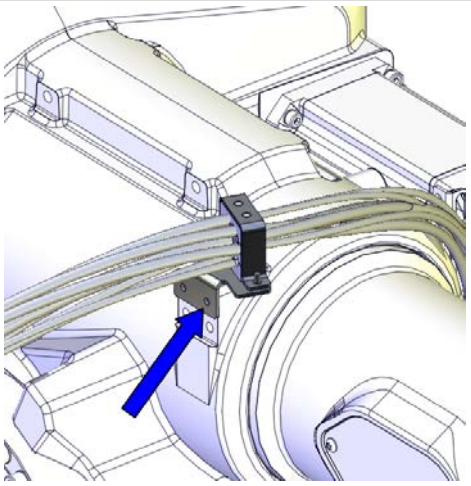
	Action	Note
16	Disconnect the 24 VDC power supply.	

Refitting cable brackets

This procedure is valid if the cabling has been kept installed in the upper arm, when removing the upper arm from the robot. If the cable harness in the upper arm instead has been removed completely, see *Refitting the cable harness - upper arm and wrist on page 245*.

Use this procedure to refit the cable brackets.

	Action	Note
1	Remove the lifting accessories.	
2	Move the cable harness and DressPack back to the correct side of the robot.	
3	Refit the axis-3 lower arm metal clamp (the one closest to the axis-3 gearbox) located on the inside of the lower arm. **Note** The screw is reached from the outside of the lower arm!	 xx1800000042
4	Fasten the cable bracket on top of the arm house.	 xx1300000541

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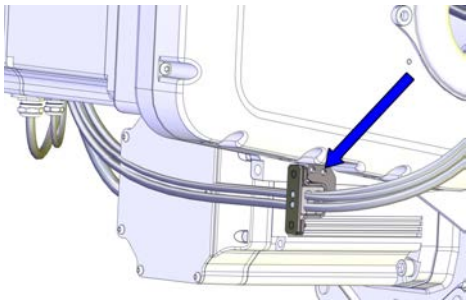
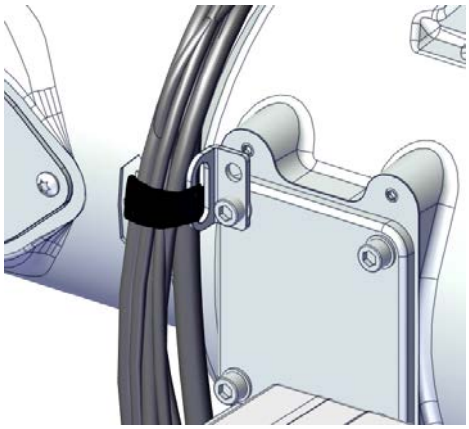
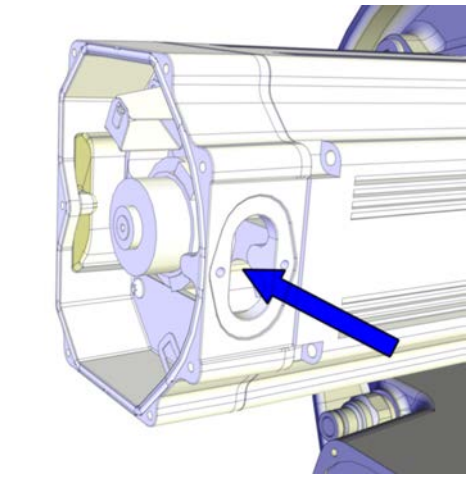
4.8.3 Replacing the axis-3 gearbox
Continued

	Action	Note
5	Fasten the cable bracket under the arm house.	 xx1300000543
6	Secure the cable harness to the cable fixing bracket with the velcro strap.	 xx1700001810

Connecting the axis-3 and axis-4 motor cables

Use this procedure to connect the motor cables.

	Action	Note
1	Push the motor cables through the cable gland opening.	 xx1300000738

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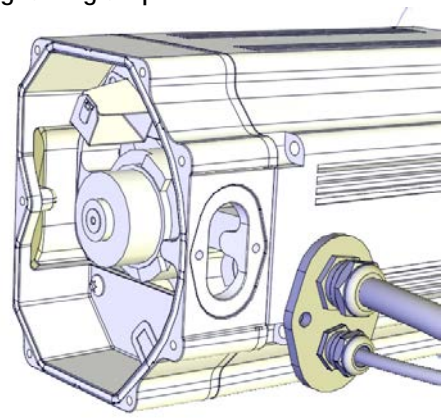
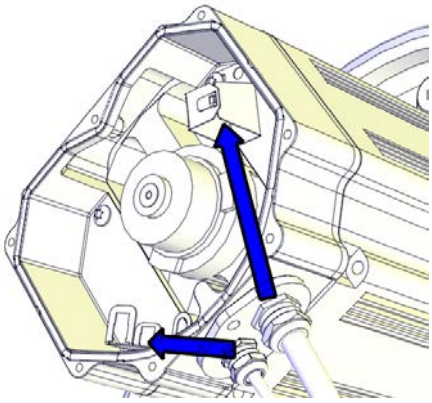
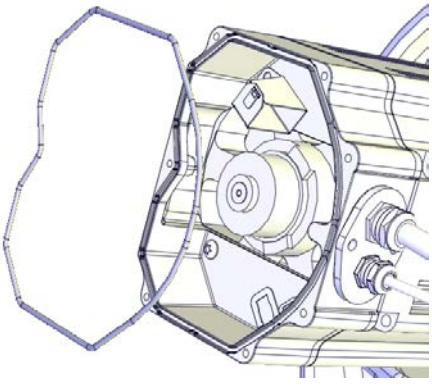
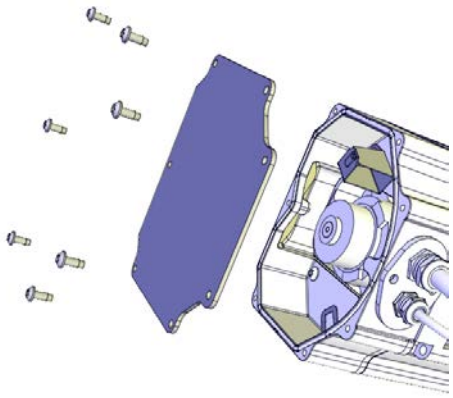
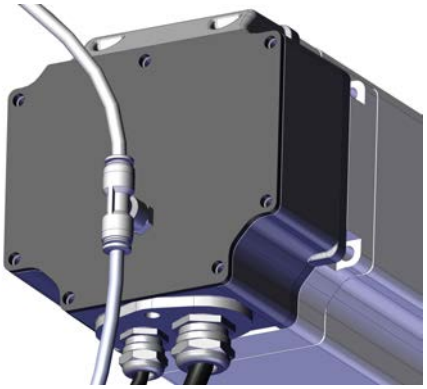
	Action	Note
2	Refit the cable gland cover. **Note** Replace the gasket if damaged.	Tightening torque: 6 Nm  xx1200001067
3	Connect the motor cables. Connect in accordance with the markings on the connectors.	 xx1200001066
4	Inspect the o-ring. **Note** Replace if damaged.	O-ring, axis-1: 3HAC067762-001 O-ring, axis-2: 3HAC067762-001 O-ring, axis-3: 3HAC067762-001 O-ring, axis-4: 3HAC067744-001  xx1200001070
5	Wipe clean o-ring and o-ring groove.	

Continues on next page

4.8.3 Replacing the axis-3 gearbox

Continued

	Action	Note
6	Refit the o-ring. **Tip** Lubricate the o-ring with some grease for a better fitting in the groove.	
7	**CAUTION** When fitting the motor cover, make sure that none of the cables inside will be damaged.	
8	Refit the motor cover with it's attachment screws. **Note** Make sure the o-ring is undamaged and properly fitted.	Attachment screws: M5x12 Stainless steel A2-70 (7 pcs) (9ADA619-44) Tightening torque: 6 Nm Activator (Loctite 7091). Locking liquid (Loctite 2400 (or equivalent Loctite 243)).  xx1200001135
9	Make sure that the covers are tightly sealed.	
10	Connect air hose to air fitting on motor. **Note** Make sure that it 'clicks' when connecting it.	 xx2100000568

