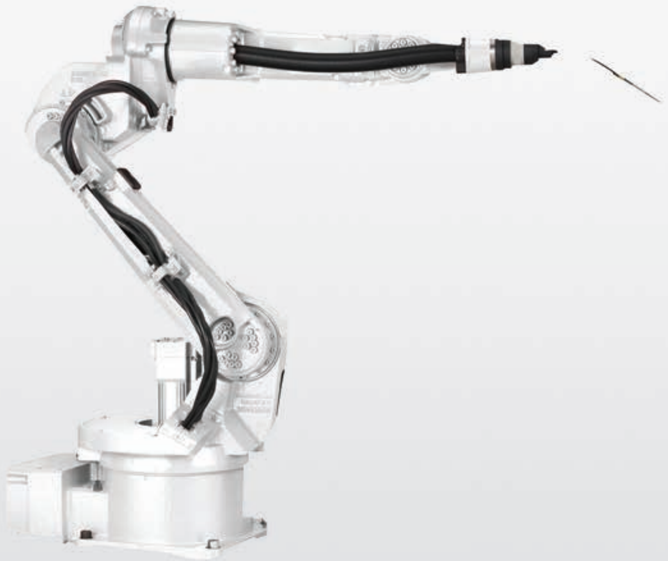
ROBOTICS

Product manual

IRB 1510



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Product manual

IRB 1510ID - 4/1.5

IRC5, IRC5C

Document ID: 3HAC087870-001

Revision: B

Keep for future reference.

Additional copies of this manual may be obtained from ABB.

Original instructions.

Table of contents

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Overview of this manual

About this manual

This manual contains instructions for:

- mechanical and electrical installation of the robot
- maintenance of the robot
- mechanical and electrical repair of the robot.

Usage

This manual should be used during:

- installation, from lifting the robot to its work site and securing it to the foundation, to making it ready for operation
- maintenance work
- repair work and calibration.

Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

Prerequisites

Maintenance/repair/installation personnel working with an ABB Robot must:

- be trained by ABB and have the required knowledge of mechanical and electrical installation/repair/maintenance work.

Product manual scope

The manual covers covers all variants and designs of the IRB 1510. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

Organization of chapters

The manual is organized in the following chapters:

Chapter	Contents
Safety, service	Safety information that must be read through before performing any installation or service work on robot. Contains general safety aspects as well as more specific information on how to avoid personal injuries and damage to the product.
Installation and commissioning	Required information about lifting and installation of the robot.
Maintenance	Step-by-step procedures that describe how to perform maintenance of the robot. Based on a maintenance schedule that may be used to plan periodical maintenance.
Repair	Step-by-step procedures that describe how to perform repair activities of the robot. Based on available spare parts.

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Chapter	Contents
Calibration information	Procedures that do not require specific calibration equipment. General information about calibration.
Decommissioning	Environmental information about the robot and its components.
Reference information	Useful information when performing installation, maintenance or repair work. Includes lists of necessary tools, additional documents, safety standards, etc.
Spare parts and exploded views	Reference to the spare part list for the robot.
Circuit diagram	Reference to the circuit diagram for the robot.

References

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

General

Document name	Document ID
Product manual, spare parts - IRB 1510	*3HAC087872-001*
Circuit diagram - IRB 1510	*3HAC087368-003*
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*

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

IRC5 robots

Document name	Document ID
Product specification - IRB 1510	*3HAC087871-001*
Product manual - IRC5 IRC5 with main computer DSQC1000.	*3HAC047136-001*
Operating manual - IRC5 with FlexPendant	*3HAC050941-001*
Operating manual - Service Information System	*3HAC050944-001*
Operating manual - Calibration Pendulum	*3HAC16578-1*
Application manual - Additional axes and standalone controller	*3HAC051016-001*
Application manual - CalibWare Field	*3HAC030421-001*
Technical reference manual - System parameters	*3HAC050948-001*

Revisions

Revision	Description
A	First edition.
B	Published in release 24A. The following updates are done in this revision: • Updated article numbers of signal cables.

Product documentation

Categories for user documentation from ABB Robotics

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

Tip

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

Product manuals

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

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

Technical reference manuals

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

Application manuals

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

An application manual generally contains information about:

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

Continues on next page

- Examples of how to use the application.

Operating manuals

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

How to read the product manual

Reading the procedures

The procedures contain references to figures, tools, material, and so on. The references are read as described below.

References to figures

The procedures often include references to components or attachment points located on the manipulator/controller. The components or attachment points are marked with *italic text* in the procedures and completed with a reference to the figure where the current component or attachment point is shown.

The denomination in the procedure for the component or attachment point corresponds to the denomination in the referenced figure.

The table below shows an example of a reference to a figure from a step in a procedure.

	Action	Note/Illustration
8.	Remove the *rear attachment screws, gearbox.*	Shown in the figure *Location of gearbox on page xx*.

References to required equipment

The procedures often include references to equipment (spare parts, tools, etc.) required for the different actions in the procedure. The equipment is marked with *italic text* in the procedures and completed with a reference to the section where the equipment is listed with further information, that is article number and dimensions.

The designation in the procedure for the component or attachment point corresponds to the designation in the referenced list.

The table below shows an example of a reference to a list of required equipment from a step in a procedure.

	Action	Note/Illustration
3.	Fit a new *sealing, axis 2* to the gearbox.	Art. no. is specified in *Required equipment on page xx.*

Safety information

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

Read more in the chapter *Safety on page 15*.

Illustrations

The robot 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 robot models, can be illustrated with illustrations that show a different robot model than the one that is described in the current manual.

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1 Safety

1.1 Safety information

1.1.1 Limitation of liability

Limitation of liability

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

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

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

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

Spare parts and equipment

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

1.1.2 Requirements on personnel

General

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

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

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

Personal protective equipment

Use personal protective equipment, as stated in the instructions.

1.2 Safety signals and symbols

1.2.1 Safety signals in the manual

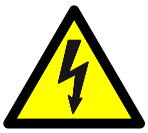
Introduction to safety signals

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

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

Hazard levels

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

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

Continues on next page

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

1.2.2 Safety symbols on manipulator labels

Introduction to symbols

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

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

Note

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

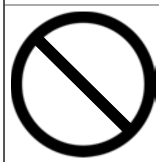
Types of symbols

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

The safety labels are language independent, they only use graphics. See *Symbols on safety labels on page 19*.

The information labels can contain information in text.

Symbols on safety labels

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

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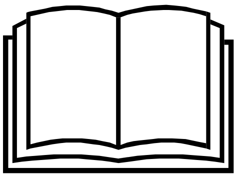
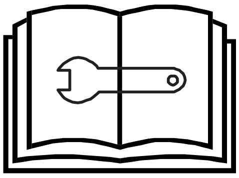
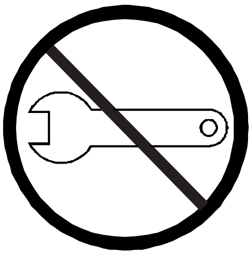
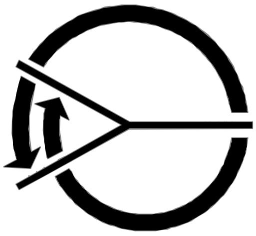
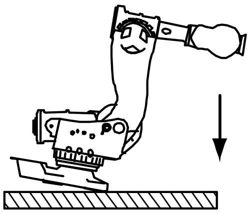
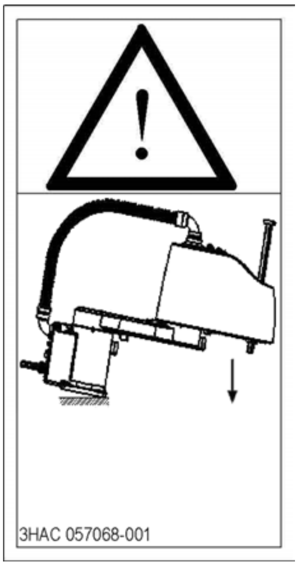
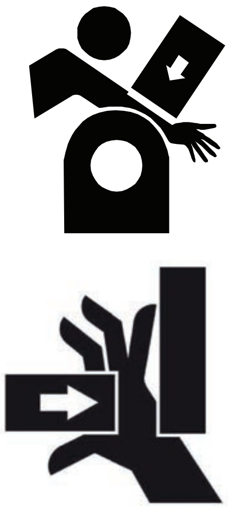
Symbol	Description
 xx0900000813	**See user documentation** Read user documentation for details. Which manual to read is defined by the symbol: • No text: *Product manual*. • EPS: *Application manual - Electronic Position Switches*.
 xx0900000816	**Before disassembly, see product manual**
 xx0900000815	**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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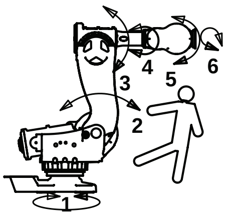
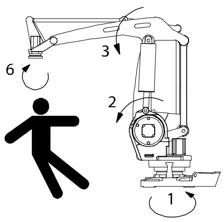
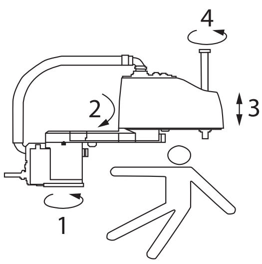
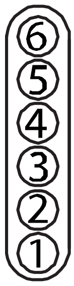
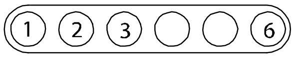
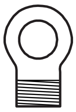
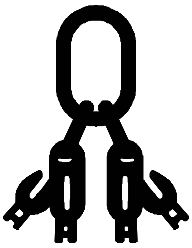
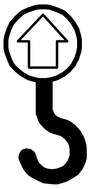
1.2.2 Safety symbols on manipulator labels

Continued

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

Continues on next page

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

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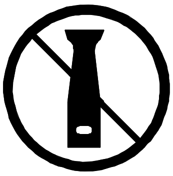
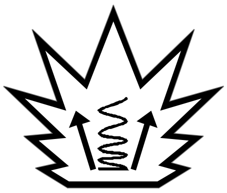
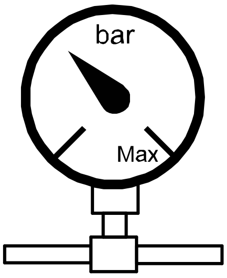
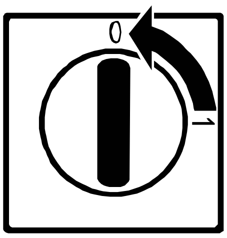
1.2.2 Safety symbols on manipulator labels

Continued

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

1.3 Robot stopping functions

Protective stop and emergency stop

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

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Compact*

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 292* 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.

Safety measures for arc welding

The following points should be observed:

- Consider the welding robot equipment as a single unit.
- Do not mix up the phase and grounding conductors when connecting the equipment to the main supply.
- The workpiece, fixtures, and positioner are usually in direct contact with the welding circuit, and should therefore be regarded as live.
- Do not touch live parts of the equipment with your bare hands or with damp gloves.
- The welding circuit shall not be grounded without necessary measures being taken to ensure proper functioning of the grounding conductor.
- The welding circuit must not be broken during the welding process.

WARNING

The welding wire is live during the welding process even before the arc is ignited.

Personal protective equipment

Use personal protective equipment, based on the risk assessment for the robot system.

Do not wear loose-fitting garments or belts, bracelets, etc., that can become entangled in the robot or positioner. Always use the prescribed personal protective equipment.

Welding fumes and any gases formed or used when welding can be dangerous to inhale.

Verify the safety functions

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

1.5 Safety during operation

Automatic operation

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

Unexpected movement of robot arm

WARNING

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

A robot may perform unexpected limited movement.

WARNING

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

1.6 Safety during maintenance and repair

1.6.1 Safety during maintenance and repair

General

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

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

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

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

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

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

Hot surfaces

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

Allergic reaction

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

Gearbox lubricants (oil or grease)

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

Note

Take special care when handling hot lubricants.

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

Continues on next page

Warning	Description	Elimination/Action
Allergic reaction	When working with lubricants there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.
Possible pressure build-up in gearbox	When opening the oil or grease plug, there may be pressure present in the gearbox, causing lubricant to spray from the opening.	Open the plug carefully and keep away from the opening. Do not overfill the gearbox when filling.
Do not overfill	Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may: • damage seals and gaskets • completely press out seals and gaskets • prevent the robot from moving freely.	Make sure not to overfill the gearbox when filling it with oil or grease. After filling, verify that the level is correct.
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 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

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 44*.

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:

- *Manually releasing the brakes on page 54*.

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.

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 291*.

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

Unexpected movement of robot arm

WARNING

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

A robot may perform unexpected limited movement.

WARNING

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

2 Manipulator description

About IRB 1510

IRB 1510 is a 6-axis industrial robot, designed specifically for manufacturing industries that use flexible robot-based automation. The robot has an open structure that is specially adapted for flexible use, and can communicate extensively with external systems.

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3 Installation and commissioning

3.1 Introduction to installation and commissioning

General

This chapter contains assembly instructions and information for installing the IRB 1510 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 15* before performing any installation work.

Note

Always connect the IRB 1510 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 - IRC5*
- *Product manual - IRC5 Compact*

3.2 Unpacking

3.2.1 Pre-installation procedure

Introduction

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

Prerequisites for installation personnel

Installation personnel working with an ABB product must:

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

Checking the pre-requisites for installation

	Action
1	Make a visual inspection of the packaging and make sure that nothing is damaged.
2	Remove the packaging.
3	Check for any visible transport damage. **Note** Stop unpacking and contact ABB if transport damages are found.
4	Clean the unit with a lint-free cloth, if necessary.
5	Make sure that the lifting accessory used (if required) is suitable to handle the weight of the robot as specified in: *Weight, robot on page 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 44*
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 49*
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: *On-site installation on page 51*
11	Install required equipment, if any.

3.2.2 Technical data

Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 1510	170 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° [i]	
Suspended	180°	

i A tilt of up to 15° does not affect the payload or reach, but it can have a negative impact on performance and lifetime. The actual value must be set in the system parameters.

Note

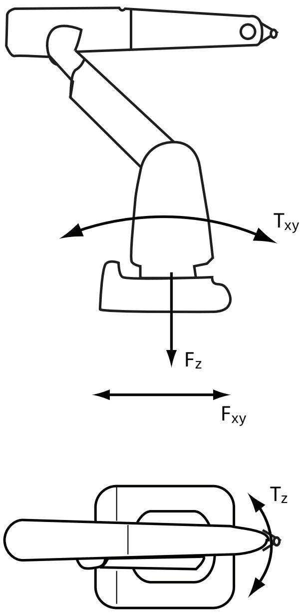
The actual mounting angle must always be configured in the system parameters, otherwise the performance and lifetime is affected. See *Setting the system parameters for a suspended or tilted robot on page 59*.

Continues on next page

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	± 1900 N	± 4300 N
Force z	1850 ±900 N	1850 ±2350 N
Torque xy	± 1550 Nm	± 3900 Nm
Torque z	± 390 Nm	± 1200 Nm

Continues on next page

Suspended

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	± 1900 N	± 4250 N
Force z	- 1850 ±750 N	-1850 ±2350 N
Torque xy	± 1550 Nm	± 3900 Nm
Torque z	± 390 Nm	± 1200 Nm

Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.5 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
Maximum ambient temperature	+55° C
Maximum ambient temperature (less than 24 hrs)	+75° C
Maximum ambient humidity	95% at constant temperature (gaseous only)

Continues on next page

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	+5°
Maximum ambient temperature	+45°
Maximum ambient humidity	95% at constant temperature (gaseous only)

Protection classes, robot

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

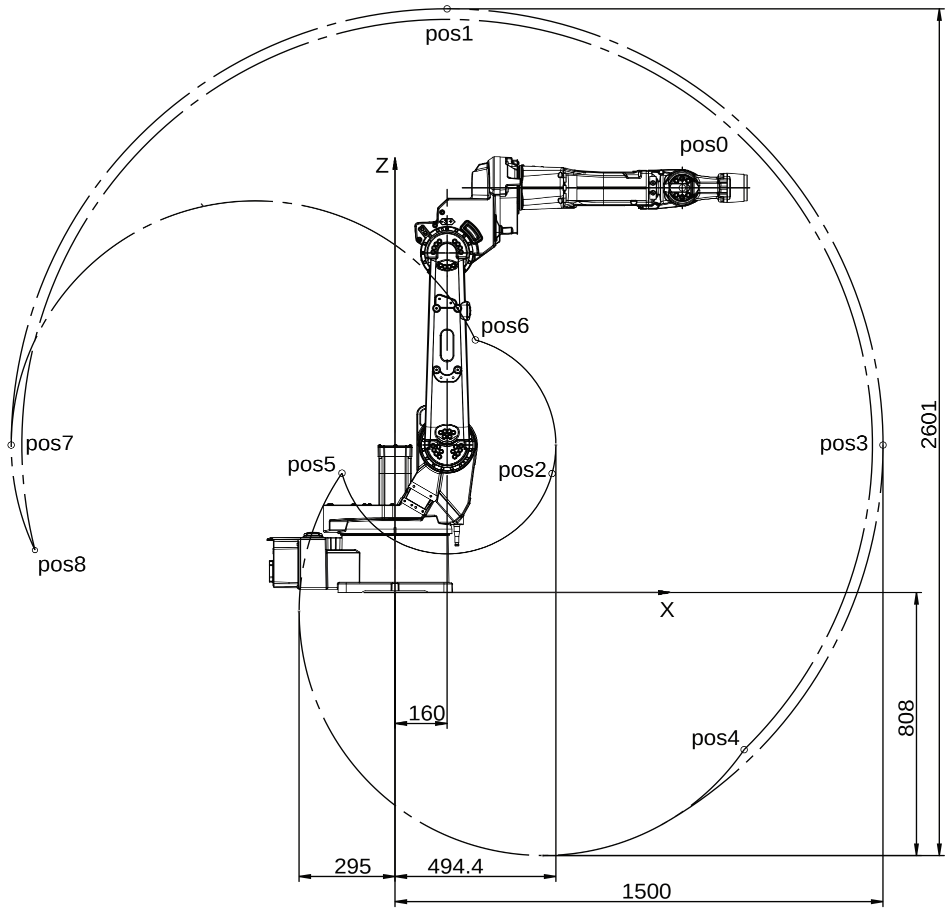
Protection type	Protection class [i]
Manipulator, protection type Standard	IP40

i According to IEC 60529.