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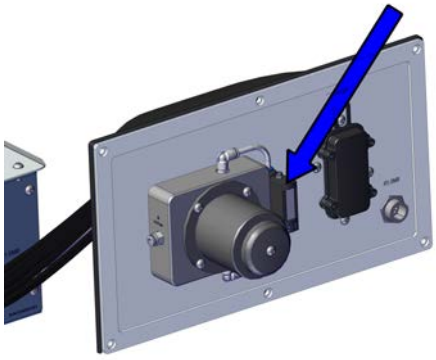
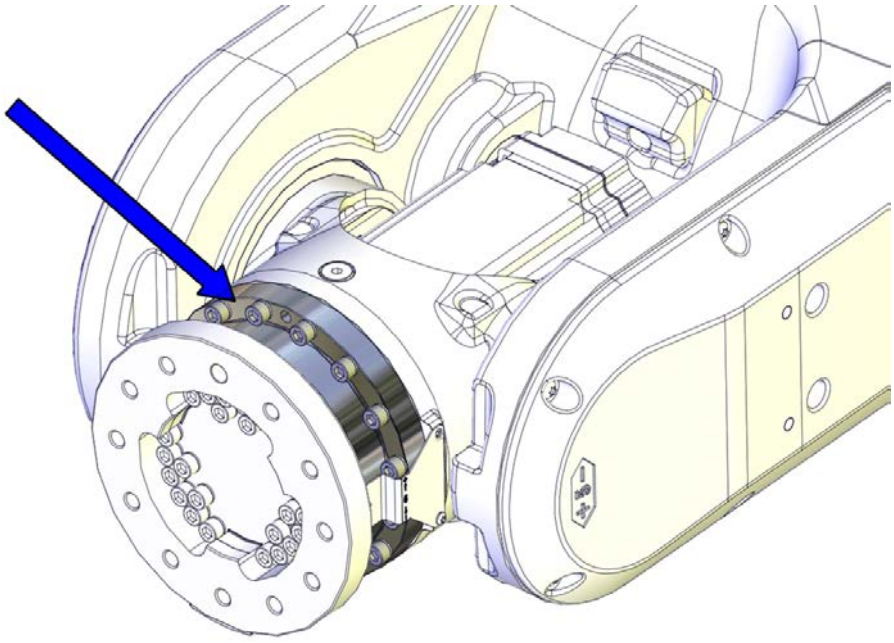
Concluding procedures

	Action	Note
1	Refill oil in the gearbox.	See *Filling oil into the axis-3 gearbox on page 157*.
2	Turn on the air pressure supply to the overpressure system.	
3	Check the leak flow value on the flow sensor and compare it to the initial value. The value should be the same. If the value is higher than the initial value, fault trace according to *Inspecting the overpressure system on page 141*.	 xx1700001593
4	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.
5	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

4.8.4 Replacing the axis-6 gearbox

Location of the axis-6 gearbox

The axis-6 gearbox is located as shown in the figure.



xx1300000824

Spare parts

Spare parts	Spare part number	Note
Axis-6 gearbox	See *Product manual, spare parts - IRB 6790*	

Consumables

Equipment, etc	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate o-rings.
O-ring	3HAB3772-107	D=102x3 Used on motor flange.
Gasket	3HAC033489-002	Used on motor cover.
O-ring	3HAB3772-58	
Turcon Roto VL seal	3HAC060656-002	The seal is damaged when the turning disc is removed and must be replaced.

Continues on next page

Stainless steel fasteners

Due to robot protection type Foundry Prime, some of the attachment screws and washers used on the robot are made of stainless steel. If damaged or lost, order new items according to this table.

Equipment to be fastened	Screws	Washers	Quantity
Gearbox	M8x40 stainless steel 3HAC060786-013	8.4x13x1.6 stainless steel 3HAC060866-001	16 pcs
Turning disc	M8x25 stainless steel 3HAC060786-010	8.4x13x1.6 stainless steel 3HAC060866-001	24 pcs

Required tools and equipment

Equipment, etc.	Article number	Note
Rotation tool	3HAB7887-1	Used to rotate the motor pinion.
24 VDC power supply	-	Used to release the motor brakes.
Leak-down tester	-	
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools.
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 651*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

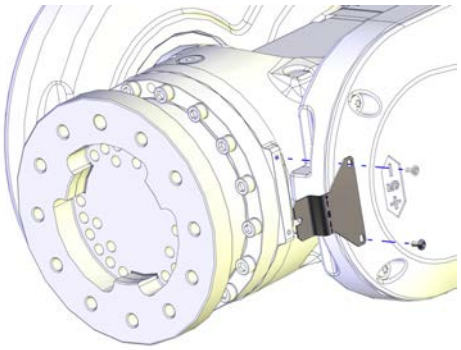
Continues on next page

4.8.4 Replacing the axis-6 gearbox
Continued

Removing the axis-6 gearbox

Use these procedures to remove the axis-6 gearbox.

Preparations before removing the axis-6 gearbox

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
3	Drain the gearbox.	See *Draining the axis-6 gearbox on page 169*.
4	Remove all equipment fitted on the turning disc.	
5	Jog the robot to: • Axis 1 = No significance (as long as the robot is secured to the foundation). • Axis 2 = +25° • Axis 3 = +20° • Axis 4 = 0° • Axis 5 = -55° • Axis 6 = -10°	
6	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the safeguarded space.	
7	Remove the synchronization plate axis-6.	 xx1300000825

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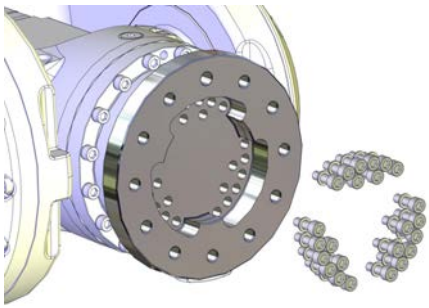
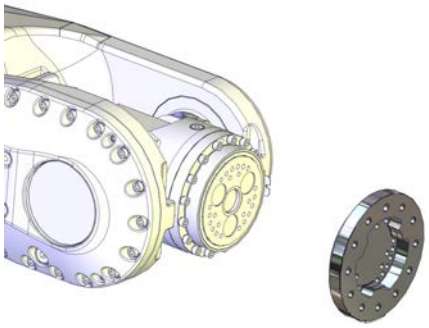
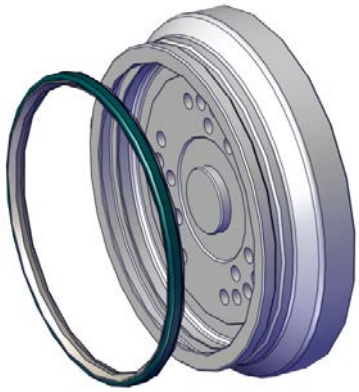
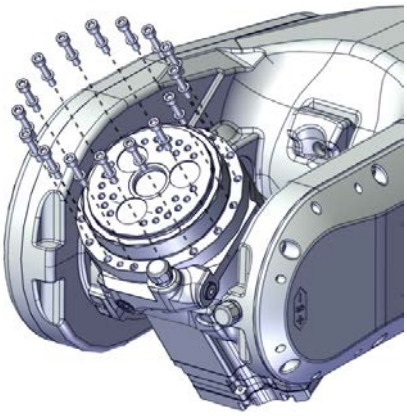
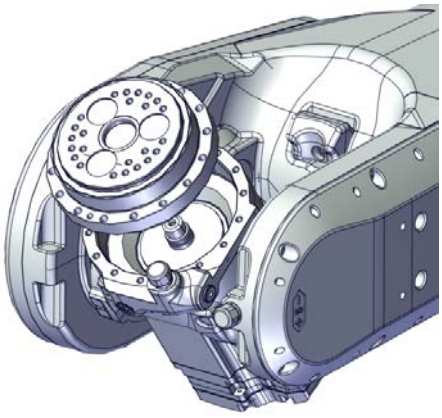
Removing the turning disc

	Action	Note
1	Remove the screws and washers, that secure the turning disc.	 xx1300000492
2	Remove the turning disc.	 xx1300000493
3	Remove the seal from the turning disc. **Note** Replace the seal if damaged.	 xx1700001592

Continues on next page

4.8.4 Replacing the axis-6 gearbox
Continued

Removing the axis-6 gearbox

	Action	Note
1	Unscrew the attachment screws that secure the axis-6 gearbox.	M8x40 stainless steel (3HAC060786-013) (16 pcs)  xx1700001600
2	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
3	Remove the gearbox. If required fit two attachment screws and press out the gearbox.	 xx1700001601

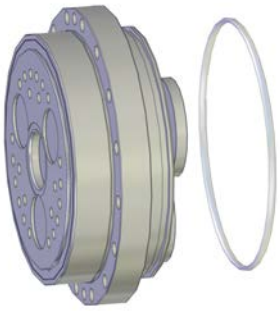
Refitting the axis-6 gearbox

Use these procedures to refit the gearbox.

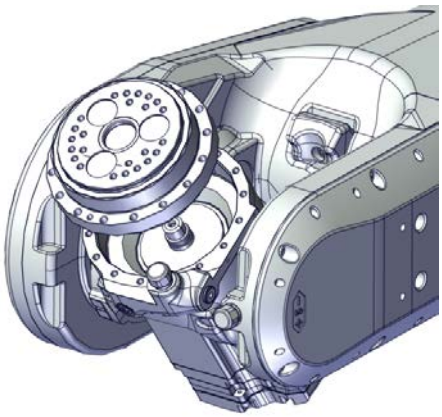
Preparations before refitting the axis-6 gearbox

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

Continues on next page

	Action	Note
2	Ensure a tight fitting of the sealing according to following steps: • Remove the o-ring and wipe it clean. **Note** The o-ring needs to be cleaned also on a new spare part. • Check the o-ring. Replace if damaged. • Wipe clean the contact surfaces from any contamination. Also wipe clean the o-ring groove. • Put some grease on the o-ring. • Fit the o-ring in the groove of the gearbox.	O-ring: 3HAB3772-58  xx1300000828

Refitting the axis-6 gearbox

	Action	Note
1	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used.	
2	Fit the gearbox to the wrist. **CAUTION** Be careful not to damage motor pinion or gears!	 xx1700001601

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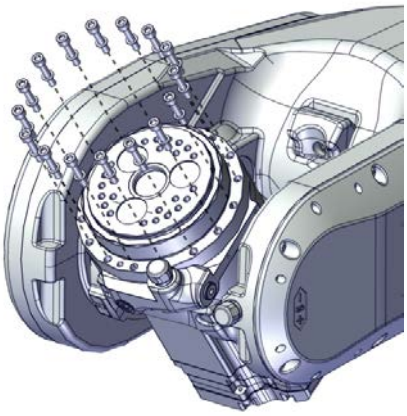
4.8.4 Replacing the axis-6 gearbox

Continued

	Action	Note
3	Secure the gearbox with its attachment screws.	Screws: M8x40 stainless steel (3HAC060786-013) (16 pcs) Washers: 8.4x13x1.6 stainless steel (3HAC060866-001) (16 pcs) Tightening torque: 35 Nm  xx1700001600
4	Perform a leak-down test.	See *Performing a leak-down test on page 184*.
5	Jog axis-5 to horizontal position.	
6	Refill oil in the gearbox.	See *Filling oil into the axis-6 gearbox on page 170*.

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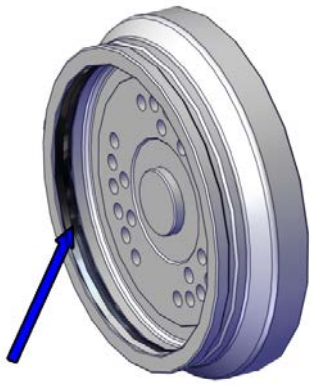
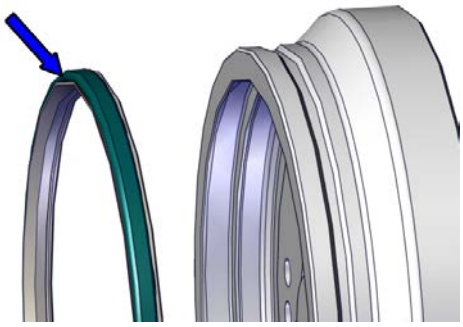
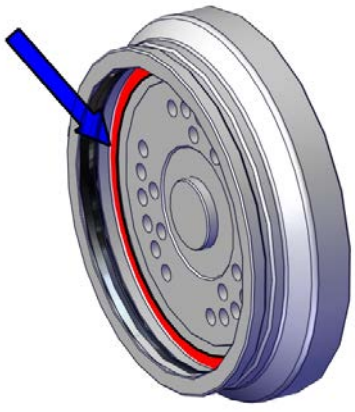
Refitting the turning disc

	Action	Note
1	Lubricate the new seal with grease and fit it to the turning disc. Face the sealing side outwards from the turning disc when orienting the seal, as shown in the figure.	Turcon Roto VL seal: 3HAC060656-002 Grease: 3HAC042536-001 (Shell Gadus S2).  xx1700001878  xx1700002033
2	Apply grease all the way around the inner corner of the turning disc. **Note** No grease is allowed on the screw flange.	Grease: 3HAC042536-001 (Shell Gadus S2).  xx1700002094

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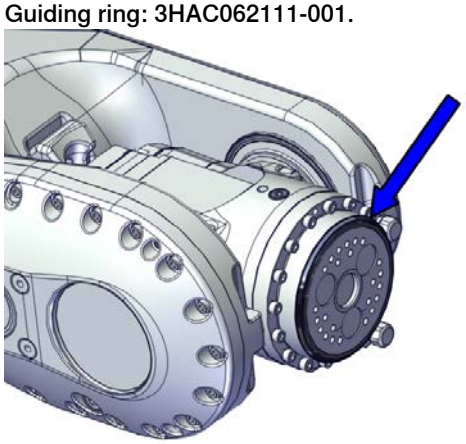
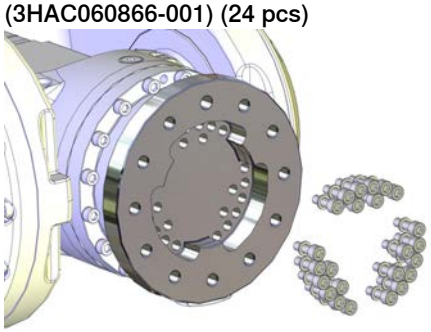
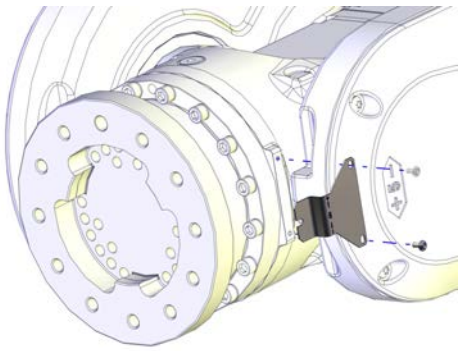
4.8.4 Replacing the axis-6 gearbox

Continued

	Action	Note
3	Ensure that the guiding ring is positioned on the gearbox.	Guiding ring: 3HAC062111-001.  xx1700001602
4	Wipe clean the contact surfaces.	
5	Secure the turning disc with new attachment screws and washers. **CAUTION** The attachment screws can not be reused. **Tip** Use three M8x35 screws first to pull in the turning disc against the gearbox, if needed. Then remove the screws and secure the turning disc with the specified attachment screws.	Tightening torque: 25 Nm + 45° ±10°. Attachment screws: M8x25 stainless steel, 3HAC060786-010 (24 pcs) Washers: 8.4x13x1.6 stainless steel (3HAC060866-001) (24 pcs)  xx1300000492

Concluding procedure

	Action	Note
1	Refit the synchronization plate axis-6.	 xx1300000825
2	Re-calibrate the robot.	Axis Calibration is described in *Calibrating with Axis Calibration method on page 650*. General calibration information is included in section *Calibration on page 637*.

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	Action	Note
3	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 108*.	

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5 Calibration

5.1 Introduction to calibration

5.1.1 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 650*.

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.

5.1.2 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 a sticker next to the identification plate of the robot (IRC5). 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.  xx0400001197	CalibWare

Brief description of calibration methods

Axis Calibration method

Axis Calibration is a standard calibration method for calibration of IRB 6790. 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.

Continues on next page

An introduction to the calibration method is given in this manual, see *Calibrating with Axis Calibration method on page 650*.

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.

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 681*.

5.1.3 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 644*. 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.

5.2 Synchronization marks and axis movement directions

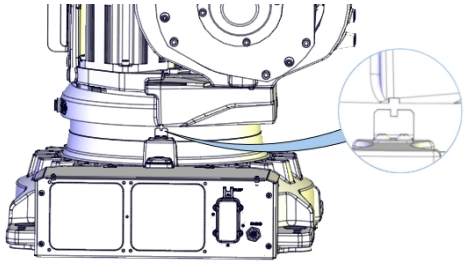
5.2.1 Synchronization marks and synchronization position for axes

Introduction

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

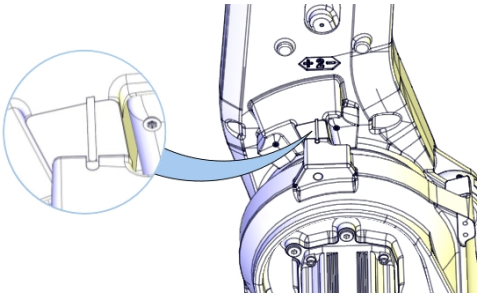
Synchronization marks, IRB 6790

Axis 1



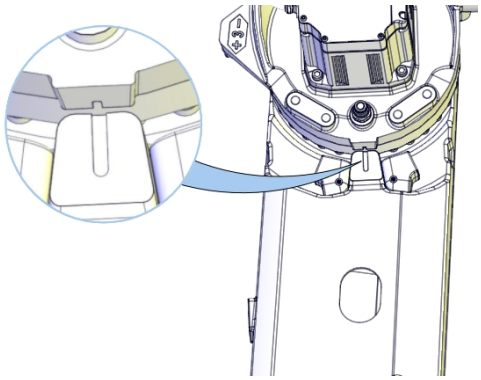
xx1300000868

Axis 2



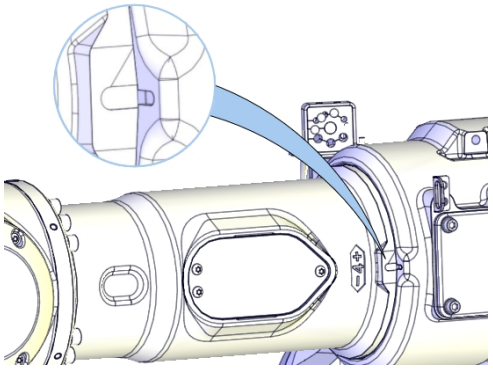
xx1300000869

Axis 3



xx1300000870

Axis 4



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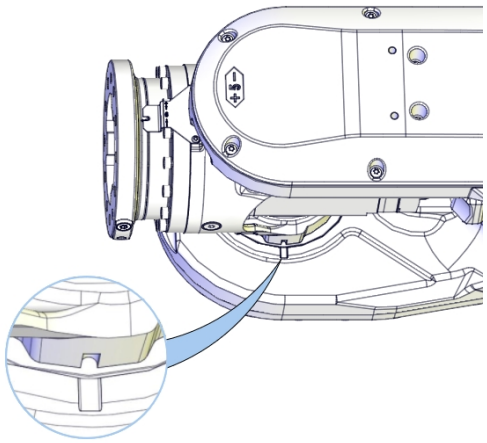
5.2.1 Synchronization marks and synchronization position for axes