3.2.3 Working range

Illustration, restricted working range IRB 1510ID - 4/1.5

The working range is restricted if the robot features an Arc Welding package. This illustration shows the restricted working range of the robot.



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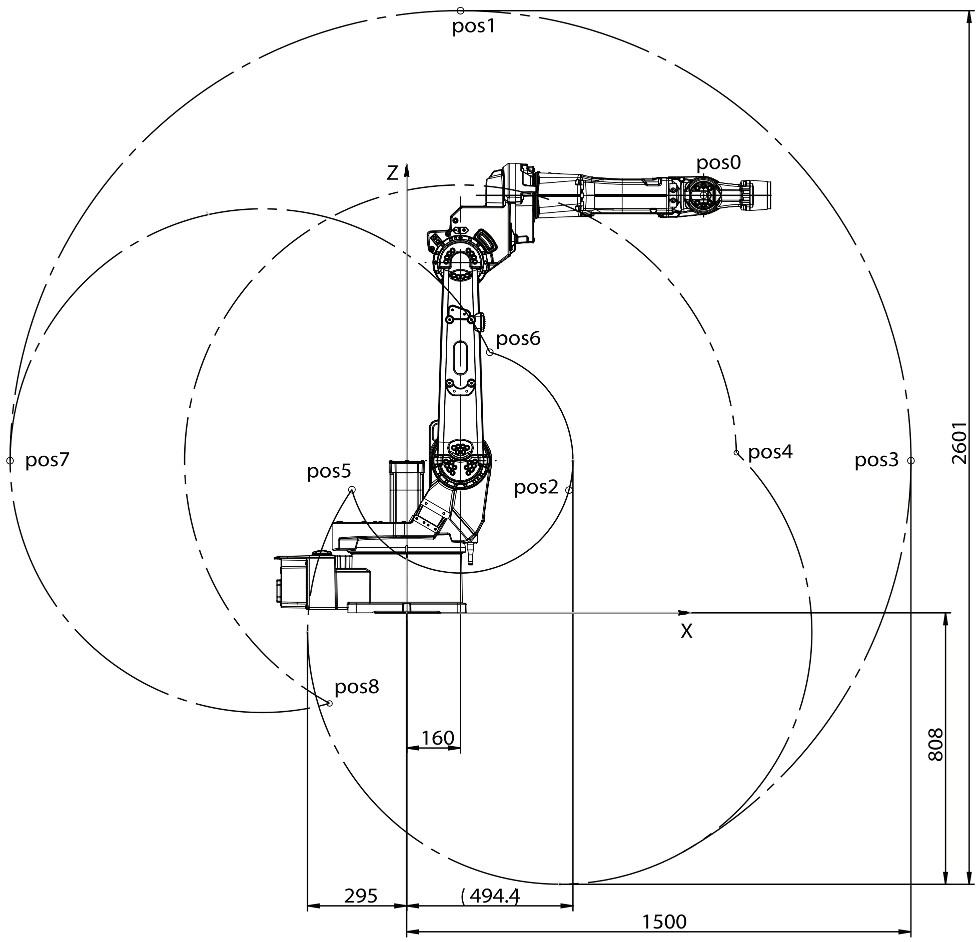
Illustration, unrestricted working range IRB 1510ID - 4/1.5

This illustration shows the unrestricted working range of the robot.



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Positions at wrist center and angle of axes 2 and 3

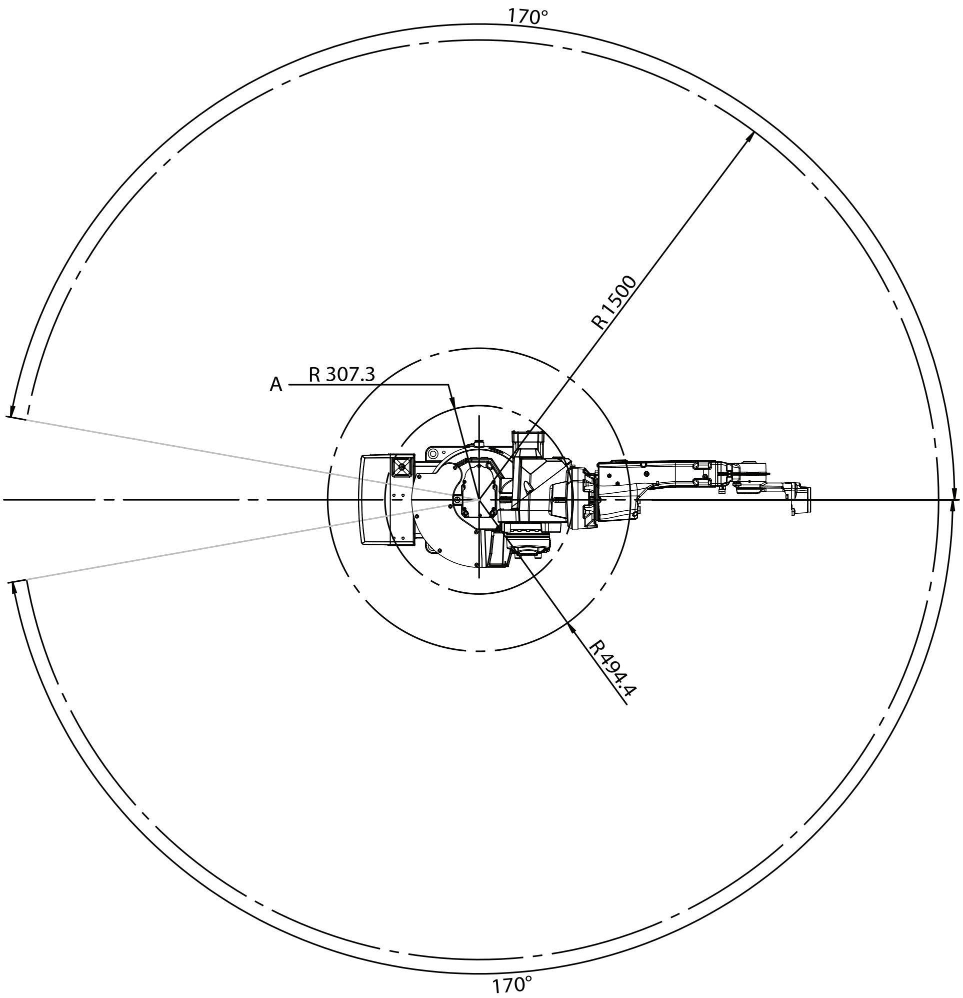
This table shows the distances to the different positions of the wrist center, shown in the previous figures.

Position in the figure	Positions at wrist center (mm)		Angle (degrees)	
	X	Z	axis 2	axis 3
pos0	883	1243	0º	0º
pos1	160	1793	0º	-74.5º
pos2	482.7	365.4	0º	+80º
pos3	1500	453	+90º	-74.5º
pos4 (restricted working range)	1073.2	-482.8	+150º	-100º
pos4 (unrestricted working range)	636.2	-192.3	+150º	-180º
pos5	-163.1	366.8	+150º	+80º

Continues on next page

Position in the figure	Positions at wrist center (mm)		Angle (degrees)	
pos6	246.8	775.9	-90º	+80º
pos7	-1180	453	-90º	-74.5º
pos8 (restricted working range)	-1106.9	130.1	-90º	-100º
pos8 (unrestric-ted working range)	-574.1	-938.9	-90º	-180º

Turning radius



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A	Minimum turning radius of axis 1

Working range

Axis	IRB 1510ID - 4/1.5	Note
Axis 1	+170º to -170º	
Axis 2	+150º to -90º	

Continues on next page

Axis	IRB 1510ID - 4/1.5	Note
Axis 3	+80º to -100º	Value for restricted working range, due to usage of Arc Welding package.
	+80º to -180º	Value for unrestricted working range.
Axis 4	+155º to -155º	Default value.
Axis 5	+135º to -135º	
Axis 6	+200º to -200º	Default value.
	+288 to -288 revolutions	Maximum value. The default working range for axis 6 can be extended by changing parameter values in the software.

3.2.4 Risk of tipping/stability

Risk of tipping

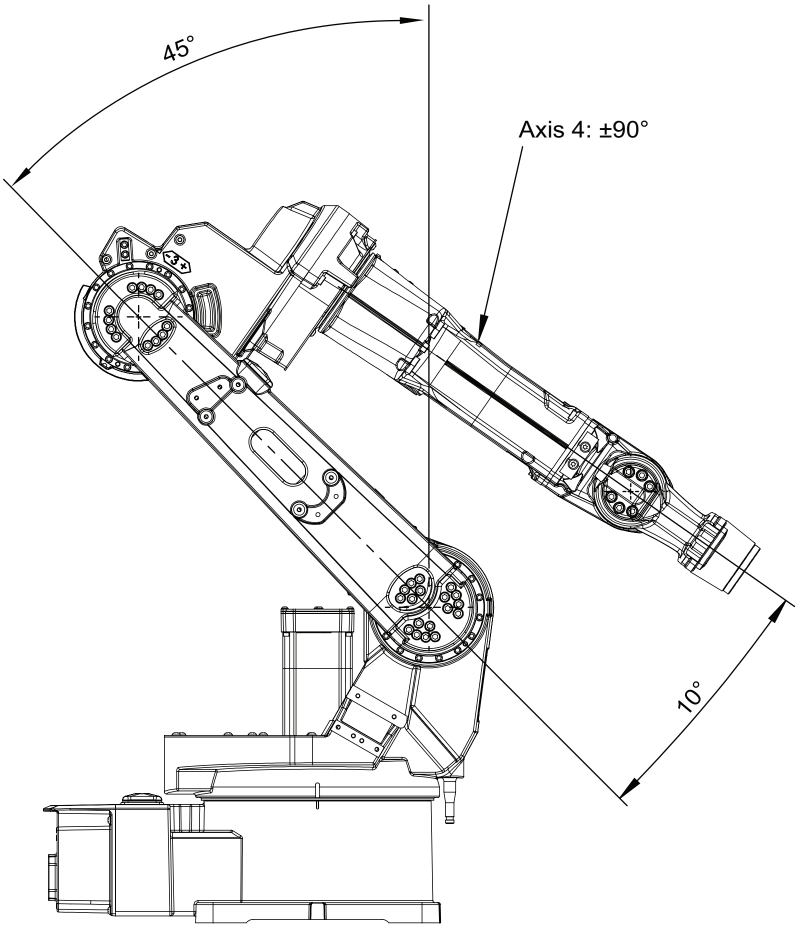
If the robot is not fastened to the foundation while moving the arm, the robot is not stable in the whole working area. Moving the arm will displace the center of gravity, which may cause the robot to tip over.

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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> **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.

3.2.5 The unit is sensitive to ESD

Description

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

Safe handling

Use one of the following alternatives:

- Use a wrist strap.

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

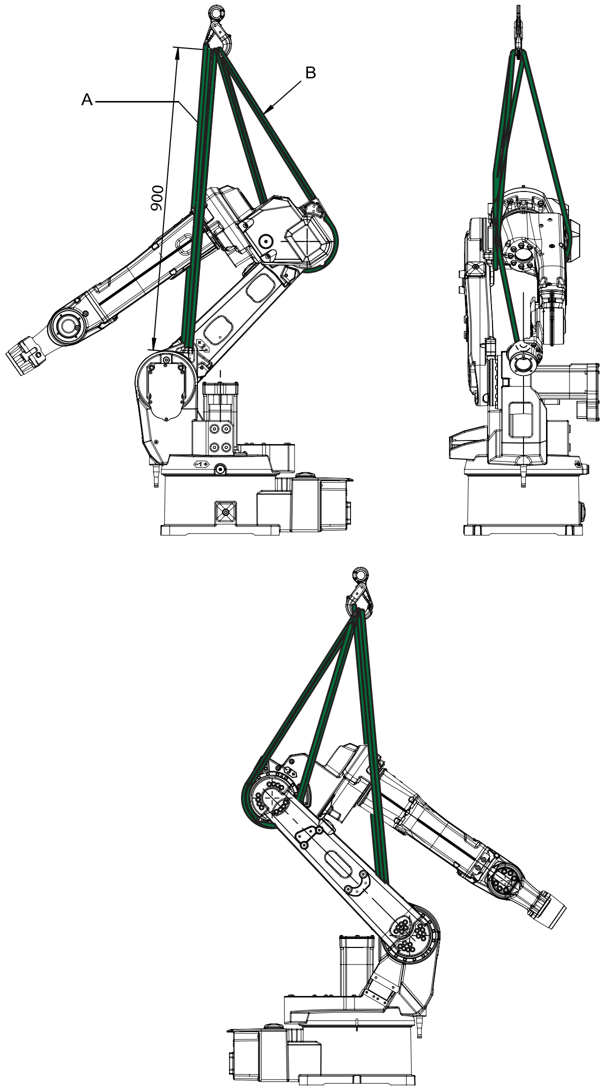
  The mat must be grounded through a current-limiting resistor.
- Use a dissipative table mat.

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

3.3 On-site installation

3.3.1 Lifting robot with roundslings

Attaching the roundslings



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A	Roundsling folded in U-shape and put through the lifting lug
B	Roundsling folded in U-shape and put around the axis 3 gearbox

Required equipment

Equipment	Art. no.	Note
Overhead crane	-	Lifting capacity: 1,000 kg.
Roundsling	-	Length: 2 m. Quantity: 2 pcs. Lifting capacity: 1,000 kg.

Continues on next page

Lifting the robot with roundslings

Use this procedure to lift the robot with roundslings.

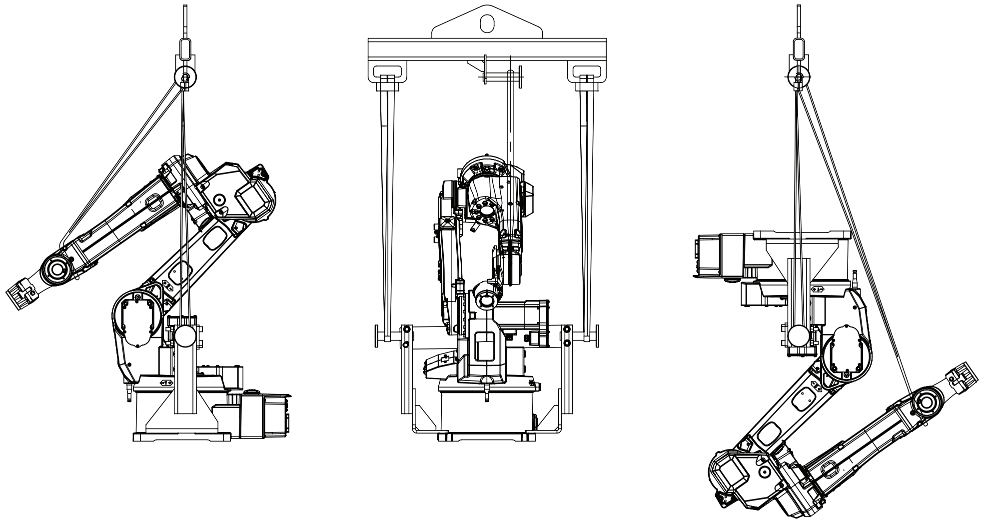
	Action	Note
1	Move the robot to an appropriate lifting position.	See *Risk of tipping/stability on page 49*.
2	Fold the two roundslings in U-shape and attach them as follows: • run one roundsling through the lug in the frame, run it on both sides of the upper arm and secure it safely at the overhead crane. • put the other roundsling around the axis 3 gearbox and secure it safely at the overhead crane.	Make sure the roundslings do not rub against any sharp edges. Capacity for the roundslings are specified in *Required equipment on page 51*. See attachment in *Attaching the roundslings on page 51*.
3	**CAUTION** The robot weighs 170 kg All lifting accessories used must be sized accordingly!	
4	**WARNING** Personnel must not, under any circumstances, be present under the suspended load!	
5	Raise the overhead crane to lift the robot.	

3.3.2 Lifting and turning a suspended mounted robot

Introduction

How to lift and turn the robot to a suspended position using the turning accessory is described in the lifting instruction delivered with the turning accessory. Article numbers for the accessory and the instruction is specified in *Special tools on page 304*. Any additional equipment required is specified in the instruction for the lifting accessory. Contact ABB for more information.