Continued

Axis 5



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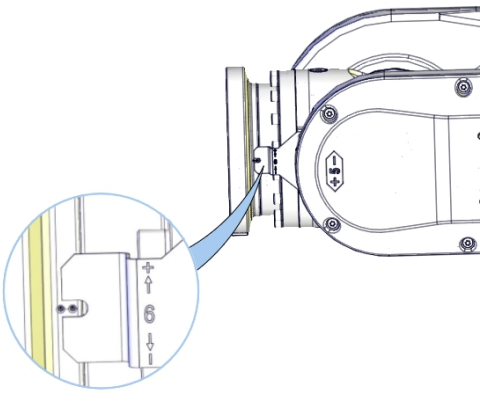
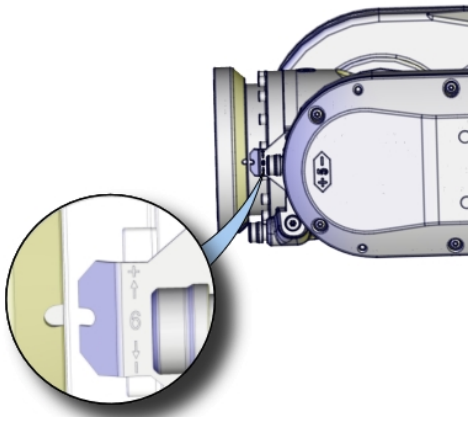
Axis 6

Two variants of synchronization mark plates.



xx1300000873



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5.2.2 Calibration movement directions for all axes

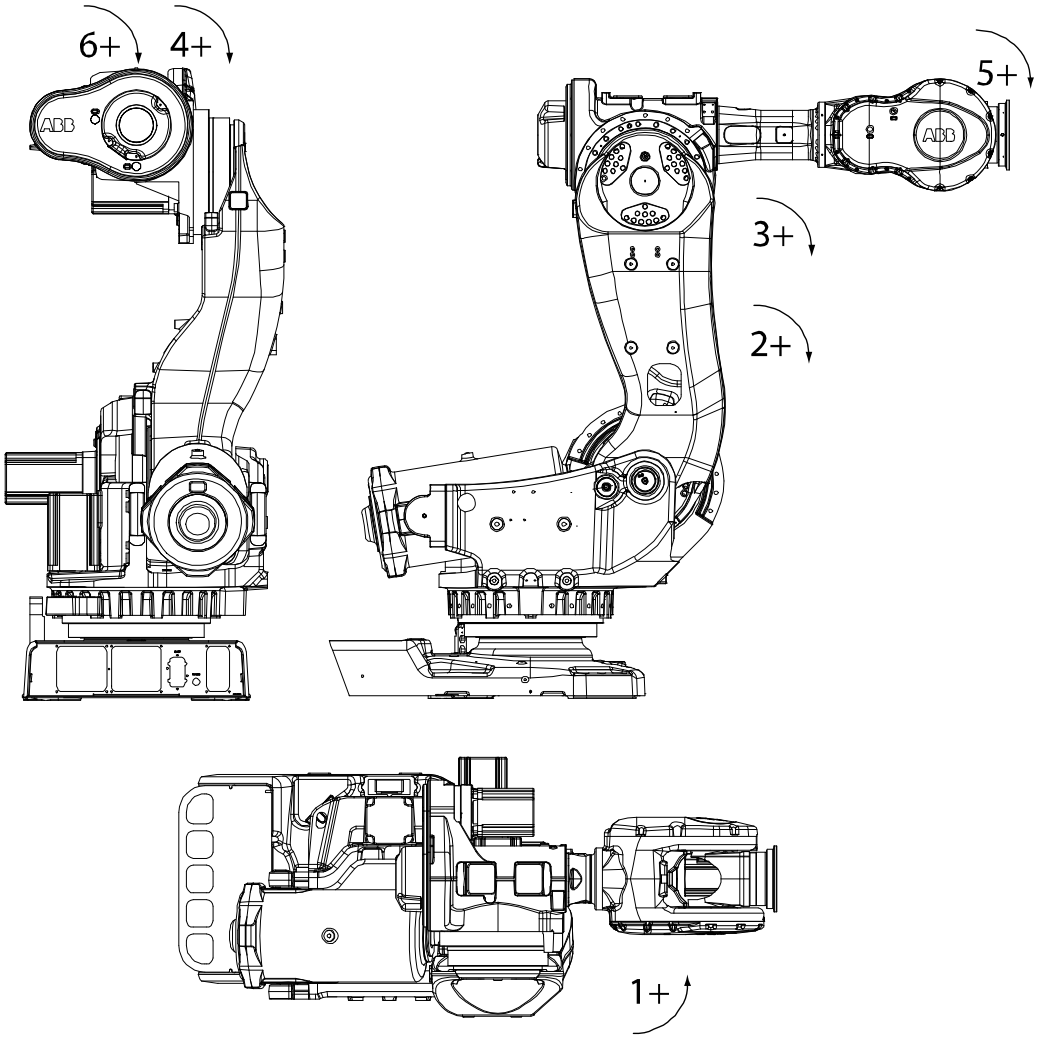
Overview

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, 6 axes

Note! The graphic shows an IRB 7600. The positive direction is the same for all 6-axis robots, except the positive direction of axis 3 for IRB 6400R, which is in the opposite direction!



xx0200000089

5.3 Updating revolution counters

5.3.1 Updating revolution counters on IRC5 robots

Introduction

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

Step 1 - Manually running the manipulator to the synchronization position

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

	Action	Note
1	Select axis-by-axis motion mode.	
2	Jog the manipulator to align the synchronization marks.	See *Synchronization marks and synchronization position for axes on page 641*.
3	When all axes are positioned, update the revolution counter.	*Step 2 - Updating the revolution counter with the FlexPendant on page 645*.

Correct calibration position of axis 4 and 6

When jogging the manipulator to synchronization position, it is extremely important to make sure that axes 4 and 6 of the following mentioned manipulators are positioned correctly. The axes can be calibrated at the wrong turn, resulting in an incorrect manipulator calibration.

Make sure the axes are positioned according to the correct calibration values, not only according to the synchronization marks. The correct values are found on a label, located either on the lower arm, underneath the flange plate on the base or on the frame.

The label can also be placed elsewhere due to the harsh environment.

At delivery the manipulator is in the correct position. Do NOT rotate axis 4 or 6 at power up before the revolution counters are updated.

If one of the following mentioned axes are rotated one or more turns from its calibration position before updating the revolution counter, the correct calibration position will be lost due to non-integer gear ratio. This affects the following manipulators:

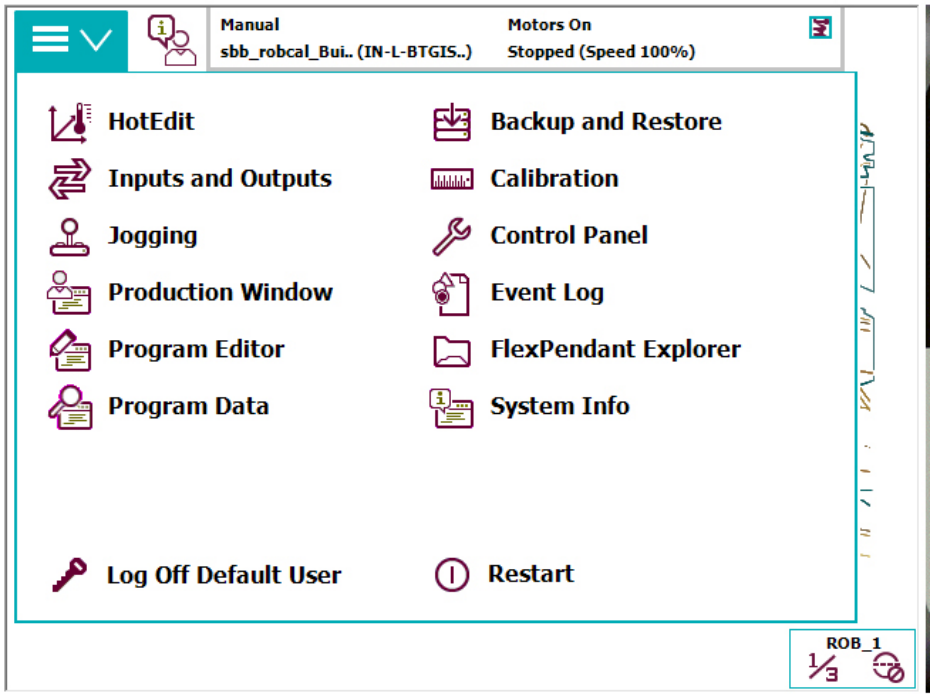
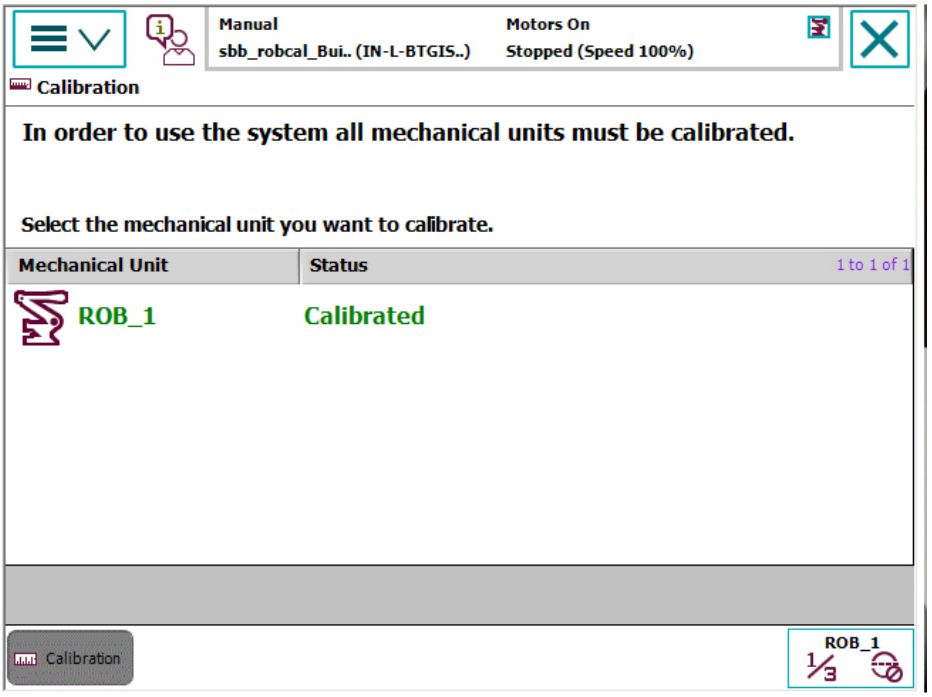
Manipulator variant	Axis 4	Axis 6
IRB 6790	Yes	No

If the synchronization marks seem to be wrong (even if the motor calibration data is correct), try to rotate the axis one turn, update the revolution counter and check the synchronization marks again (try both directions, if needed).

Continues on next page

Step 2 - Updating the revolution counter with the FlexPendant

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

	Action
1	On the **ABB** menu, tap **Calibration**.  xx1500000942
2	All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.  xx1500000943

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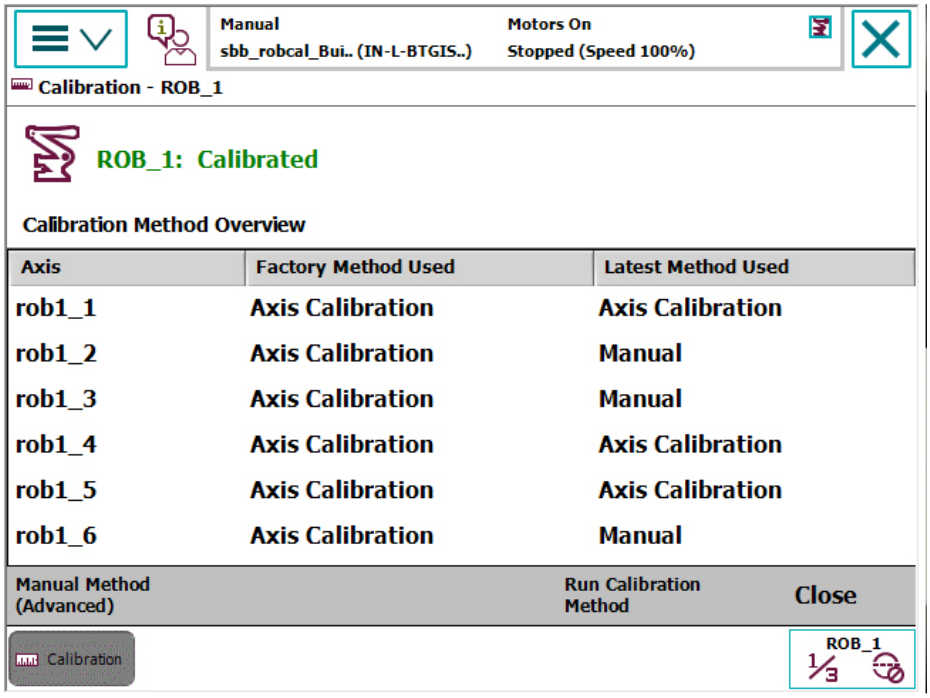
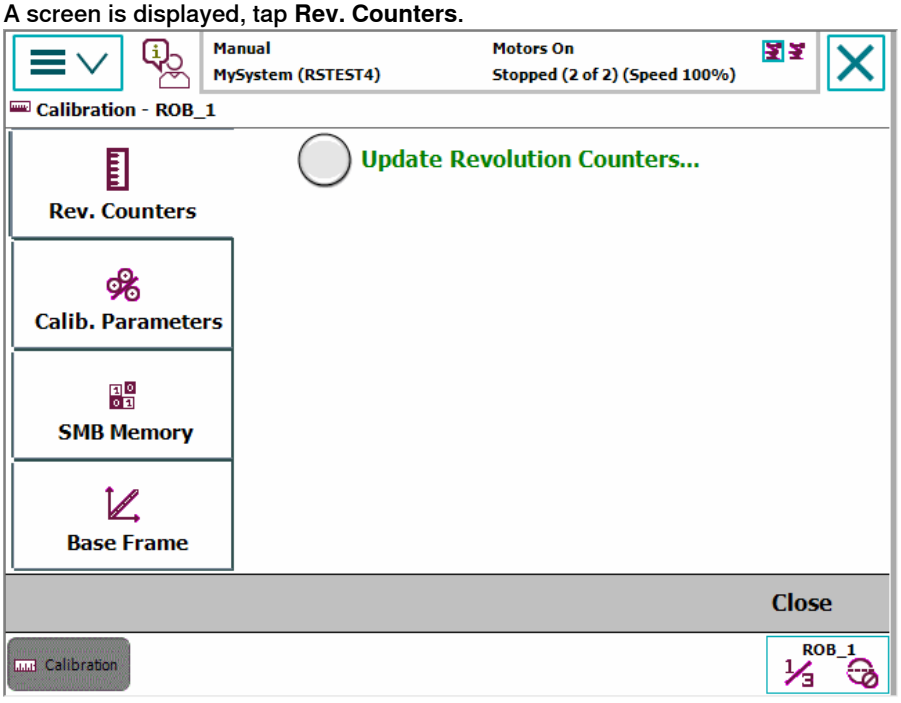
5.3.1 Updating revolution counters on IRC5 robots

Continued

	Action
3	**This step is valid for RobotWare 6.02 and later.** Calibration method used at factory for each axis is shown, as well as calibration method used during last field calibration. Tap **Manual Method (Advanced).**  xx1500000944
4	A screen is displayed, tap **Rev. Counters**.  en0400000771

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	Action
5	Tap **Update Revolution Counters...**. A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions: • Tap **Yes** to update the revolution counters. • Tap **No** to cancel updating the revolution counters. Tapping **Yes** displays the axis selection window.
6	Select the axis to have its revolution counter updated by: • Ticking in the box to the left • Tapping **Select all** to update all axes. Then tap **Update**.
7	A dialog box is displayed, warning that the updating operation cannot be undone: • Tap **Update** to proceed with updating the revolution counters. • Tap **Cancel** to cancel updating the revolution counters. Tapping **Update** updates the selected revolution counters and removes the tick from the list of axes.
8	**CAUTION** If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury! Check the synchronization position very carefully after each update. See *Checking the synchronization position on page 663*.

5.3.2 Updating revolution counters on OmniCore robots

Introduction

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

Step 1 - Manually running the manipulator to the synchronization position

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

	Action	Note
1	Select axis-by-axis motion mode.	
2	Jog the manipulator to align the synchronization marks.	See *Synchronization marks and synchronization position for axes on page 641*.
3	When all axes are positioned, update the revolution counter.	*Step 2 - Updating the revolution counter with the FlexPendant on page 648*.

Correct calibration position of axis 4 and 6

When jogging the manipulator to synchronization position, it is extremely important to make sure that axes 4 and 6 of the following mentioned manipulators are positioned correctly. The axes can be calibrated at the wrong turn, resulting in an incorrect manipulator calibration.

Make sure the axes are positioned according to the correct calibration values, not only according to the synchronization marks. The correct values are found on a label, located either on the lower arm, underneath the flange plate on the base or on the frame.

The label can also be placed elsewhere due to the harsh environment.

At delivery the manipulator is in the correct position. Do NOT rotate axis 4 or 6 at power up before the revolution counters are updated.