Illustration



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3.3.3 Manually releasing the brakes

General

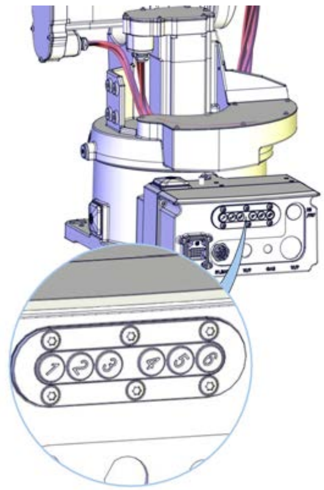
The section below details how to release the holding brakes of each axis' motor.

This may be done in one of three ways:

- using the brake release unit when the robot is connected to the controller.
- using the brake release unit when the robot is disconnected from the controller, but connected to an external power supply at the connector R1.MP.
- using an external voltage supply directly on the motor connector.

Using the brake release unit when the robot is connected to the controller

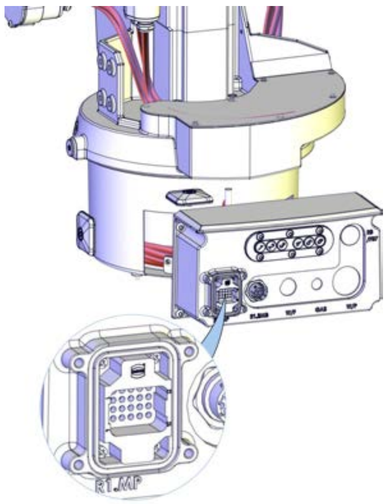
Use this procedure to release the holding brakes with the internal brake release unit.

	Action	Note
1	The internal brake release unit is located at the base of the robot and equipped with six buttons for controlling the axes brakes. The buttons are numbered according to the numbers of the axes.	 xx1100000312 *Figure 3.1: Brake release buttons*
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 arm!	
3	Release the holding brake on a particular robot axis by pressing the corresponding button on the internal brake release panel and keeping it depressed. The brake will function again as soon as the button is released.	

Continues on next page

Using the brake release unit with an external power supply

This section details how to release the holding brakes with the internal brake release unit using an external voltage supply. This is done if the robot is not connected to the controller.

	Action	Note
1	**DANGER** Incorrect connections, such as supplying power to the wrong pin, may cause all brakes to be released simultaneously!	Also, be careful not to interchange the 24V and 0V pins. If they are mixed up, damage can be caused to a resistor diode and to the system board.
2	Connect an external power supply to connector R1.MP.	 xx1100000390 Supply: • 0V on pin 12 • 24V on pin 11
3	Push the brake release button to release the holding brakes, according to the previous procedure.	

3.3.4 Orienting and securing the robot

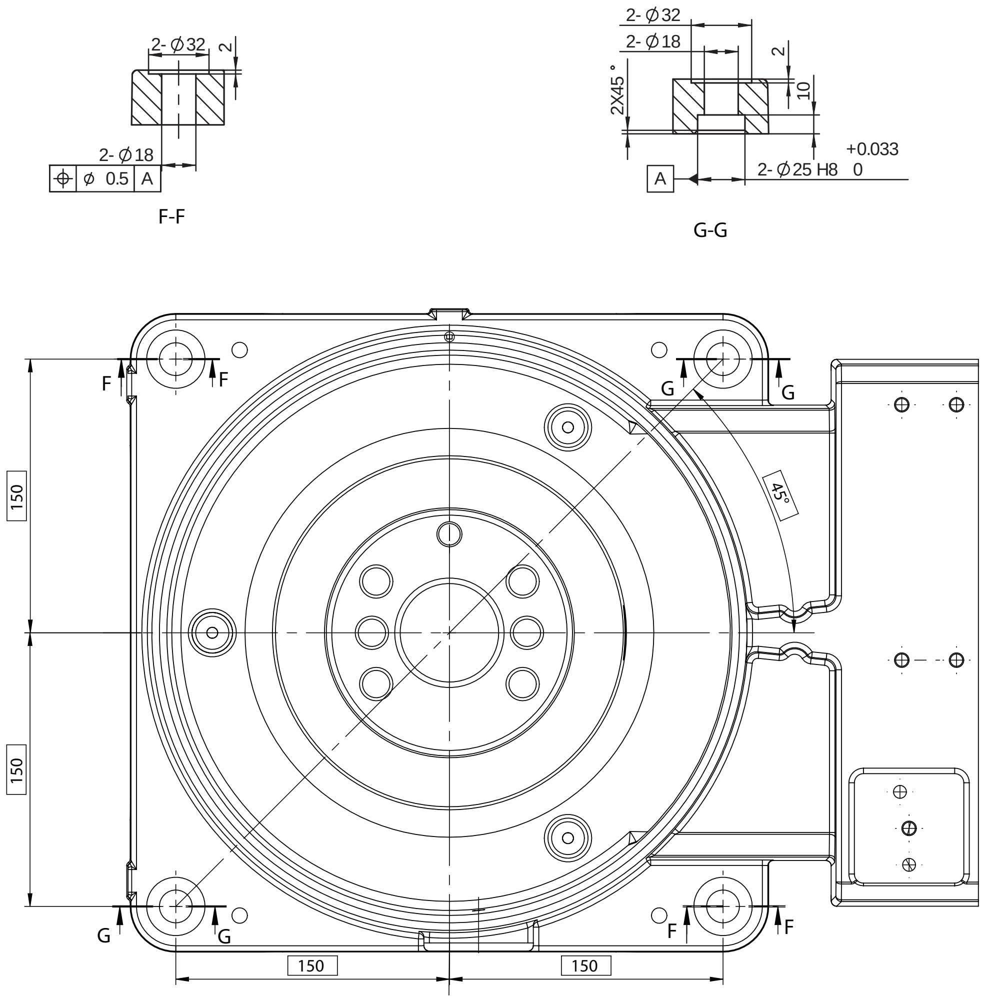
General

This section details how to orient and secure the robot at a horizontal level at the installation site.

Hole configuration, base

The figure shows the hole pattern and dimensions of the robot base.

Two of the holes in the base (view G-G) are designed to include a guiding sleeve.



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Attachment bolts, specification

Attachment bolts	4 pcs M16 x 45
Washers	30 x 17 x 3
Quality	8.8
Tightening torque	200 Nm

Continues on next page

Guiding sleeves

Use a pair of guiding sleeves to make the robot installation easier.

External diameter: 25 mm. Internal diameter: 18 mm.

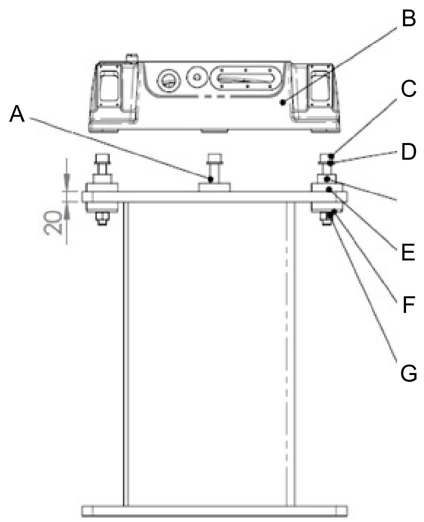
Orienting and securing the robot to installation site

	Action	Note
1	Make sure the installation site for the robot conforms to the specifications in section *Pre-installation procedure on page 40*.	
2	Prepare the installation site with attachment holes.	Hole configuration of the base is shown in the figure *Hole configuration, base on page 56*.
3	Lift the robot to the installation site.	Detailed in section *Lifting robot with roundslings on page 51*.
4	Guide the robot gently using two of the attachment bolts while lowering it into its mounting position.	
5	Fit and tighten the *bolts and washers* in the base attachment holes.	Specified in section *Attachment bolts, specification on page 56*.

Isolating AW manipulator

CAUTION

If the manipulator is used for arc welding and is mounted on a pedestal, make sure that the manipulator is isolated from the pedestal with isolators.



A	Attachment point, front (no guide sleeve)
B	Manipulator base
C	Screw M16x120
D	Plain washer

Continues on next page

E	Guide sleeve
F	Isolator
G	Nut M16

3.3.5 Setting the system parameters for a suspended or tilted robot

General

The robot is configured for mounting parallel to the floor, without tilting, on delivery. If the robot is mounted in any other angle than 0°, then the system parameters that describe the mounting angle (how the robot is oriented relative to the gravity) must be re-defined.

Note

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

Note

The mounting positions are described in *Mounting positions on page 41*, and the requirements on the foundation are described in *Requirements, foundation on page 43*.

System parameters

Note

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

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

Gravity Beta

If the robot is mounted upside down or on a wall (rotated around the y-axis), then the robot base frame and the system parameter *Gravity Beta* must be redefined. *Gravity Beta* should then be π (+3.141593) if the robot is mounted upside down (suspended), or ±π/2 (±1.570796) if mounted on a wall.

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

Continues on next page

Gravity Alpha

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

Note

The system parameter *Gravity Alpha* is not supported for all robot types. It is not supported for IRB 140, IRB 1410, IRB 1600ID, IRB 2400, IRB 4400, IRB 6400R, IRB 6400 (except for IRB 6400 200/2.5 and IRB 6400 200/2.8), IRB 6600, IRB 6650, IRB 6650S and IRB 7600 (except for IRB 7600 325/3.1).

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

Note

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

Gamma Rotation

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

Mounting angles and values

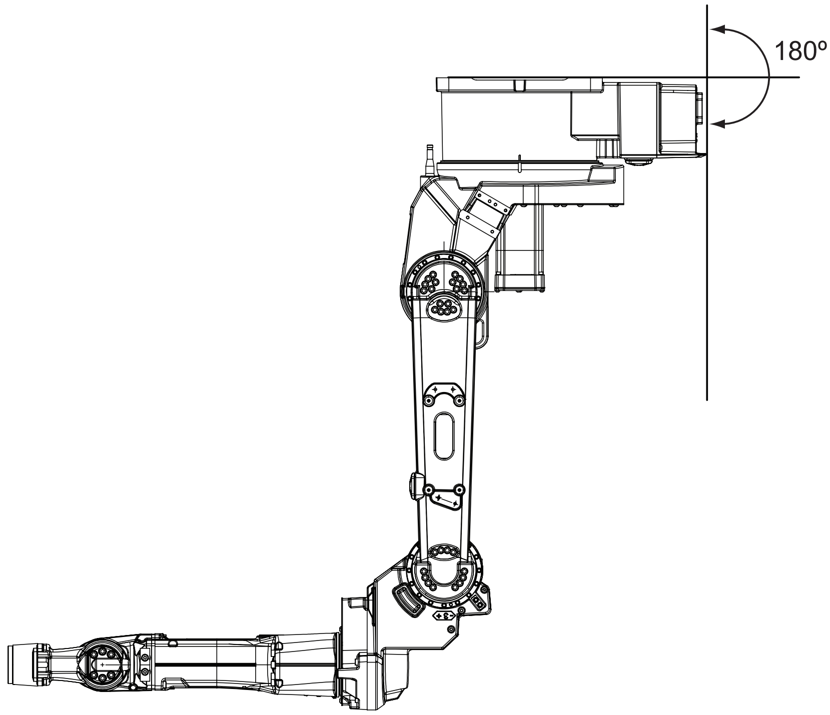
The parameter *Gravity Beta* (or *Gravity Alpha*) specifies the mounting angle of the robot in radians. It is calculated in the following way.

`Gravity Beta = A° x 3.141593/180 = B radians`, where `A` is the mounting angle in degrees and `B` is the mounting angle in radians.

Example of position	Mounting angle (A°)	Gravity Beta
Floor mounted	0°	0.000000 (Default)
Suspended mounting	180°	3.141593

Continues on next page

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



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-	Suspended mounting, mounting angle 180º

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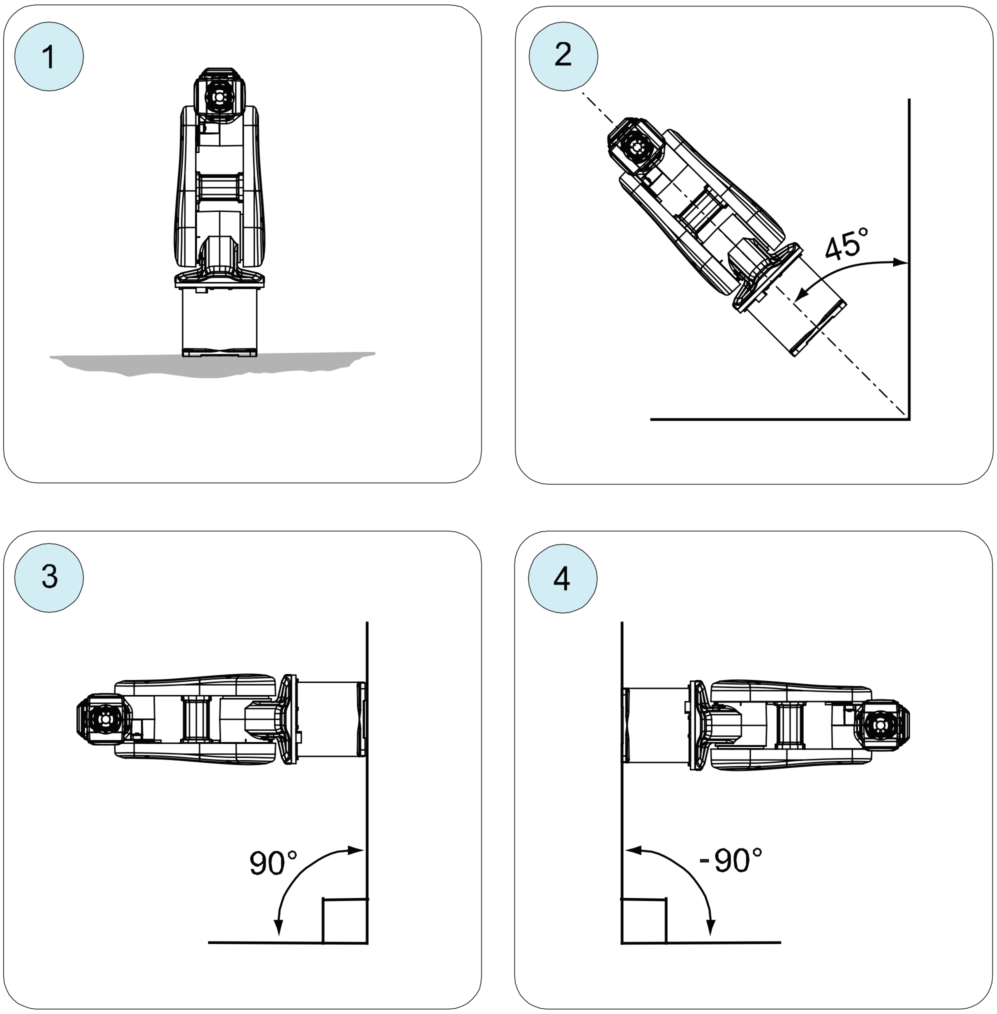
Examples of mounting angles tilted around the X axis (*Gravity Alpha*)

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



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Pos	Mounting angle	Gravity Alpha
1	0° (Floor mounted)	0
2	45° (Tilted)	0.785398
3	90° (Wall)	1.570796
4	-90° (Wall)	-1.570796

Note

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

Continues on next page

Defining the parameter in RobotWare

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

How to calculate a new value is detailed in *Mounting angles and values on page 60*.

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

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

3.3.6 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*

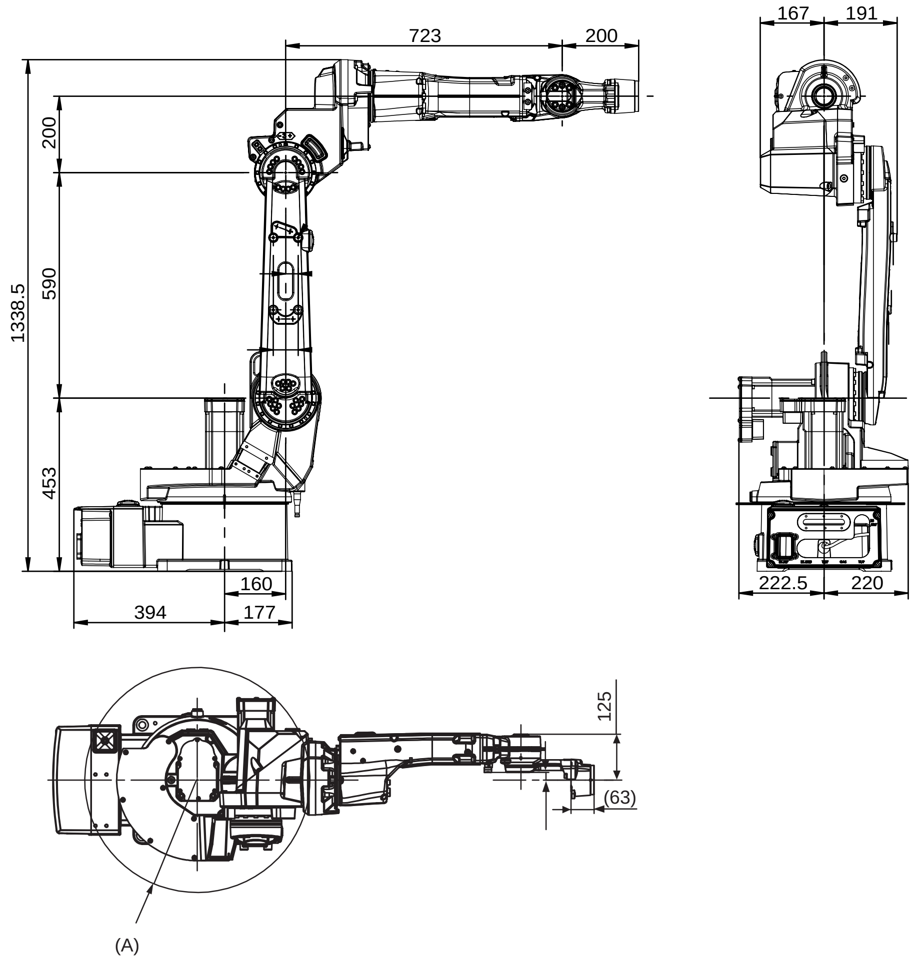
Stopping time and braking distances

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*.

3.3.7 Fitting equipment on the robot (robot dimensions)

Robot dimensions

The figure shows the dimension of the robot.



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A	Minimum turning radius R=307 mm

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Attachment holes and dimensions

Extra loads can be mounted on the wrist, the upper arm housing, and on the lower arm. The attachment holes are shown in the figures in this section.

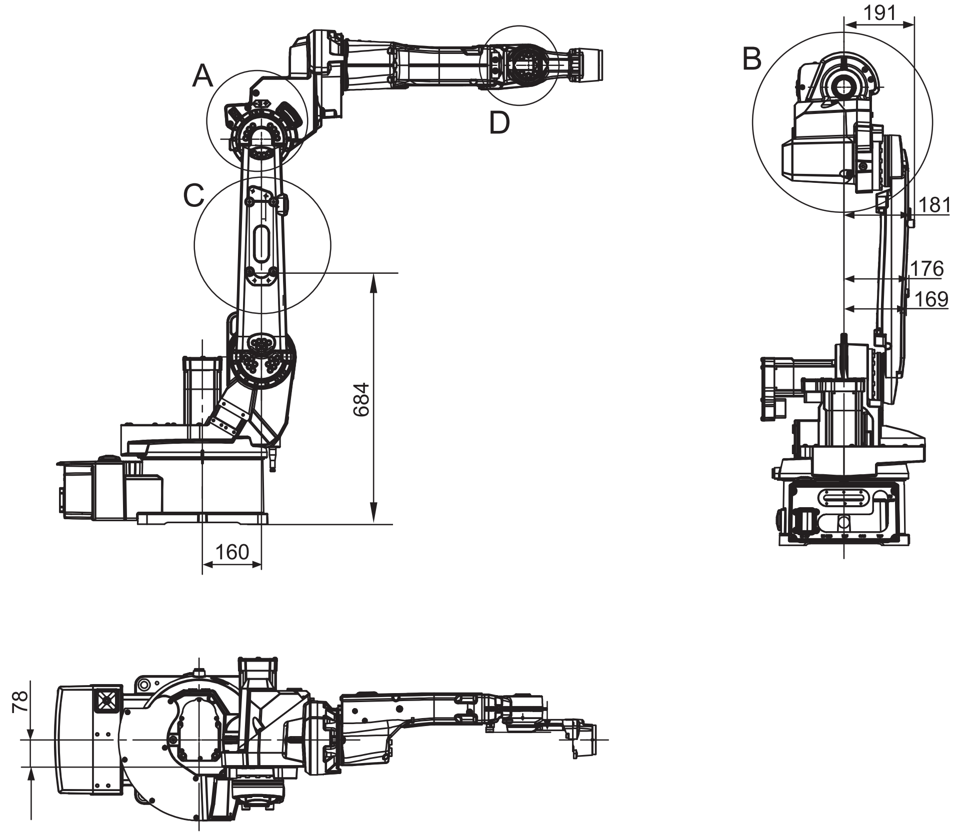

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Figure 3.2: Overview of attachment holes and dimensions

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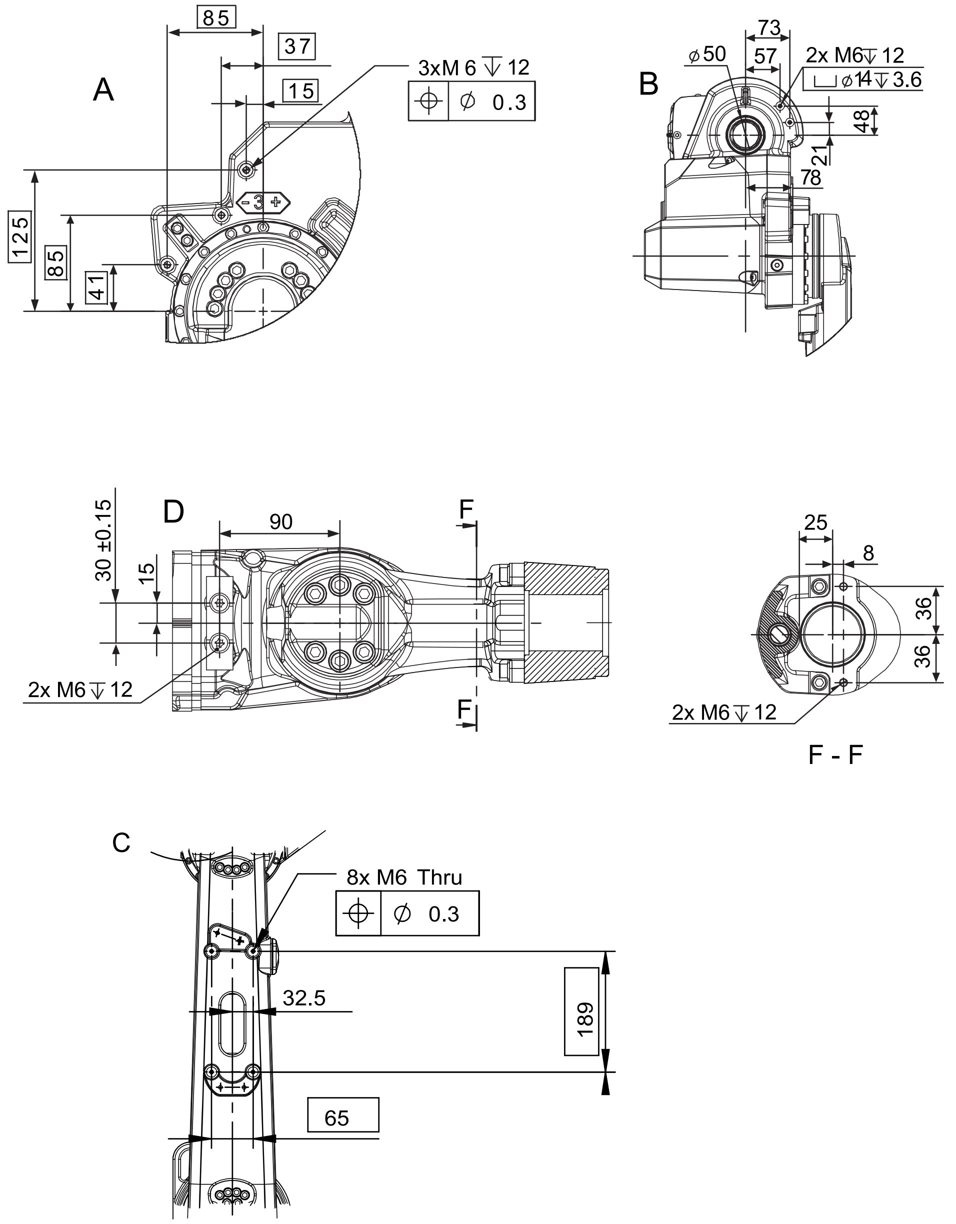

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Figure 3.3: Detailed illustrations of attachment holes on the robot

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Tool flange dimensions

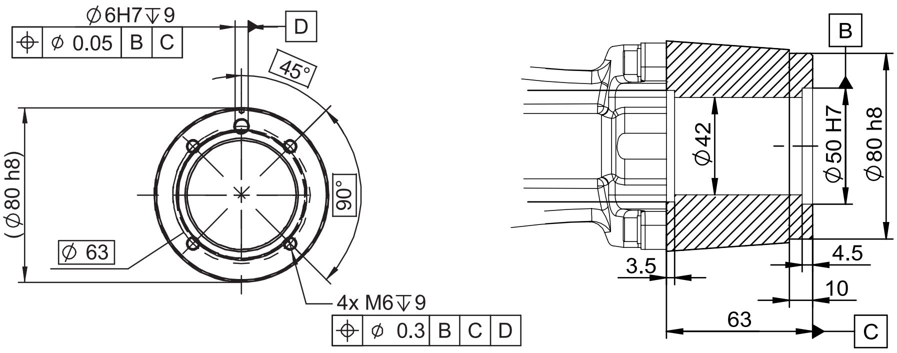

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Figure 3.4: Tool flange dimensions

Fastener quality

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

3.4 Restricting the working range

3.4.1 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 3, hardware (mechanical stop). The mechanical stop must be installed on axis 3 if the robot features an Arc Welding package.

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.

3.4.2 Installation of additional mechanical stops on axis 3

General

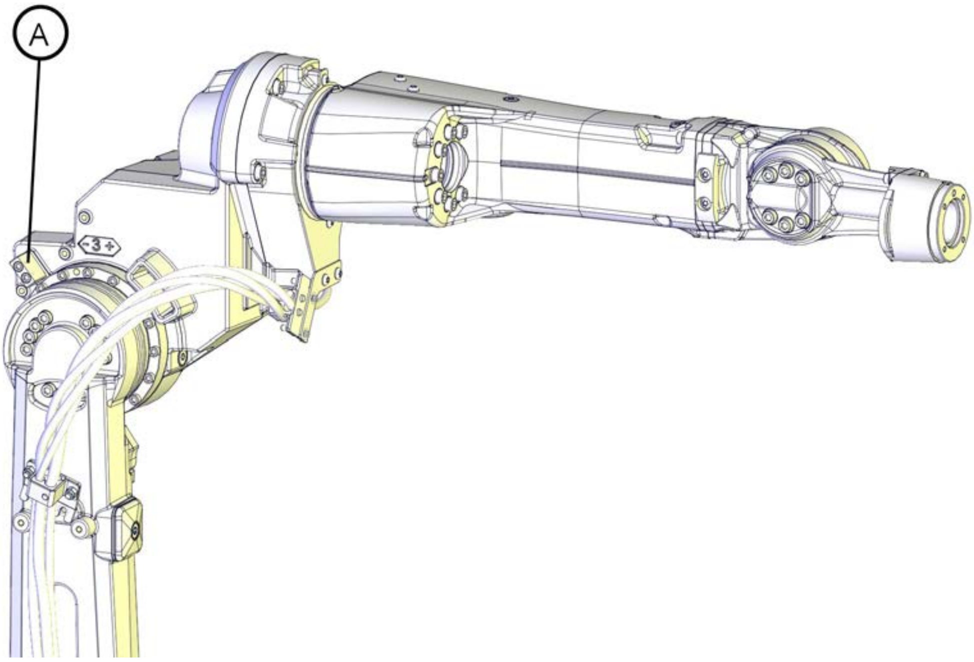
This section details how to install an additional mechanical stop on axis 3 in order to restrict the working range of the axis.

Restrictions in working range

If the robot features an Arc Welding package, the working range of axis 3 must be restricted with the additional mechanical stop.

Illustration, mechanical stop, axis 3

The mechanical stop is installed at the upper arm housing, as shown in the figure below.



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A	Additional mechanical stop, axis 3

Required equipment

Equipment	Art. no.	Note
Mechanical stop, axis 3	See *Spare parts on page 307*.	
Technical reference manual - System parameters	-	Art. no. is specified in *References on page 10*.

Continues on next page

Installation of mechanical stop, axis 3

The procedure below details how to install the mechanical stop to axis 3.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Fit the mechanical stop to the two mounting holes at the upper arm housing, with the two attachment screws and washers. Tighten the screws.	See *Illustration, mechanical stop, axis 3 on page 70*. 2 pcs: M6 x 40, quality 12.9, tightening torque: 14 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.	

3.5 Electrical connections

3.5.1 Robot cabling and connection points

Introduction

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

CAUTION

Connect the male and female connectors perfectly aligned horizontally to avoid any kind of tilt or skew.

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. Specified in the table *Robot cables on page 72*.
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 include the air hose. See the product manual for the controller, see document number in *References on page 10*.
External axes cables (option)	Handles power supply to and control of the external axes' motors as well as feedback from the servo system. See *Application manual - Additional axes and standalone controller*, 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 control cabinet 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

Continues on next page

Robot cable, power

The following table lists the power cables for connecting IRC5 controller

Cable	Art. no.
Robot cable, power: 7 m	3HAC040503-001
Robot cable, power: 15 m	3HAC040503-002

Robot cable, signals

The following table lists the signal cables for connecting IRC5 controller

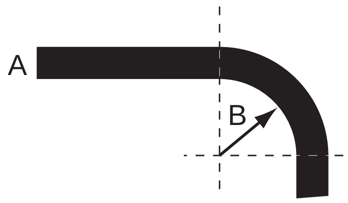
Cable	Art. no.
Robot cable signal, shielded: 7 m	3HAC2493-1
Robot cable signal, shielded: 15 m	3HAC2530-1

Tip

In case duplicate CP/CS harnesses are included on delivery, one can be saved as a spare part.

Bending radius for static floor cables

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



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A	Diameter
B	Diameter x10

3.6 Start of robot in cold environments

Introduction

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

Problems with starting the robot

Event message from Motion Supervision

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

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

Robot stopping with other event message

Use this procedure if the robot is not starting.

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

Adjusting the speed and acceleration during warm-up

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

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

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

3.7 Test run after installation, maintenance, or repair

Safe handling

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

DANGER

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

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

Collision risks

CAUTION

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

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4 Maintenance

4.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 1510.

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

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

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

Safety information

Observe all safety information before conducting any service work.

There are general safety aspects that must be read through, as well as more specific safety information that describes the danger and safety risks when performing the procedures. Read the chapter *Safety on page 15* before performing any service work.

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

Note

If the IRB 1510 is connected to power, always make sure that the IRB 1510 is connected to protective earth and a residual current device (RCD) before starting any maintenance work.

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Compact*
- *Robot cabling and connection points on page 72*.

4.2 Maintenance schedule and expected component life

4.2.1 Specification of maintenance intervals

Introduction

The intervals are specified in different ways depending on the type of maintenance activity to be carried out and the working conditions of the IRB 1510:

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

  The SIS used in M2004 is further described in the *Operating manual - Service Information System*.

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

Overhaul

Depending on application and operational environment a complete overhaul may be necessary in average around 40000 hours.

ABB Connected Services and its Assessment tools can help you to identify the real stress level of your robot, and define the optimal ABB support to maintain your robot working.

Contact your local ABB Customer Service to get more information.

4.2.2 Maintenance schedule

General

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

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

The inspection intervals *do not* specify the life of each component. Values for these are specified in the section *Expected component life on page 81*

Instructions for how to perform the different maintenance activities are found in sections:

- *Inspection activities on page 82*
- *Replacement activities on page 109*
- *Cleaning activities on page 133*

Activities and intervals, standard equipment

The following table specifies the required maintenance activities and intervals.

Maintenance activity	Equipment	Interval
Cleaning	Robot	*Cleaning the IRB 1510 on page 133*
Inspection	Oil level in axis-1 gearbox	Every 12 months.
Inspection	Oil level in axis-2 gearbox	Every 12 months.
Inspection	Oil level in axis-3 gearbox	Every 12 months.
Inspection	Oil level in axis-4 gearbox	Every 48 months.
Inspection	Oil level in axis-5 gearbox	Every 48 months.
Inspection	Oil level in axis-5-6 gearbox (ID)	Every 12 months.
Inspection	Oil level in axis-6 gearbox	No inspection needed.
Inspection	Robot harness	Every 12 months[i].
Inspection	Information labels	Every 12 months.
Inspection	Dampers	Every 12 months.
Inspection	Mechanical stop	Every 12 months.
Change	Oil in axis-1 gearbox	First change when DTC [ii] reads: • 6,000 hours Second change when DTC[ii] reads: • 24,000 hours Following changes: • Every 24,000 hours.
Change	Oil in axis-2 gearbox	First change when DTC [ii] reads: • 6,000 hours Second change when DTC[ii] reads: • 24,000 hours Following changes: • Every 24,000 hours.

Continues on next page

Maintenance activity	Equipment	Interval
Change	Oil in axis-3 gearbox	First change when DTC [ii] reads: • 6,000 hours Second change when DTC [ii] reads: • 24,000 hours Following changes: • Every 24,000 hours.
Change	Oil in axis-4 gearbox	No change needed.
Change	Oil in axis-5 gearbox	No change needed.
Change	Oil in axis-5-6 gearbox	First change when DTC [ii] reads: • 6,000 hours Second change when DTC [ii] reads: • 24,000 hours Following changes: • Every 24,000 hours.
Change	Oil in axis-6 gear	No change needed.
Overhaul	Robot	Every: • 40,000 hours .
Replacement	Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact)	36 months or battery low alert [iii]
Replacement	Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A	Battery low alert [iv]

i Replace when damage or cracks is detected or life limit is approaching that specified in section *Expected component life on page 81*.

ii DTC = Duty Time Counter. Shows the operational time of the robot.

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

See the replacement instruction for more details.

iv The battery low alert (38213 **Battery charge low**) is displayed when remaining backup capacity (robot powered off) is less than 2 months. The typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended with a battery shutdown service routine. See the operating manual for the robot controller for instructions.