If one of the following mentioned axes are rotated one or more turns from its calibration position before updating the revolution counter, the correct calibration position will be lost due to non-integer gear ratio. This affects the following manipulators:

Manipulator variant	Axis 4	Axis 6
IRB 6790	Yes	No

If the synchronization marks seem to be wrong (even if the motor calibration data is correct), try to rotate the axis one turn, update the revolution counter and check the synchronization marks again (try both directions, if needed).

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**.

Continues on next page

	Action
3	In the **Selection** column select the axes for which revolution counters need to be updated.
4	Tap **Update**. A dialog box is displayed warning that the updating operation cannot be undone.
5	Tap **OK** to update the revolution counter.
6	**CAUTION** If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury! Check the synchronization position very carefully after each update. See *Checking the synchronization position on page 663*.

5.4 Calibrating with Axis Calibration method

5.4.1 Description of Axis Calibration

Instructions for Axis Calibration procedure given on the FlexPendant

The actual instructions of how to perform the calibration procedure and what to do at each step is given on the FlexPendant. You will be guided through the calibration procedure, step by step.

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

Overview of the Axis Calibration procedure

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

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

The Axis Calibration procedure described roughly:

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

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

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

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

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

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

Continues on next page

Routines in the calibration procedure

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

Fine calibration routine

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

Reference calibration routine

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

Note

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

Note

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

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

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

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

Update revolution counters

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

Validation

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

Position of robot axes

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

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

Continues on next page

5.4.1 Description of Axis Calibration
Continued

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

Requirements for axis positioning during calibration

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

System containing SafeMove

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

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

5.4.2 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	3HAC055412-001	Delivered as a set of calibration tools.

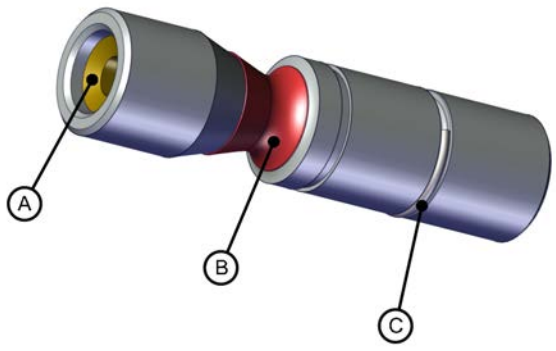
Examining the calibration tool

Check prior to usage

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

WARNING

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



xx1500001914

A	Tube insert
B	Plastic protection
C	Steel spring ring

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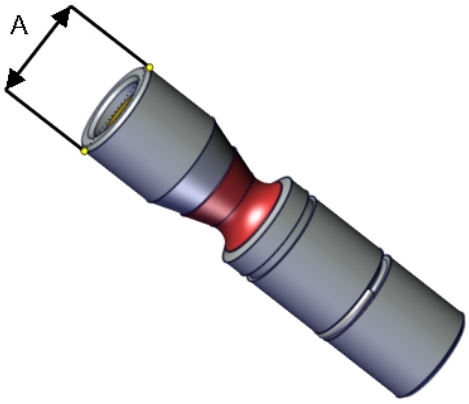
5.4.2 Calibration tools for Axis Calibration
Continued

Periodic check of the calibration tool

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

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



xx1500000951

A	Outer diameter

Identifying the calibrating tools

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

Note

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

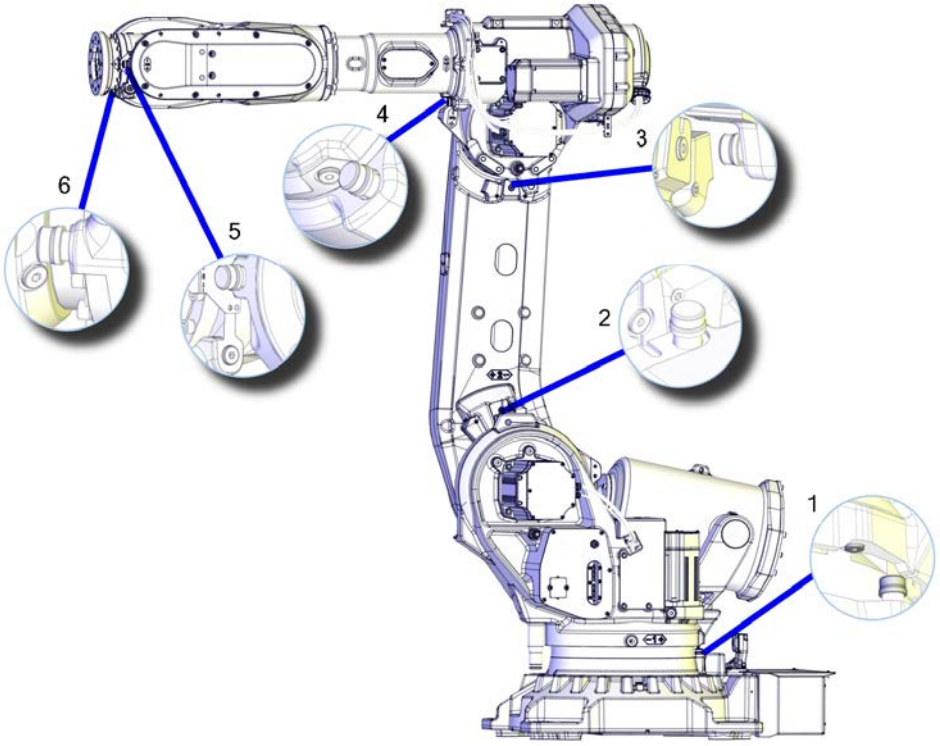
	Action	Note
1	It is possible to use any RFID solution, with the correct dimensions. ABB has verifed function on some suppliers fulfilling the requirements of NFC compatible devices (13.56 Mhz) according to ISO 14443 or ISO 15693. **Note** The maximum dimensions on the RFID chip must not exceed Ø7.9 mm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

5.4.3 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.



xx1500000890

Spare parts

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

Spare part	Article number	Note
Protection cover and plug set	3HAC064875-001	Contains replacement calibration pin covers and protective plugs for the bushing.

5.4.4 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	3HAC055412-001	Delivered as a set of calibration tools.

Required consumables

Consumable	Article number	Note
Clean cloth	-	

Spare parts

Spare part	Article number	Note
Protection cover and plug set	3HAC064875-001	Contains replacement calibration pin covers and protective plugs for the bushing.

Overview of the calibration procedure on the FlexPendant

The actual instructions of how to perform the calibration procedure and what to do at each step is given on the FlexPendant. You will be guided through the calibration procedure, step by step.

Use the following list to learn about the calibration procedure before running the RobotWare program on the FlexPendant. It gives you a brief overview of the calibration procedure.

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

1. Choose calibration routine. The routines are described in *Routines in the calibration procedure on page 651*.
2. Choose which axis/axes to calibrate.
3. The robot moves to synchronization position.
4. Validate the synchronization marks.
5. The robot moves to preparation position.
6. Remove the protective cover from the fixed pin and the protection plug from the bushing, if any, and install the calibration tool.
7. The robot performs a measurement sequence by rotating the axis back and forth.

Continues on next page

8 Remove the calibration tool and reinstall the protective cover on the fixed pin and the protection plug in the bushing, if any.

9 The robot moves to verify that the calibration tool is removed.

10 Choose whether to save the calibration data or not.

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

Preparation prior to calibration

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

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

Starting the calibration procedure

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

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

Continues on next page

5.4.4 Axis Calibration - Running the calibration procedure
Continued

	Action	Note
5	**Valid for RobotWare 7** Tap **Calibration Methods** on the right pane and then tap **Calibration**. The software will automatically call for the procedure for the valid calibration method.	
6	Follow the instructions given on the FlexPendant.	A brief overview of the sequence that will be run on the FlexPendant is given in *Overview of the calibration procedure on the FlexPendant on page 656*.

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 643*

Axis Calibration with SafeMove option

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

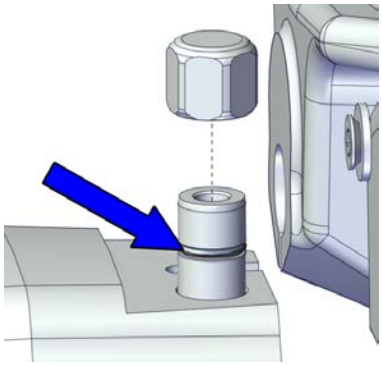
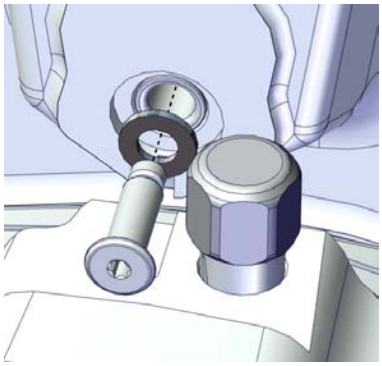
However, SafeMove may generate other warning messages anytime during the Axis Calibration routine. When a warning message is displayed, tap **Acknowledge** to confirm the unsynchronized state and continue Axis Calibration procedure.

CAUTION

SafeMove must be synchronized after the calibration is completed.