4.2.3 Expected component life

General

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

Expected component life

Component	Expected life	Note
Robot cable harness	40,000 hours	See note [i]

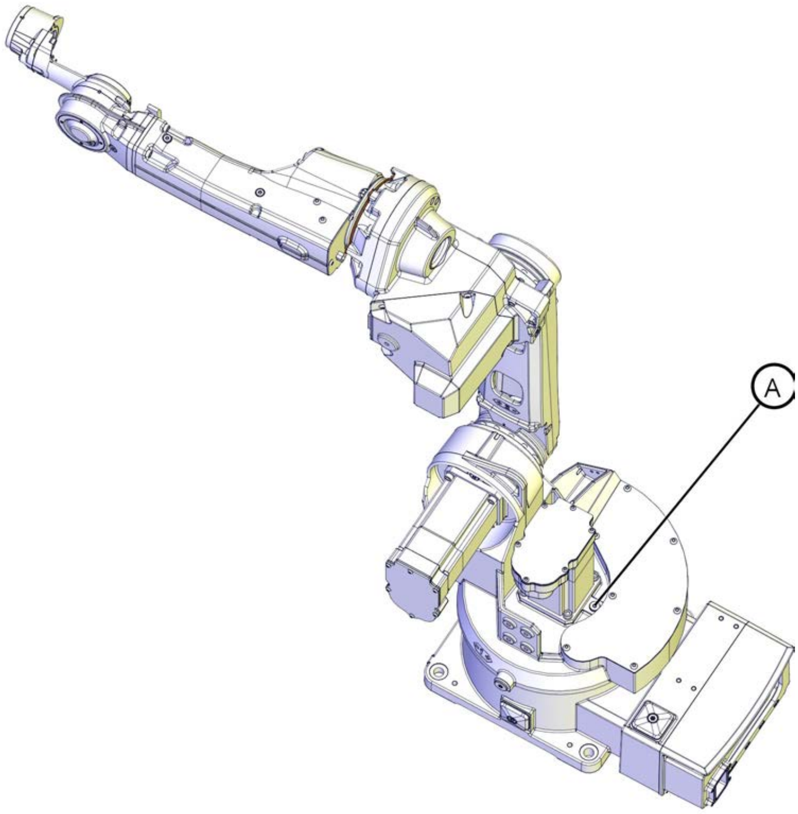
[i] The expected life can also be affected by grouping harnesses/cables other than standard options. The life expectancy is based on a test cycle that for every axis goes from the calibration position to minimum angle, to maximum angle and back to the calibration position. Deviations from this test cycle will result in differences in expected life!

4.3 Inspection activities

4.3.1 Inspecting the oil level, axis-1 gearbox

Location of oil plugs

The axis 1 gearbox is located between the frame and base of the robot. The oil plug for inspection is shown in the figure.



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A	Oil plug, inspection

Required equipment

Equipment	Note
Lubrication oil	See section *Type of lubrication in gearboxes on page 109*.
Standard toolkit	Content is defined in section *Standard tools on page 303*.
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.

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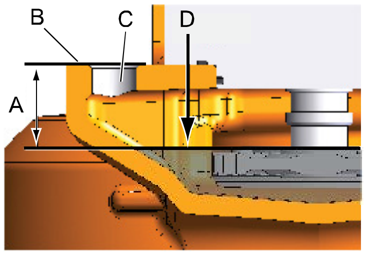
Inspecting oil level, axis-1 gearbox (floor mounted)

Use this procedure to inspect the oil level in the axis-1 gearbox, when the robot is floor mounted.

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	Open the *oil plug, inspection*.	See *Location of oil plugs on page 82*.
5	Measure the oil level at the oil plug hole. Required oil level: • 39 mm ± 3 mm below the surface for the motor flange. The oil level shall only just start to be observed when looking through the oil filling hole. See figure!	 xx1000000824 Parts: • A: 39 mm ± 3 mm • B: Surface for motor flange • C: Filling hole • D: Oil level
6	Add oil if required.	How to fill oil is described in section: • *Changing the oil, axis 1 gearbox on page 111*
7	Refit the oil plug, inspection.	Tightening torque: • 10 Nm

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Inspecting oil level, axis 1-gearbox (suspended robot)

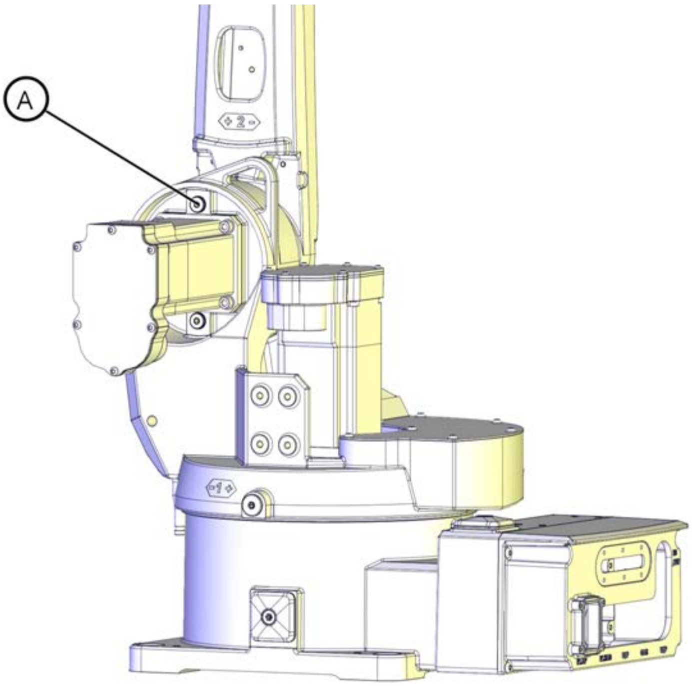
Use this procedure to inspect the oil level in the axis-1 gearbox.

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Lift down the robot from its suspended position and secure it on the floor.	See *Lifting and turning a suspended mounted robot on page 53*.
4	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5	Open the *oil plug inspection* on the axis-1 gearbox.	See the figure in: • *Location of oil plugs on page 82*
6	Required oil level: • 22 mm ± 3 mm below the surface for the motor flange.	
7	Add oil if required.	How to fill oil is described in section: • *Changing the oil, axis 1 gearbox on page 111*
8	Refit the oil plug.	Tightening torque: • 10 Nm

4.3.2 Inspecting the oil level, axis 2 gearbox

Location of axis 2 gearbox

The axis 2 gearbox is located in the lower arm rotational center, underneath the motor attachment. The oil plugs are shown in the figure.



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A	Oil plug, inspection

Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubrication oil	See section *Type of lubrication in gearboxes on page 109*.
Standard toolkit	Content is defined in section *Standard tools on page 303*.
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.

Continues on next page

Inspecting oil level, axis 2 gearbox

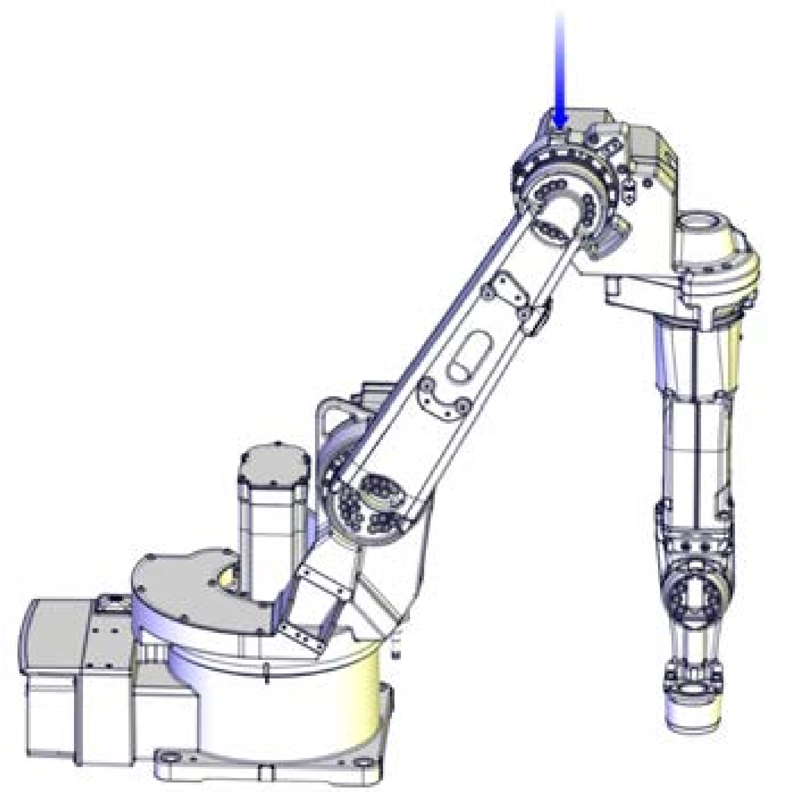
Use this procedure to inspect the oil level in the axis 2 gearbox. A suspended robot must be taken down and secured standing on the floor for inspection.

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	If the robot is suspended, lift it down from its suspended position and secure it on the floor. Then open the oil plug for inspection.	See *Lifting and turning a suspended mounted robot on page 53*. See *Location of axis 2 gearbox on page 85*.
5	Measure the oil level at the oil plug hole. Required oil level: • 23 mm ± 3 mm below the lower edge of the oil plug hole.	
6	Add oil if required.	How to fill oil is described in section • *Changing the oil, axis-2 gearbox on page 116*
7	Refit the oil plug. **Note** Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.	Tightening torque: • 10 Nm

4.3.3 Inspecting the oil level, axis 3 gearbox

Location of axis 3 gearbox

The axis 3 gearbox is located in the upper arm rotational center, underneath the motor attachment. The oil plug for inspection is shown in the figure.



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-	Oil plug, inspection

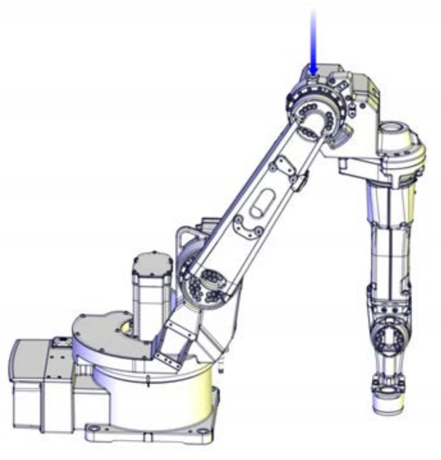
Required equipment

Equipment	Note
Lubrication oil	See section *Type of lubrication in gearboxes on page 109*.
Standard toolkit	Content is defined in section *Standard tools on page 303*.
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.

Continues on next page

Inspecting the oil level, axis 3 gearbox

Use this procedure to inspect the oil level in the axis 3 gearbox. A suspended robot must be taken down and secured standing on the floor for inspection.

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
2	Move both the upper and lower arm so that the upper arm points straight down. The oil plug for inspection must be completely perpendicular.	 xx1100000443
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
4	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5	Open the *oil plug for inspection*.	See the figure in: • *Location of axis 3 gearbox on page 87*
6	Measure the oil level at the oil plug hole. Required oil level: • 42 mm from the flange of the oil plug hole.	
7	Add oil if required.	How to fill oil is described in section: • *Changing the oil, axis-3 gearbox on page 120*

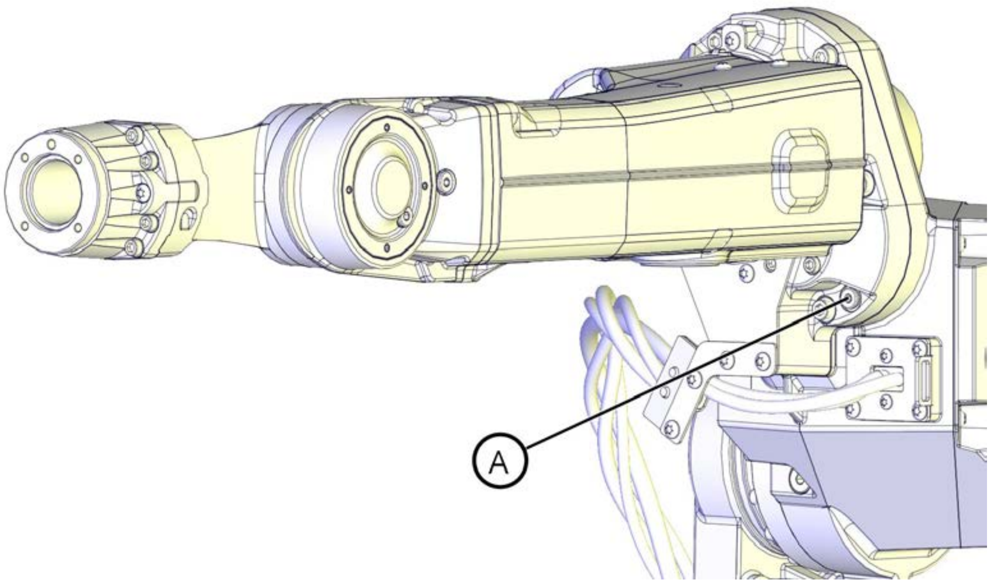
Continues on next page

	Action	Note
8	Refit the oil plug.	Tightening torque: • 10 Nm

4.3.4 Inspecting the oil level, axis 4 gearbox

Location of axis 4 gearbox

The axis 4 gearbox is located in the upper armhouse. The oil plug is shown in the figure.



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A	Oil plug, inspection

Required equipment

Equipment	Note
Lubrication oil	See section *Type of lubrication in gearboxes on page 109*.
Standard toolkit	Content is defined in section *Standard tools on page 303*.
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.

Inspecting the oil level, axis 4 gearbox

Use this procedure to inspect the oil level in the axis 4 gearbox. A suspended robot must be taken down and secured standing on the floor for inspection.

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

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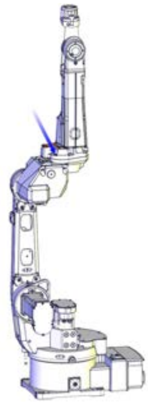
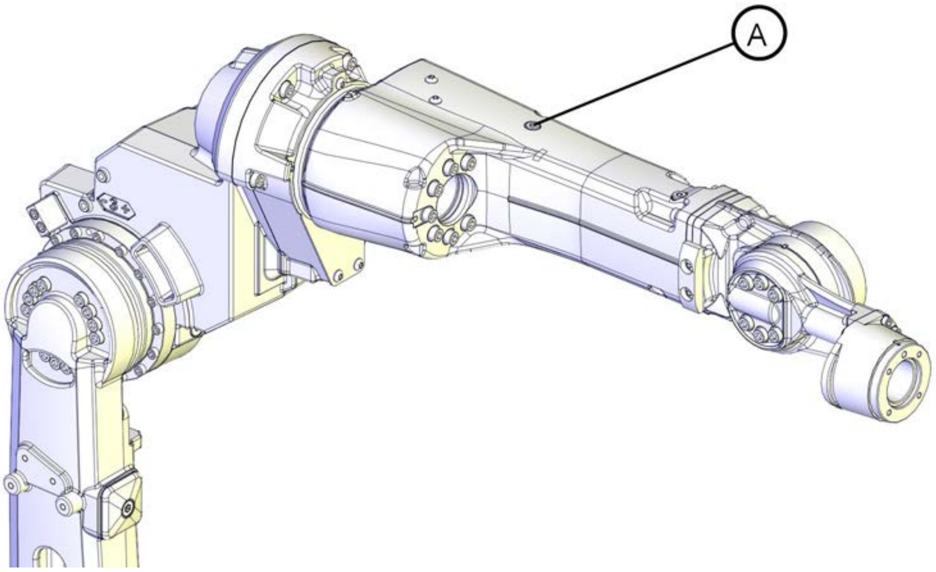
	Action	Note
2	Move the robot to where the upper arm points straight up and the oil plug hole is on top of the axis 4 gearbox.	 xx1100000476
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
4	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5	Open the *oil plug*.	See the figure in: • *Location of axis 4 gearbox on page 90*
6	Measure the oil level at the oil plug hole. Required oil level: • 35 mm ± 3 mm	
7	Add oil if required.	
8	Refit the oil plug, filling.	Tightening torque: • 3 Nm

4.3.5 Inspecting the oil level, axis 5 gearbox

Location of axis 5 gearbox

The axis 5 gearbox is located inside the upper arm. The oil plug is shown in the figure.



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A	Oil plug for inspection

Required equipment

Equipment	Art. no.	Note
Lubricating oil	1171 2016-604	Mobil Gear XP320 15 ml **Note!** Do not mix with other oils!
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.

Inspecting oil level, axis 5 gearbox

Use this procedure to inspect the oil level in the axis 5 gearbox. A suspended robot must be taken down and secured standing on the floor for inspection.