Continues on next page

After calibration

	Action	Note
1	Check the o-ring on the fixed calibration pin. Replace if damaged or missing.	 xx1600002102 Protection cover and plug set: 3HAC064875-001.
2	Reinstall the protective cover on the fixed calibration pin on each axis, directly after the axis has been calibrated. Replace the cover with new spare part, if missing or damaged.	
3	Reinstall the protective plug and sealing in the bushing on each axis, directly after the axis has been calibrated. Ensure that the sealing is not damaged. Tighten the plug lightly so that the sealing washer is just about fastened between the plug and the bushing. Then tighten 1/4 turn more. Replace the plug and the sealing with new spare part, if missing or damaged.	 xx1600002103 Protection cover and plug set: 3HAC064875-001.

5.4.5 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).

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

Manual tuning of calibration offset

Manual tuning of calibration offset is normally not needed, but can be useful in some situations. The requirement to do manual tuning is that there is a known accurate position, that worked accurately before the repair (step 5, see *Brief introduction to Reference Calibration on page 660*).

Continues on next page

Example "Adjust axis 4":

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

5.5 Verifying the calibration

Introduction

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

Verifying the calibration

Use this procedure to verify the calibration result.

	Action	Note
1	Run the calibration home position program twice. Do not change the position of the robot axes after running the program!	See *Checking the synchronization position on page 663*.
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 641*.
3	Write down the values on a new label and stick it on top of the calibration label. The label is located on the lower arm. The label can also be placed elsewhere due to the harsh environment.	

5.6 Checking the synchronization position

Introduction

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

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

Continues on next page

5.6.1 Checking the synchronization position on IRC5 robots

Using a MoveAbsJ instruction

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

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

4	Create the following program:
	`MoveAbsJ [[0,0,0,0,0,0],`
	`[9E9,9E9,9E9,9E9,9E9,9E9]]`
	`\NoEOffs, v1000, fine, tool0`	

5	Run the program in manual mode.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See *Synchronization marks and synchronization position for axes on page 641* and *Updating revolution counters on page 644*.

Using the jogging window

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

	Action	Note
1	On the **ABB** menu, tap **Jogging**.	
2	Tap **Motion mode** to select group of axes to jog.	
3	Tap to select the axis to jog, axis 1, 2, or 3.	
4	Manually run the robots axes to a position where the axis position value read on the FlexPendant, is equal to zero.	
5	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See *Synchronization marks and synchronization position for axes on page 641* and *Updating revolution counters on page 644*.

5.6.2 Checking the synchronization position on OmniCore robots

Using a MoveAbsJ instruction

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

	Action	Note
1	Tap **Code**.	
2	Create a new program.	
3	Use **MoveAbsJ** in the **Add Instruction** menu.	

4	Create the following program:
	`MoveAbsJ [[0,0,0,0,0,0],`
	`[9E9,9E9,9E9,9E9,9E9,9E9]]`
	`\NoEOffs, v1000, fine, tool0`	

5	Run the program in manual mode.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See *Synchronization marks and synchronization position for axes on page 641* and *Updating revolution counters on page 644*.

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 641* and *Updating revolution counters on page 644*.

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6 Decommissioning

6.1 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 668*.

Transportation

Prepare the robot or parts before transport, this to avoid hazards.

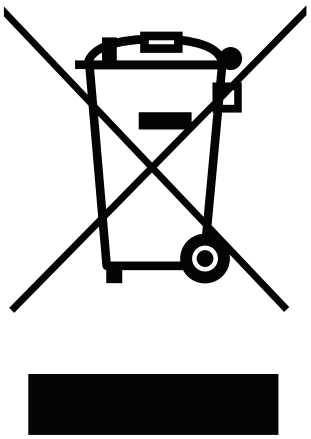
6.2 Environmental information

Introduction

ABB robots contain components in different materials. During decommissioning, all materials shall be dismantled, recycled, or reused responsibly, according to the relevant laws and industrial standards. Robots or parts that can be reused or upcycled helps to reduce the usage of natural resources.

Disposal symbol

The following symbol indicates that the product must not be disposed of as common garbage. Handle each product according to local regulations for the respective content (see table below).



xx1800000058

Materials used in the product

The table specifies some of the materials in the product and their respective use throughout the product.

Dispose components properly according to local regulations to prevent health or environmental hazards.

Material	Example application
Aluminium	Covers, synchronization brackets
Batteries, Lithium	Serial measurement board
Cast iron/nodular iron	Base, lower arm, upper arm
Copper	Cables, motors
Neodymium	Brakes, motors
Nickel	Coating, turning disc
Oil, grease	Gearboxes
Plastic/rubber	Cables, connectors, drive belts, and so on.
Stainless steel	Screws, washers
Steel	Gears, screws, base frame, and so on.

Continues on next page

Oil and grease

Where possible, arrange for oil and grease to be recycled. Dispose of via an authorized person/contractor in accordance with local regulations. Do not dispose of oil and grease near lakes, ponds, ditches, down drains, or onto soil. Incineration must be carried out under controlled conditions in accordance with local regulations.

Also note that:

- Spills can form a film on water surfaces causing damage to organisms. Oxygen transfer could also be impaired.
- Spillage can penetrate the soil causing ground water contamination.

6.3 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.

6.4 Decommissioning of balancing device

General

There is much energy stored in the balancing device. Therefore a special procedure is required to disassemble it. The coil springs inside the balancing device exert a potentially lethal force unless disassembled properly.

The device must be disassembled by a decommissioning company.

Required equipment

Equipment	Article number	Note
Standard toolkit	-	Content is defined in section *Standard toolkit on page 680*.
Protective clothing that also covers face and hands	-	Must protect against spatter of sparks and flames.
Cutting torch with a long shaft	-	For opening housing and cutting coils. The long shaft is a safety requirement.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

DANGER

Do not, under any circumstances, deal with the balancing device in any other way than that detailed in the product documentation! For example, attempting to open the balancing device is potentially lethal!

Action on field, decommissioning

The procedure below details the actions to perform on field, when the balancing device is to be decommissioned.

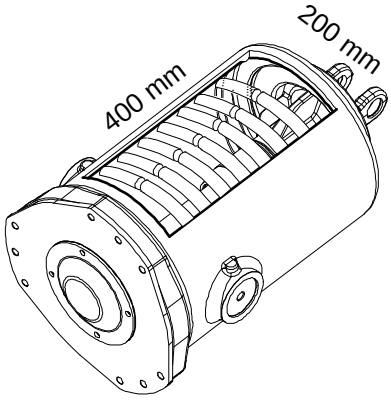
	Action	Note
1	Remove the balancing device from the robot.	Detailed in section *Replacing the balancing device on page 403*.
2	Send the device to a decommissioning company.	Make sure the decommissioning company is well informed about the stored energy built up by high tensioned compression springs and that the device contains some grease. The following procedure contains useful information about decommissioning.

Continues on next page

6.4 Decommissioning of balancing device
Continued

Decommissioning at decommissioning company, balancing device

The instruction below details how to decommission the balancing device. Contact ABB Robotics for further consultation.

	Action	Note
1	**DANGER** There is stored energy built up by high tensioned compression springs inside the balancing device! When a coil is cut the released tension creates a spatter of sparks and flames. The working area must be free of flammable materials. Position the balancing device so that the spatter will be directed away from personnel.	
2	Clamp the device at the working location. Place the device at ground level so that the hole and spring coils are cut from a safe distance and somewhat from above.	
3	**DANGER** The hole must be cut as specified in the figure. Pieces of the spring can be thrown out from the cylinder at high speed if the hole is cut larger than specified!	
4	Cut a hole in the housing as shown in the figure.	Use a cutting torch with a long shaft.  xx0700000391
5	Cut the coils of the springs inside the housing as specified below:	Use a cutting torch with a long shaft.
6	Double-check the number of coils cut and make sure all the tension in the springs is removed. Double-check the number of coils cut and make sure all the tension in the springs is removed.	

7 Reference information

7.1 Introduction

General

This chapter includes general information, complementing the more specific information in the different procedures in the manual.

7.2 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

7.3 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	

7.4 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

Stainless steel screws

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

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.

Continues on next page

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.

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

Continues on next page

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
M12	82	115	140
M16	200	290	340
M20	400	560	670
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

7.5 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.	

7.6 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	Comment
1	Ring-open-end spanner 8-19 mm	
1	Socket head cap 2.5-17 mm	
1	Torx socket no: 20-60	
1	Box spanner set	
1	Torque wrench 10-100 Nm	
1	Torque wrench 75-400 Nm	
1	Ratchet head for torque wrench 1/2	
2	Hexagon-headed screw M10x100	
1	Hexagon-headed screw M16x90	
1	Hex bit socket head cap no. 14 socket 40 mm L=100 mm	
1	Hex bit socket head cap no. 14 socket 40 mm L=20 mm	To be shortened to 12 mm
1	Hex bit socket head cap no. 6 socket 40 mm L=145 mm	
1	Hex bit socket head cap no. 6 socket 40mm bit L=220 mm	
1	Plastic mallet	

7.7 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 680*, and of special tools, listed directly in the instructions and also gathered in this section.