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

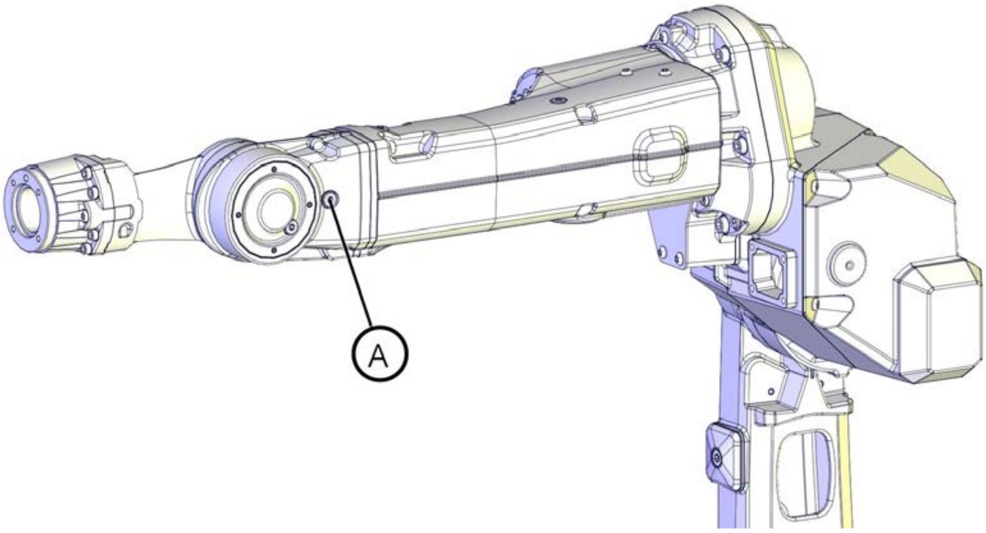
Continues on next page

	Action	Note
2	Rotate the upper arm so that the oil plug is on top of the upper arm and is completely perpendicular.	See *Location of axis 5 gearbox on page 92*.
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
4	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5	Open the oil plug.	See *Location of axis 5 gearbox on page 92*.
6	Measure the oil level at the oil plug hole. Required oil level: • 30 mm ± 3 mm below the lower edge of the oil plug hole.	
7	Add oil if required.	
8	Refit the oil plug, filling.	Tightening torque: • 3 Nm

4.3.6 Inspecting the oil level, axis 5-6 gearbox

Location of axis 5-6 gearbox

The axis 5-6 gearbox is located in the wrist unit. The oil plug for inspection is shown in the figure.



xx1100000449

A	Oil plug for inspection

Required equipment

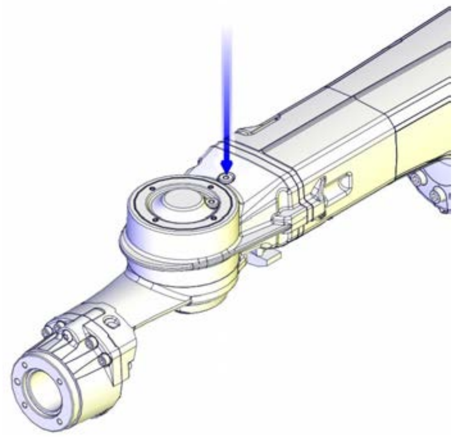
Equipment	Art. no.	Note
Lubricating oil	3HAC0860-1	Optimol Optigear BM 100 **Note!** Do not mix with other oils! 130 ml Amount at oil change: 110 ml **Note!** Do not mix with other oils!
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	-	These procedures include references to the tools required.

Inspecting oil level, axis 5-6 gearbox

Use this procedure to inspect the oil level in the axis 5-6 gearbox. A suspended robot must be taken down and secured standing on the floor for inspection.

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

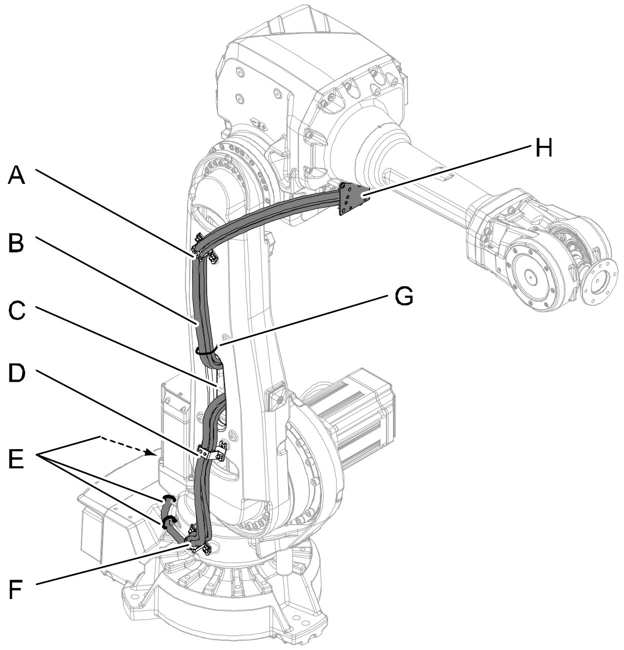
Continues on next page

	Action	Note
2	Rotate axis 4 +90° so that the oil plug is on top of the wrist unit and is completely perpendicular.	 xx1100000477
3	 **DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
4	 **CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5	Open the oil plug.	
6	Measure the oil level at the oil plug hole. Required oil level: • 25 mm ± 3 mm from the oil plug flange.	
7	Add oil if required.	How to fill oil is described in section • *Changing the oil in axis 5-6 gearbox, IRB 1510ID on page 125*
8	Refit the oil plug, filling.	Tightening torque: • 3 Nm

4.3.7 Inspecting the cable harness

Location of cable harness

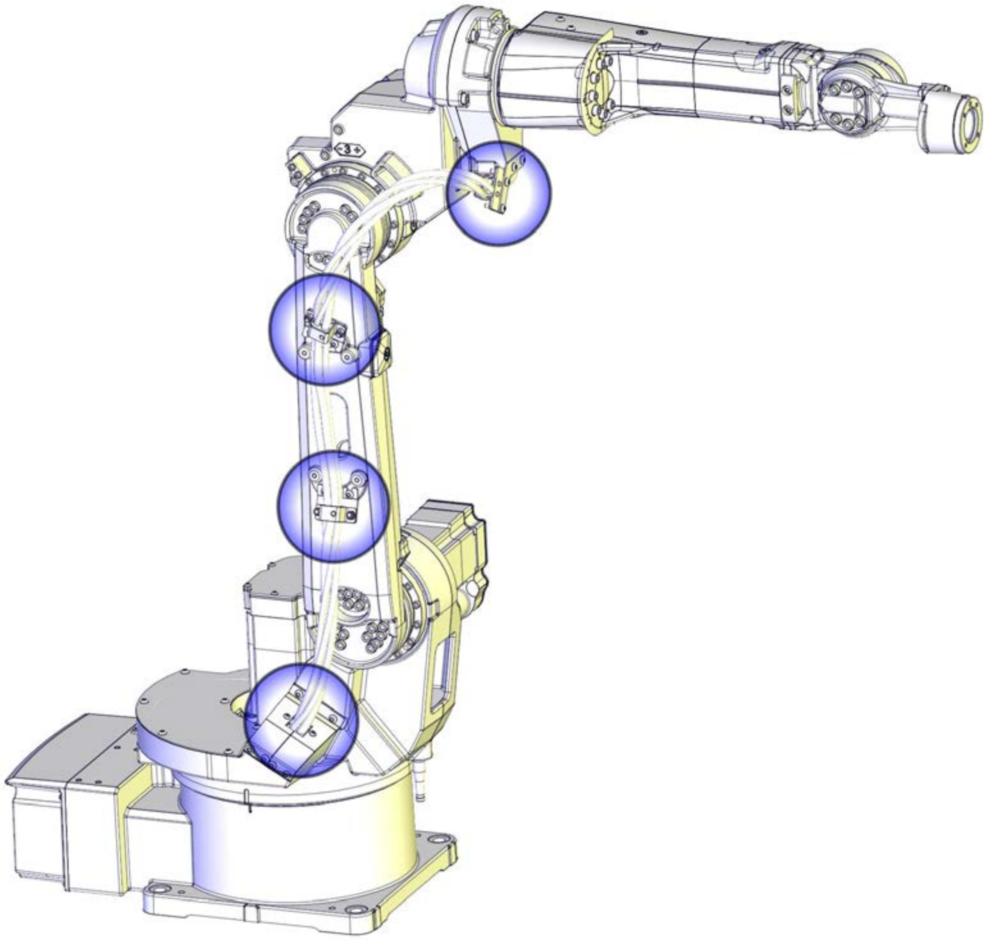
The figure shows the location of the cable harness.



xx0900000012

A	Bracket, lower arm
B	Cable harness
C	Hole in lower arm
D	Bracket, lower arm
E	Cable straps steel (One not visible here)
F	Bracket, frame
G	Cable strap plastic, lower arm
H	Bracket, armhouse

Continues on next page



xx1100000467

Required equipment

Equipment	Note
Standard toolkit	Content is defined in section *Standard tools on page 303*.
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.
Circuit diagram	See *Circuit diagram - IRB 1510*.

Continues on next page

Inspecting the cable harness

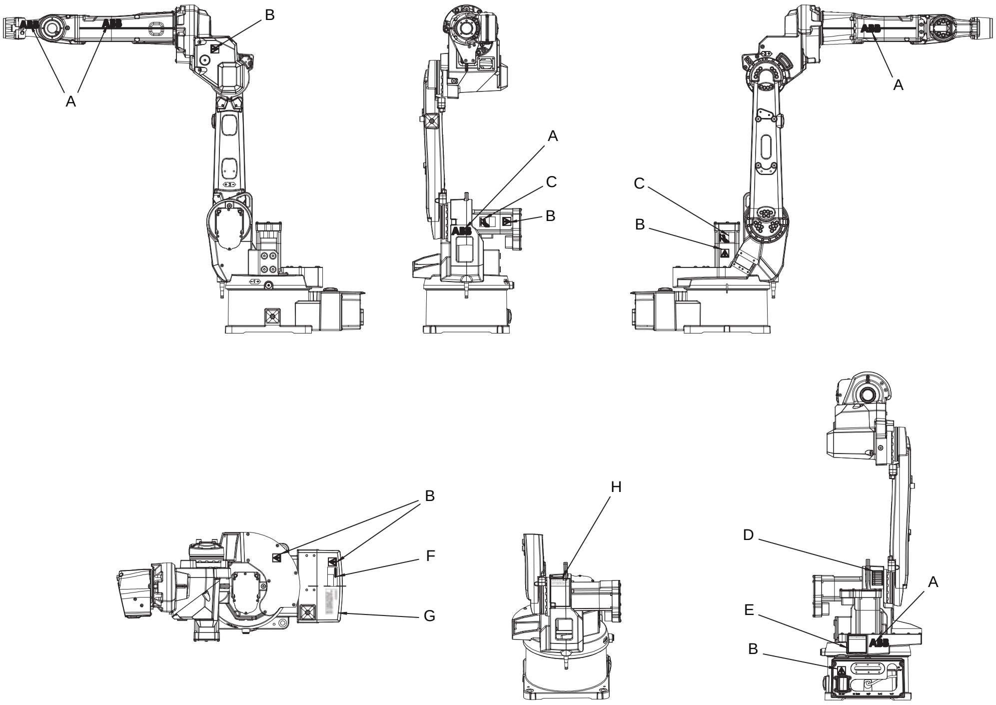
Use this procedure to inspect the cable harness. The inspection points are shown in the figure *Location of cable harness on page 96*

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Make an overall visual inspection of the cable harness in order to detect wear or damage.	
3	Check the *connectors at the base*.	
4	Check the *connectors at the armhouse*.	
5	Check that all *brackets* and *straps* are properly attached to the robot.	
6	Replace the cable harness if wear, cracks or damage is detected.	How to replace the cable harness is described in *Repair on page 135*.

4.3.8 Inspecting information labels

Location of information labels

The figure shows the location of the information labels to be inspected.



xx1100000468

A	ABB logotype
B	Warning sign - Symbol of flash
C	Instruction plate - High temperature
D	Calibration label
E	Rating label
F	Instruction plate - Brake release unit
G	Oil quantity label
H	Instruction plate - Lifting of robot

Required equipment

Equipment	Spare part number	Note
Labels	See *Spare parts on page 307*.	

Continues on next page

Inspecting labels

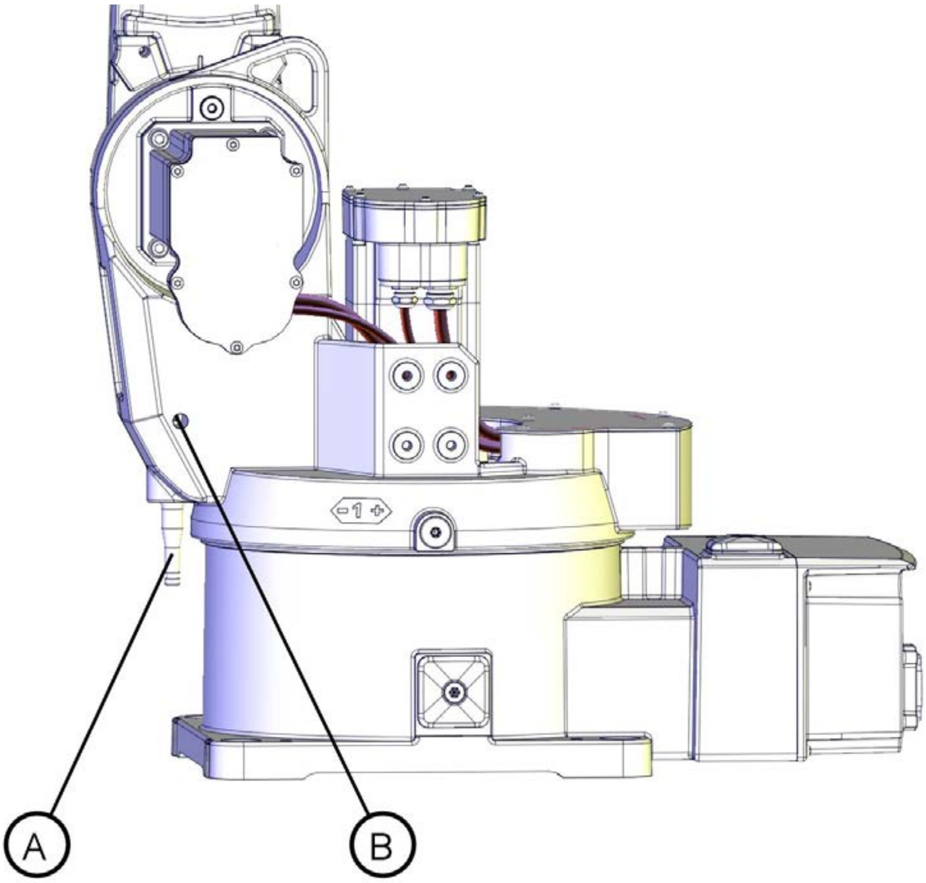
Use this procedure to inspect the labels on the robot.

	Action	Note
1	⚠ **DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Check all labels.	See the figure in *Location of information labels on page 99*.
3	Replace any missing or damaged labels.	

4.3.9 Inspecting the mechanical stop pin, axis 1

Location of mechanical stop pin, axis 1

The mechanical stop pin is located on the frame as shown in the figure.



xx1100000444

A	Mechanical stop pin
B	Stop screw

Required equipment

Equipment	Article number	Note
Mechanical stop pin axis 1	See *Spare parts on page 307*.	
Standard toolkit		Content is defined in section *Standard tools on page 303*.
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.

Continues on next page

Inspection of mechanical stop pin, axis 1

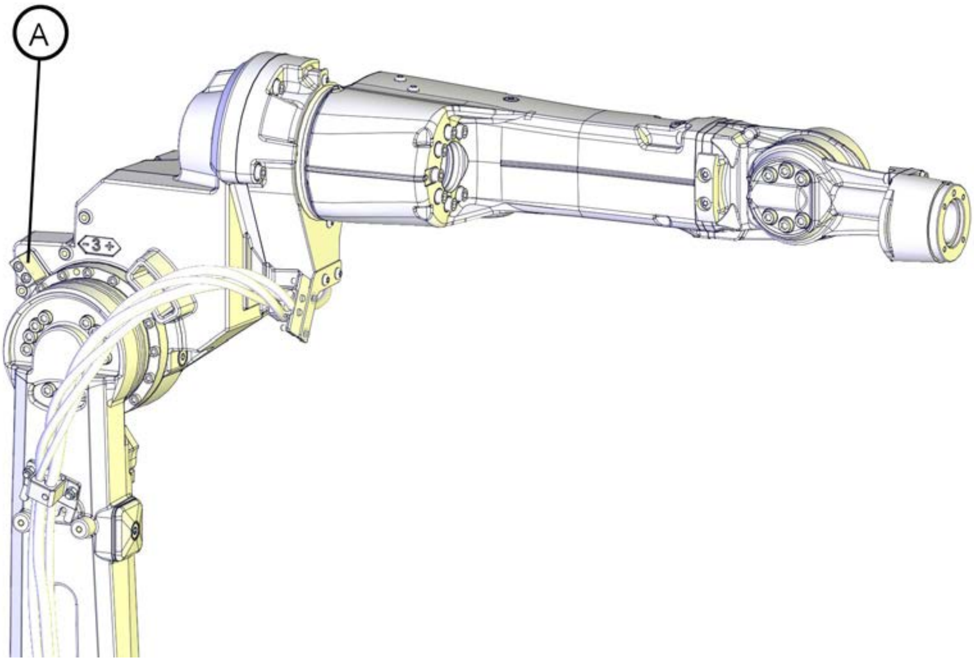
Use this procedure to inspect the mechanical stop pin, axis 1.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Regularly check that the *mechanical stop pin* is not bent or damaged in any other way.	See the figure in: • *Location of mechanical stop pin, axis 1 on page 101*
3	**Note** If the mechanical stop pin has been deformed or damaged, it must be replaced.	
4	Check that the mechanical stop pin is properly attached.	