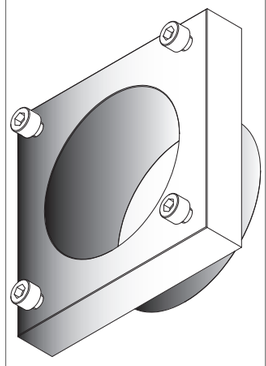
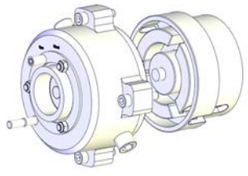
Special tools

Continues on next page

7.7 Special tools

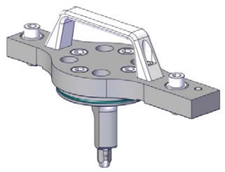
Tools and equipment with spare part number: (These tools can be ordered from ABB)			Cable harness	SMB	Brake release unit	Lower arm	Upper arm	Wrist	Turning disc	Balancing device	Spherical roller bearing (link ear)	Rear bearing (balancing device)	Axis 1 motor	Axis 2 motor	Axis 3 motor	Axis 4 motor	Axis 5 motor	Axis 6 motor	Axis 1 gearbox	Axis 2 gearbox	Axis 3 gearbox	Axis 6 gearbox
Guide pins																						
3HAC15520-1	Guide pin, M8x100																2					
3HAC15521-2	Guide pin, M10x150												2	2	2	2			2	2	2	
3HAC13056-2	Guide pin, M12x150					x	x	2												x	x	
3HAC13056-3	Guide pin, M12x200					x	x												x	x	x	
3HAC13120-2	Guide pin, M16x150					x													x	x		
3HAC13120-3	Guide pin, M16x200					x													x	x		
Lifting accessories																						
3HAC15556-1	Lifting accessory (chain)	 xx1200001241				x	x								x				x	x	x	
3HAC14459-1	Lifting accessory, motor												x						x			
3HAC15534-1	Lifting accessory, motor													x	x					x		
3HAC046128-001	Lifting accessory, gearbox																			x		
3HAC046128-001	Lifting accessory, gearbox																				x	
3HAC16131-1	Lifting eye M12	 xx1200001242				2	2												2	2	2	
3HAC14457-4	Lifting eye M16	 xx1200001242																	2	x		
-	Lifting shackle SA-10-8-NA1	 xx1200001243				x				x	x	x								x		

Continues on next page

Tools and equipment with spare part number: (These tools can be ordered from ABB)			Cable harness	SMB	Brake release unit	Lower arm	Upper arm	Wrist	Turning disc	Balancing device	Spherical roller bearing (link ear)	Rear bearing (balancing device)	Axis 1 motor	Axis 2 motor	Axis 3 motor	Axis 4 motor	Axis 5 motor	Axis 6 motor	Axis 1 gearbox	Axis 2 gearbox	Axis 3 gearbox	Axis 6 gearbox
-	Fender washer Outer diameter: minimum 26 mm, maximum 30 mm, hole diameter: 13 mm, thickness: 3 mm.	 xx1400002196				x	x												x	x	x	
-	Roundsling, 1.5 m Length: 1.5 m. Lifting capacity: 2,000 kg.					x													x	x		
-	Roundsling, 1 m Length: 1 m, lifting capacity: 1,000 kg.					x		x		x	x	x	x	x	x				x	x		
3HAC047054-003	Fork lift accessory set					x				x		x							x	x		
Press, puller and unloading tools																						
3HAC12475-6	AdapterM20-M16					x				x										x		
3HAC028920-001	Dismantle and mounting tool					x				x	x	x								x		
3HAC030662-001	Distance tool	 xx1400000726				x					x	x								x		
3HAC020902-001	Hydraulic press tool, balancing device	 xx1300000672								x												
3HAC11731-1	Hydraulic cylinder									x	x	x								x		

Continues on next page

7.7 Special tools

Tools and equipment with spare part number: (These tools can be ordered from ABB)			Cable harness	SMB	Brake release unit	Lower arm	Upper arm	Wrist	Turning disc	Balancing device	Spherical roller bearing (link ear)	Rear bearing (balancing device)	Axis 1 motor	Axis 2 motor	Axis 3 motor	Axis 4 motor	Axis 5 motor	Axis 6 motor	Axis 1 gearbox	Axis 2 gearbox	Axis 3 gearbox	Axis 6 gearbox
3HAC13086-1	Hydraulic pump 70 MPa									x	x	x								x		
-	Threaded bar, M16x340					x				x		x								x		
Removal tools																						
-	ScrewsM8x75, fully threaded																				3	
3HAC14631-1	Removal tool motor M12												x	x	x	x	x	x				
Other tools																						
-	24 VDC power supply					x	x	x					x	x	x	x	x	x	x	x	x	x
3HAC046645-003	Aligning tool	 xx1700001659																	x			
-	Long AllenKeySocketIN19L 6-140															x	x	x				
3HAC12342-1	Bits extender												x	x	x				x	x		
3HAC055412-001	Calibration tool box, Axis Calibration [iii]					x	x	x	x				x	x	x	x	x	x	x	x	x	x
3HAC043870-009	Guide for reduction gear	 xx1700002195																	x			
-	Leak-down tester												x	x	x	x	x	x	x	x	x	x
-	Lock screw, M16x120									x	x	x		x								
-	Oil collecting vessel													x	x				x	x	x	x
-	Oil dispenser													x	x				x	x	x	x

Continues on next page

Tools and equipment with spare part number: (These tools can be ordered from ABB)			Cable harness	SMB	Brake release unit	Lower arm	Upper arm	Wrist	Turning disc	Balancing device	Spherical roller bearing (link ear)	Rear bearing (balancing device)	Axis 1 motor	Axis 2 motor	Axis 3 motor	Axis 4 motor	Axis 5 motor	Axis 6 motor	Axis 1 gearbox	Axis 2 gearbox	Axis 3 gearbox	Axis 6 gearbox
3HAC067546-001	Pinion	 xx1800001147																			x	
3HAB7887-1	Rotation tool					x	x						x	x	x	x	x	x	x	x	x	x

IRB 6790 - 235/2.65, IRB 6790 - 205/2.80, IRB 6700 - 200/2.60, IRB 6700 - 155/2.85
Included in Dismantle and mounting tool (3HAC028920-001).

iii The robot is calibrated by either Calibration Pendulum or Axis Calibration at factory. Always use the same calibration method as used at the factory.
Information about valid calibration method is found on the calibration label or in the calibration menu on the FlexPendant.

Continues on next page

7.8 Lifting accessories and lifting instructions

General

Many repair and maintenance activities require different pieces of lifting accessories, which are specified in each procedure.

The use of each piece of lifting accessories is *not* detailed in the activity procedure, but in the instruction delivered with each piece of lifting accessories.

The instructions delivered with the lifting accessories should be stored for later reference.

8 Spare parts

8.1 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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9 Circuit diagrams

9.1 Circuit diagrams

Overview

The circuit diagrams are not included in this manual, but are available for registered users on myABB Business Portal, *www.abb.com/myABB*.

See the article numbers in the tables below.

Controllers

Product	Article numbers for circuit diagrams
Circuit diagram - OmniCore V250XT	*3HAC074000-008*
Circuit diagram - OmniCore V400XT	*3HAC082020-008*
Circuit diagram - IRC5	*3HAC024480-011*

Manipulators

Product	Article numbers for circuit diagrams
Circuit diagram - IRB 120	*3HAC031408-003*
Circuit diagram - IRB 140 type C	*3HAC6816-3*
Circuit diagram - IRB 260	*3HAC025611-001*
Circuit diagram - IRB 360	*3HAC028647-009*
Circuit diagram - IRB 390	*3HAC060545-009*
Circuit diagram - IRB 460	*3HAC036446-005*
Circuit diagram - IRB 660	*3HAC025691-001*
Circuit diagram - IRB 760	*3HAC025691-001*
Circuit diagram - IRB 1200	*3HAC046307-003*
Circuit diagram - IRB 1410	*3HAC2800-3*
Circuit diagram - IRB 1600/1660	*3HAC021351-003*
Circuit diagram - IRB 1510	*3HAC087368-003*
Circuit diagram - IRB 1520	*3HAC039498-007*
Circuit diagram - IRB 2400	*3HAC6670-3*
Circuit diagram - IRB 2600	*3HAC029570-007*
Circuit diagram - IRB 4400/4450S	*3HAC9821-1*
Circuit diagram - IRB 4600	*3HAC029038-003*
Circuit diagram - IRB 6620	*3HAC025090-001*
Circuit diagram - IRB 6620 / IRB 6620LX	*3HAC025090-001*
Circuit diagram - IRB 6640	*3HAC025744-001*
Circuit diagram - IRB 6650S	*3HAC13347-1* *3HAC025744-001*

Continues on next page

9.1 Circuit diagrams
Continued

Product	Article numbers for circuit diagrams
Circuit diagram - IRB 6660	*3HAC025744-001* *3HAC029940-001*
Circuit diagram - IRB 6700 / IRB 6790	*3HAC043446-005*
Circuit diagram - IRB 7600	*3HAC13347-1* *3HAC025744-001*
Circuit diagram - IRB 14000	*3HAC050778-003*
Circuit diagram - IRB 910SC	*3HAC056159-002*

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