4.3.10 Inspecting, additional mechanical stops

Location of additional mechanical stops

Additional mechanical stops are provided for axes 3 and 4.



xx1100000351

A	Additional mechanical stop, axis 3

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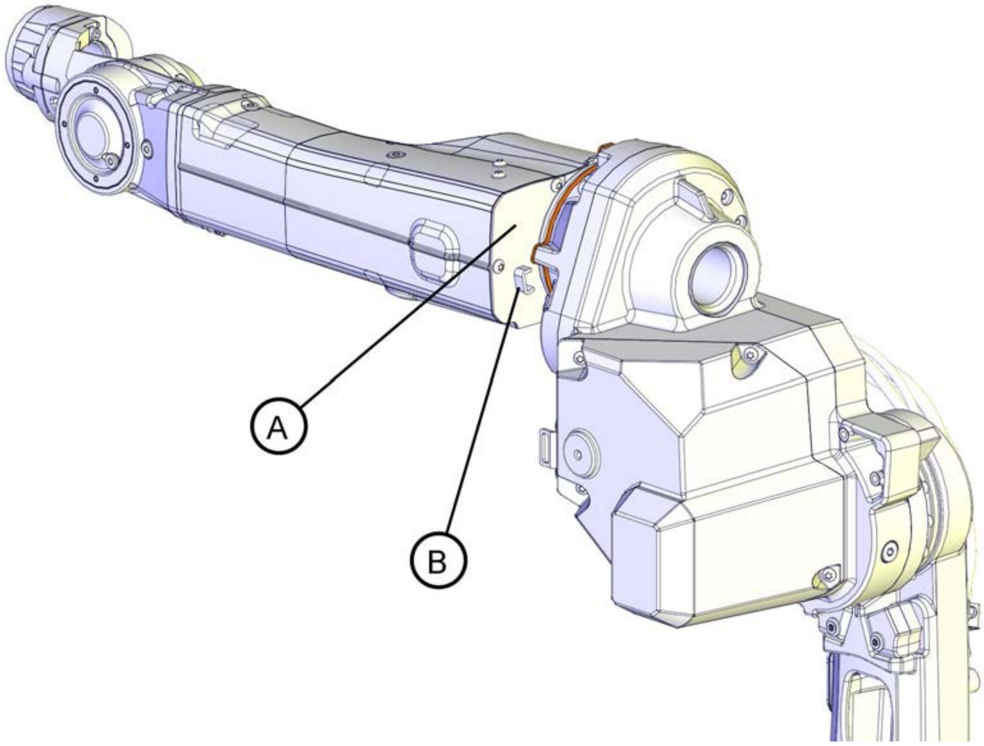


xx1100000469

A	Metal sheet
B	Additional mechanical stop, axis 4 (welding on the metal sheet)

Required equipment

Equipment	Spare part no.	Note
Additional mechanical stops	See *Spare parts on page 307*.	
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.

Inspecting, mechanical stops

Use this procedure to inspect additional mechanical stops on axes 3 and 4.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Check *additional stops* on axes 3 and 4 for damage.	See *Location of additional mechanical stops on page 103*.

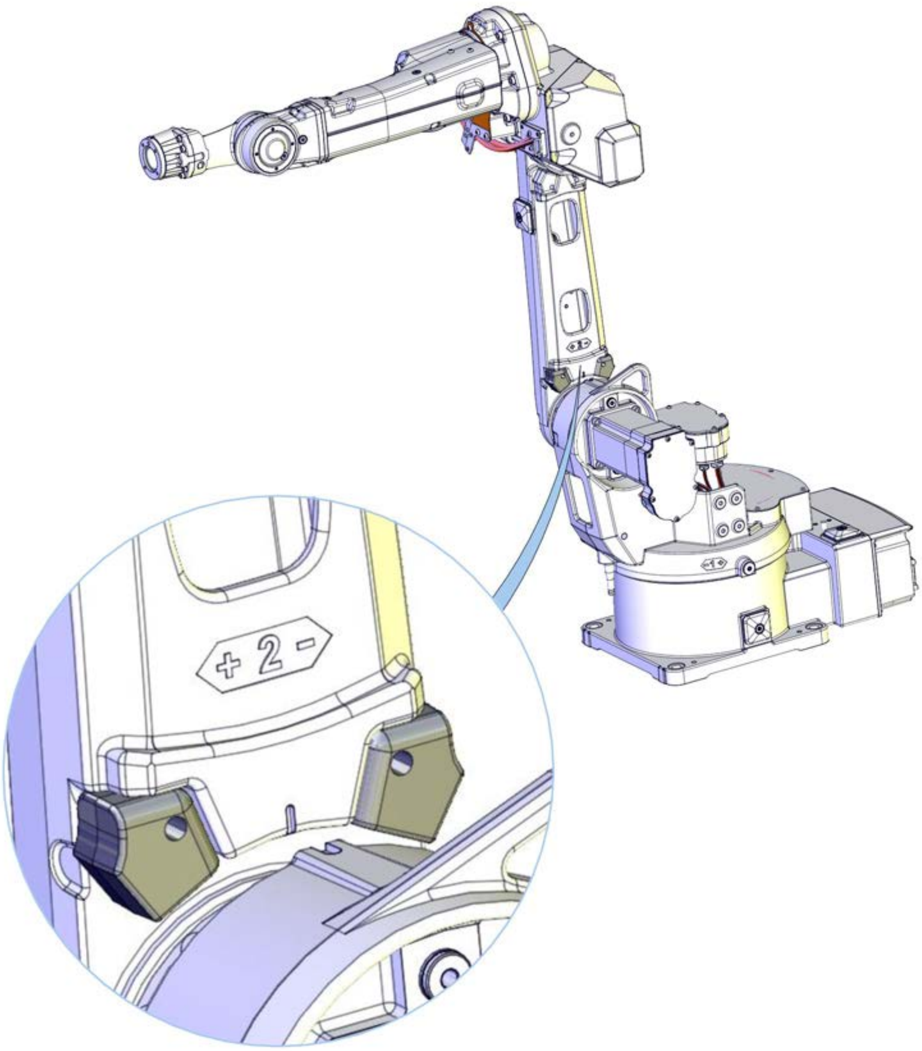
Continues on next page

	Action	Note
3	Make sure the stops are properly attached. Correct tightening torque, mechanical stops: • Axis 3: 14 Nm.	
4	If any damage is detected, the *mechanical stops* must be replaced! Correct attachment screws: • Axis 3: M6 x 40, quality 12.9 (2 pcs) • Axis 4: M6 x 8, quality 8.8 (3 pcs)	Art. no. is specified in *Required equipment on page 104*.

4.3.11 Inspecting dampers

Location of dampers

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



xx1100000356

-	Dampers, axis 2

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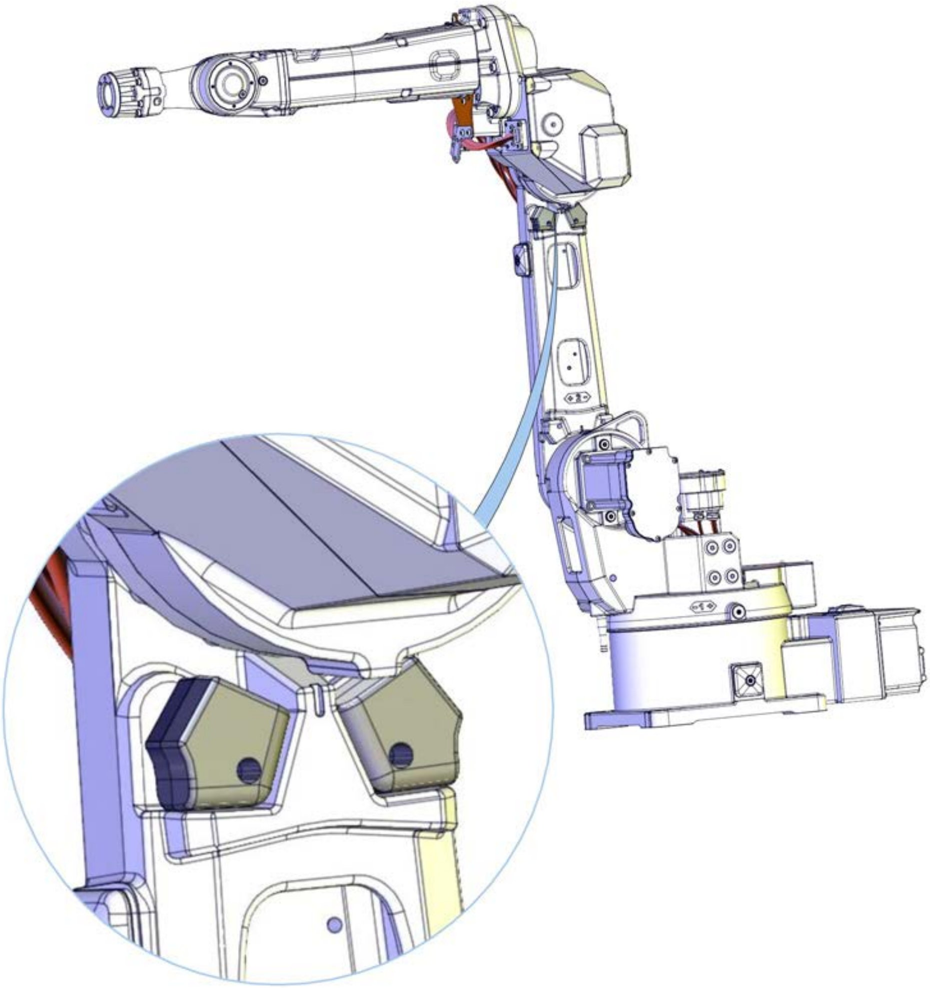


xx1100000357

-	Dampers, axis 3

Required equipment

Equipment	Spare part no.	Note
Damper	See *Spare parts on page 307*.	
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.

Continues on next page

Inspecting dampers

Use this procedure to inspect the dampers.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Check all *dampers* for damage or cracks.	See the figure in: • *Location of dampers on page 106*
3	Check all dampers for existing impressions larger than 2-3 mm.	
4	Check attachment screws for deformation.	
5	If any damage is detected the damper must be replaced.	

4.4 Replacement activities

4.4.1 Type of lubrication in gearboxes

Introduction

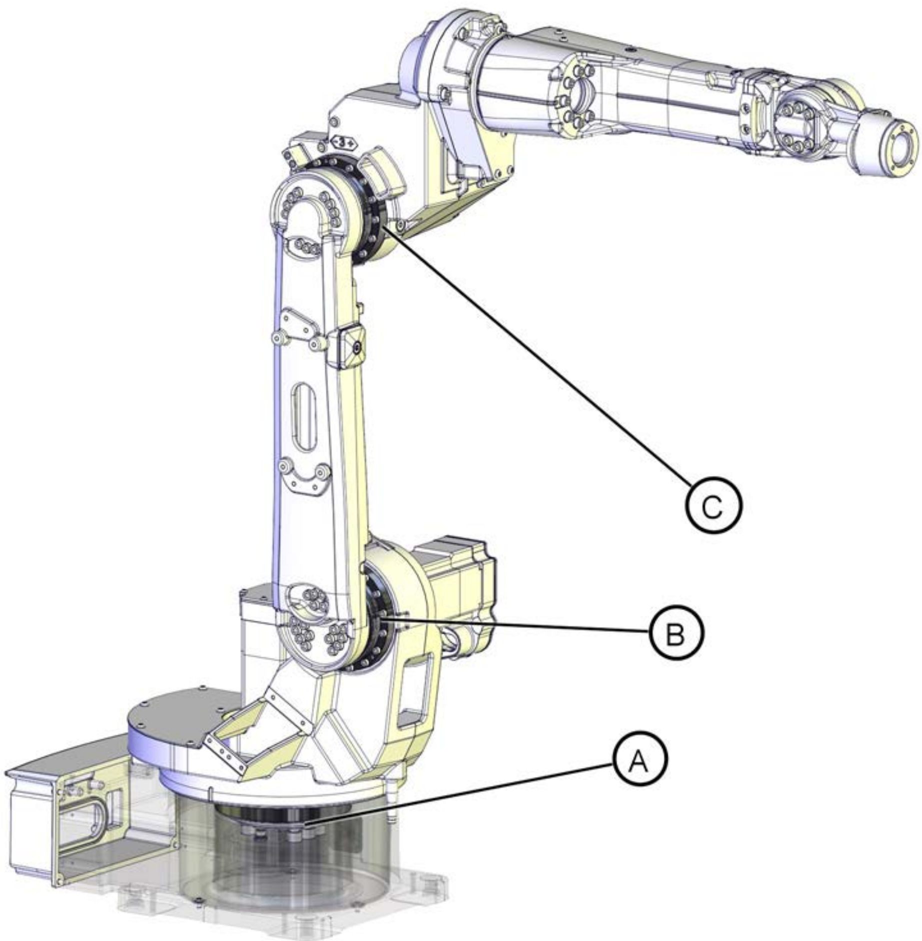
This section describes where to find information about the type of lubrication, article number and the amount of lubrication in the specific gearbox. It also describes the equipment needed when working with lubrication.

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.



xx1100000336

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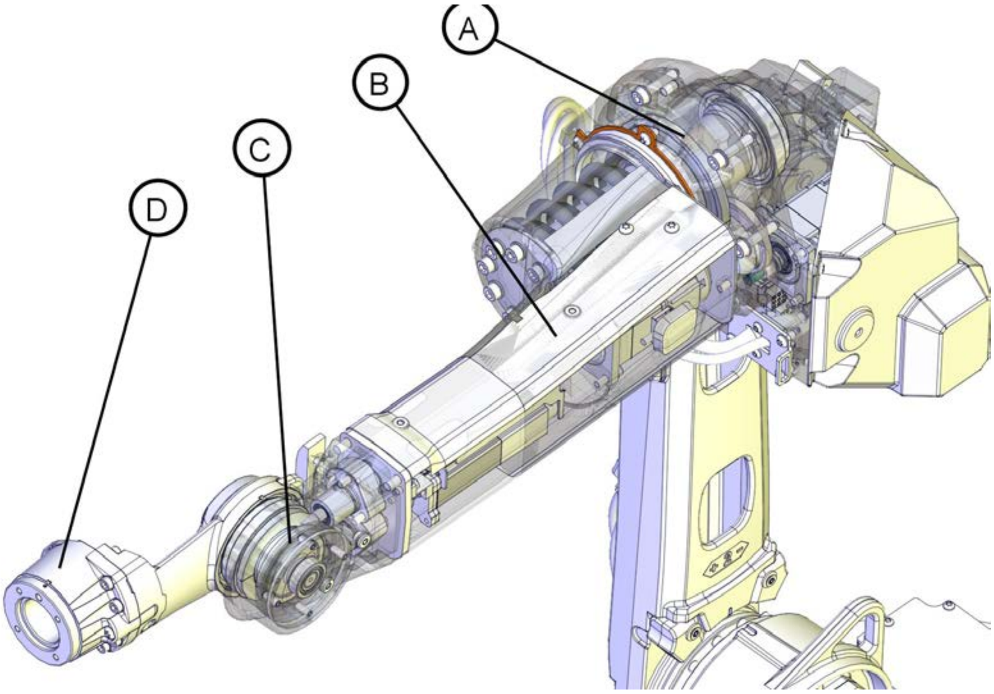
A	Axis 1 gearbox
B	Axis 2 gearbox
C	Axis 3 gearbox



xx1100000337

A	Axis 4 gearbox
B	Axis 5 gearbox
C	Axis 5 and 6 gearbox
D	Axis 6 gearbox

Equipment

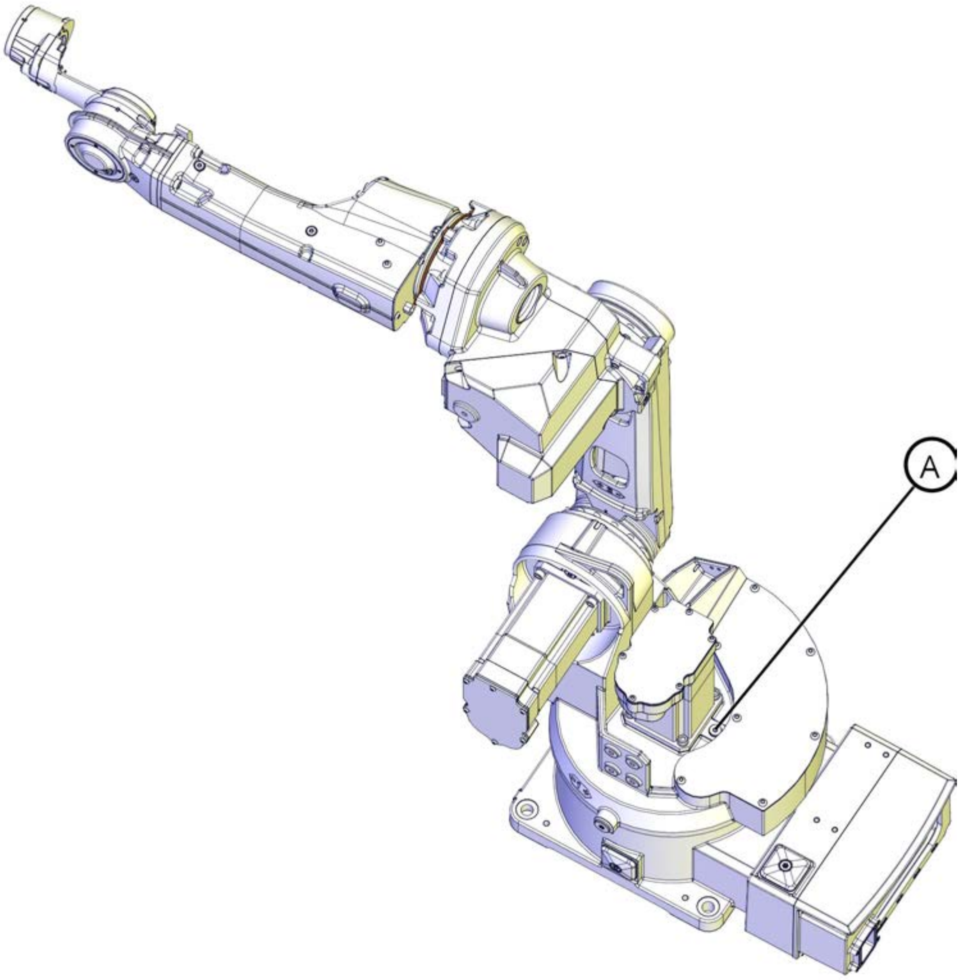
Equipment	Note
Oil dispenser	Includes pump with outlet pipe. Use the suggested dispenser or a similar one: • Orion OriCan article number 22590 (pneumatic)
Nipple for quick connect fitting, with o-ring	

4.4.2 Changing the oil, axis 1 gearbox

Location of oil plugs

The axis 1 gearbox is located between the frame and base of the robot.

The oil plug is shown in the figure.



xx1100000339

A	Oil plug for filling

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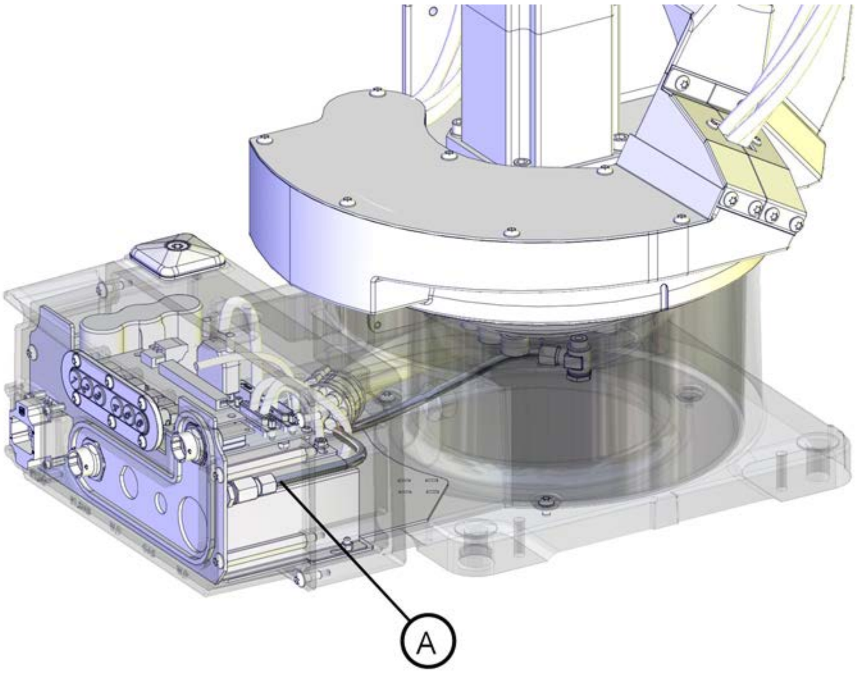


xx1100000338

A	Draining hose

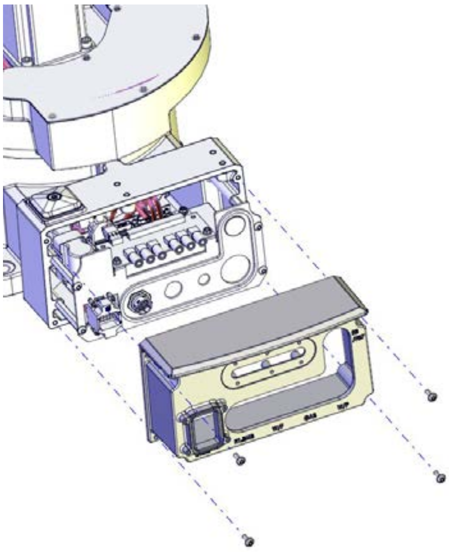
Required equipment

Equipment	Note
Lubricating oil	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*. See *Type and amount of oil in gearboxes on page 109*.
Oil collecting vessel	The capacity of the vessel must be sufficient to take the complete amount of oil.
Compressed air	Used to accelerate the draining procedure.
Standard toolkit	Content is defined in section *Standard tools on page 303*.
Other tools and procedures may be required.	See references to these procedures in the step-by-step instructions below.

Continues on next page

Draining, axis 1 gearbox

Use this procedure to drain the gearbox of oil. A suspended robot must be taken down and secured standing on the floor for oil change.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
3	Remove the push button guard from the base.	
4	Remove the centering piece from the push button unit.	
5	Remove the base cover.	 xx1100000315
6	Cut the straps that hold the oil draining hose fastened inside the robot base.	
7	Pull out the oil draining hose so that it reaches the oil collecting vessel.	

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	Action	Note
8	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
9	Open the oil plug at the end of the hose and place the hose end at the oil collecting vessel to collect the oil.	
10	Open the oil plug for filling and use compressed air to accelerate the process. Maximum pressure allowed: 10 kPa.	See *Location of oil plugs on page 111*. **Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
11	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See section *Decommissioning on page 291* for more information.	
12	**Note** There will be some oil left in the gearbox after draining.	
13	Refit the *oil plugs*.	See *Required equipment on page 112*. Tightening torque: 10 Nm
14	Fasten the oil draining hose inside the base with straps.	
15	Refit the base cover.	
16	Refit the centering piece to the push button unit.	
17	Refit the push button guard to the base.	

Continues on next page

Filling oil, axis 1 gearbox

Use this procedure to fill the gearbox with oil. A suspended robot must be taken down and secured standing on the floor for oil change.

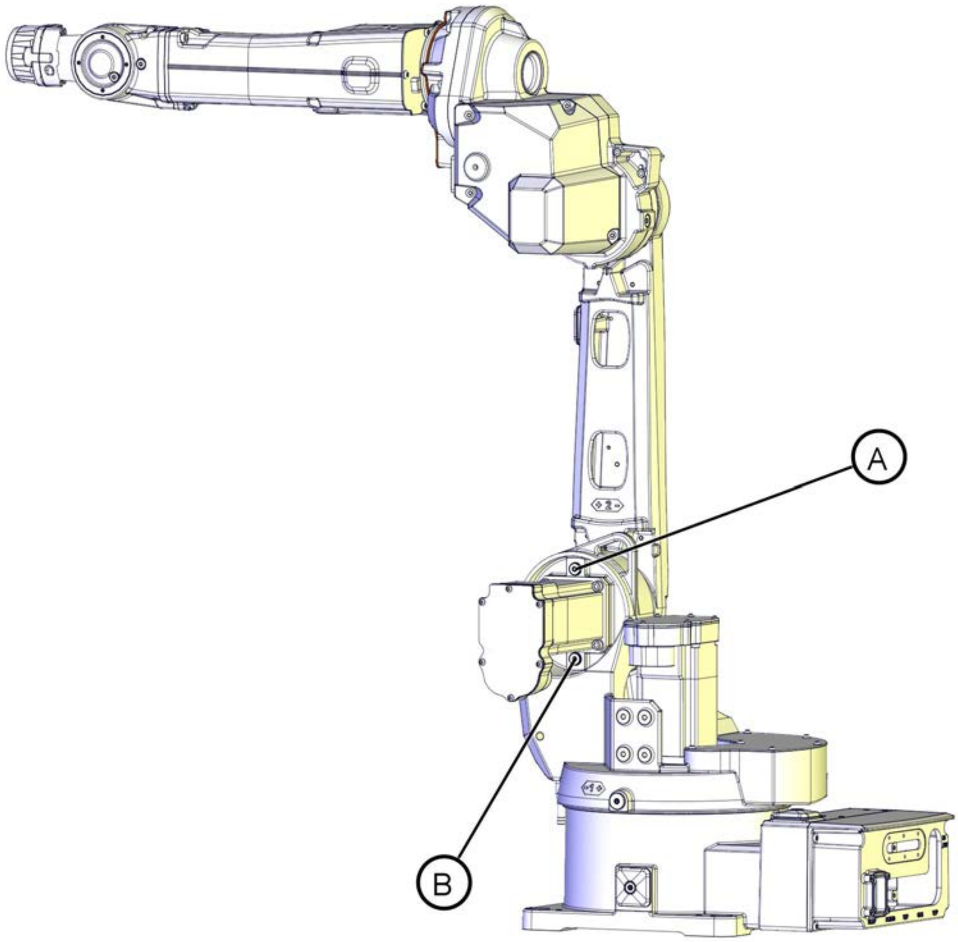
	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
3	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	Open the *oil plug for filling*.	See *Location of oil plugs on page 111*.
5	Refill the gearbox with *lubricating oil*. **Note** The amount of oil to be filled depends on the amount previously being drained.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 109*.
6	Inspect the oil level.	How to inspect the oil level is described in *Inspecting the oil level, axis-1 gearbox on page 82*.
7	Refit the *oil plug*.	Tightening torque: 10 Nm.

4.4.3 Changing the oil, axis-2 gearbox

Location of oil plugs

The axis-2 gearbox is located in the lower arm rotational center, underneath the motor attachment.

Oil plugs are shown in the figure.



xx1100000340

A	Oil plug for filling (draining when sealing mounted)
B	Oil plug for draining (filling when sealing mounted) (Quick connect fitting)

Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubricating oil	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*. See *Type and amount of oil in gearboxes on page 109*.
Oil collecting vessel	The capacity of the vessel must be sufficient to take the complete amount of oil.

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Equipment	Note
Nipple (TEMA IF 3820 S06)	To be fitted on a hose, and then used for draining connected to the *quick connect fitting*. See *Location of oil plugs on page 116*.
Standard toolkit	Content is defined in section *Standard tools on page 303*.

Draining, axis-2 gearbox

Use this procedure to drain the gearbox of oil.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
3	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	Either • connect a nipple to the *quick connect fitting* in the hole for draining or • remove the *quick connect fitting*.	See the figure in: • *Location of oil plugs on page 116*
5	Open the *oil plug, filling*.	See the figure in: • *Location of oil plugs on page 116* **Note** Drainage will be quicker if the oil plug, filling is removed.
6	Drain the gearbox oil using an *oil collecting vessel*.	**Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.

Continues on next page

	Action	Note
7	**WARNING** Used oil is hazardous material and must be disposed of in a safe way. See section *Decommissioning on page 291* for more information.	
8	**Note** There will be some oil left in the gearbox after draining.	
9	Refit *oil plug*. **Note** Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.	Tightening torque: • 10 Nm

Filling oil, axis-2 gearbox

Use this procedure to fill the gearbox with oil.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
3	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	Open *oil plug, filling*.	See the figure in: • *Location of oil plugs on page 116*

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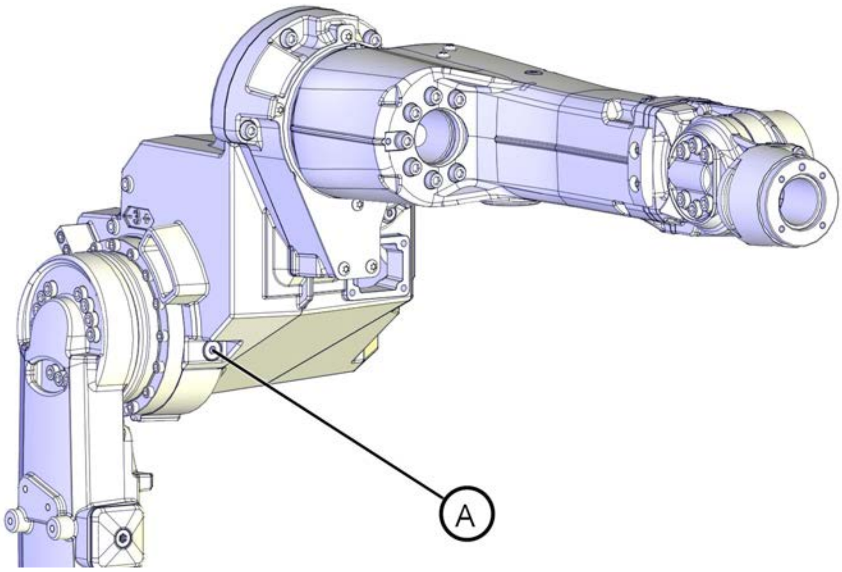
	Action	Note
5	Refill the gearbox with *lubrication oil*. **Note** The amount of oil to be filled depends on the amount previously being drained.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 109*.
6	Inspect the oil level.	How to inspect the oil level is described in section: • *Inspecting the oil level, axis 2 gearbox on page 85*
7	Refit *oil plug*. **Note** Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.	Tightening torque: • 10 Nm

4.4.4 Changing the oil, axis-3 gearbox

Location of oil plugs

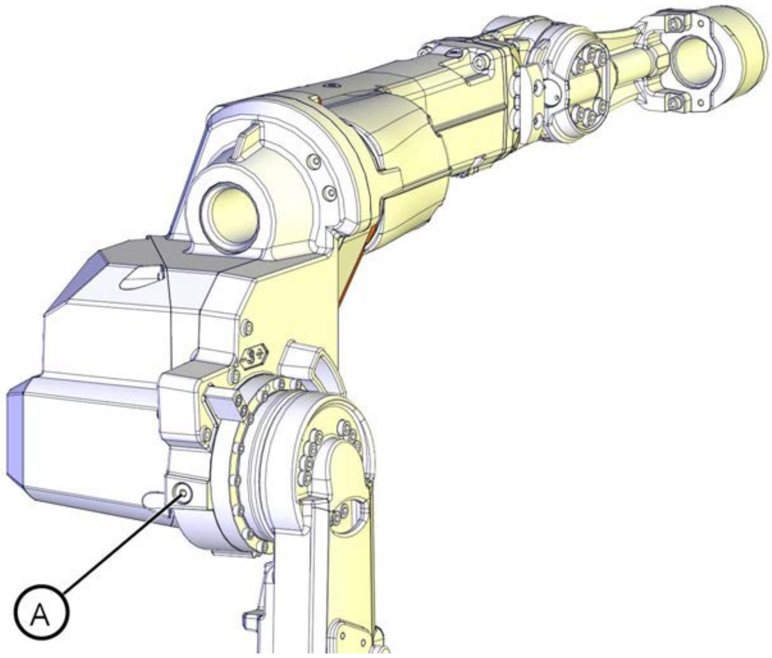
The axis-3 gearbox is located in the upper arm rotational center.

Oil plugs are shown in the figure.



xx1100000341

A	Oil plug, gearbox



xx1100000342

A	Oil plug, armhouse

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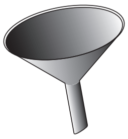
Required equipment

Equipment	Note
Lubricating oil	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*. See *Type and amount of oil in gearboxes on page 109*.
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 109*
Funnel	 xx1200000862
Standard toolkit	Content is defined in section *Standard tools on page 303*.

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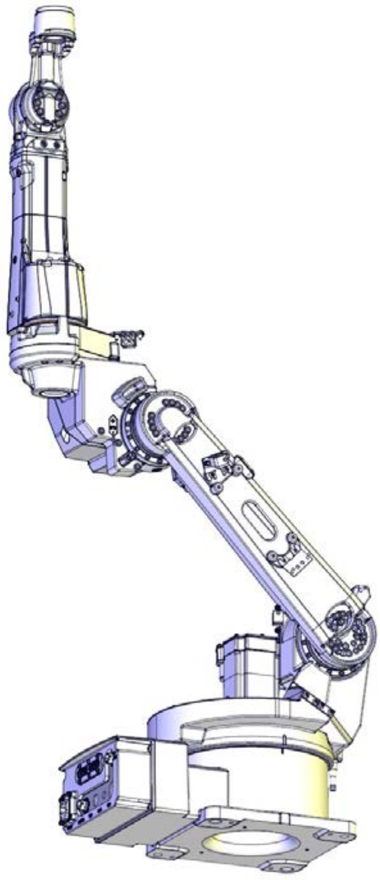
Draining, axis-3 gearbox

Use this procedure to drain the gearbox of oil.

	Action	Note
1	Move the lower arm -45° and the upper arm -90° so that the oil plug in the armhouse is faced downwards.	 xx1100000487
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	

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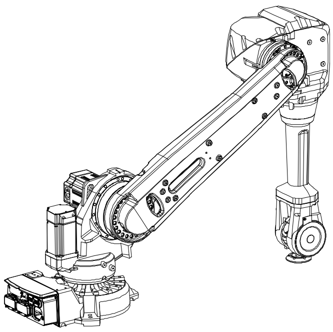
	Action	Note
4	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5	Open the *oil plug, armhouse*	See the figure in: • *Location of oil plugs on page 120*
6		See the figure in: • *Location of oil plugs on page 120*
7	Drain the gearbox oil using an *oil collecting vessel*.	**Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
8	**WARNING** Used oil is hazardous material and must be disposed of in a proper way. See section *Decommissioning* for more information.	
9	Refit oil plugs.	Tightening torque: 10 Nm

Filling oil, axis-3 gearbox

Use this procedure to fill the gearbox with oil.

	Action	Note
1	Move the upper arm to a position where the wrist is pointing towards the floor as shown in the figure.	 xx0800000329
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	

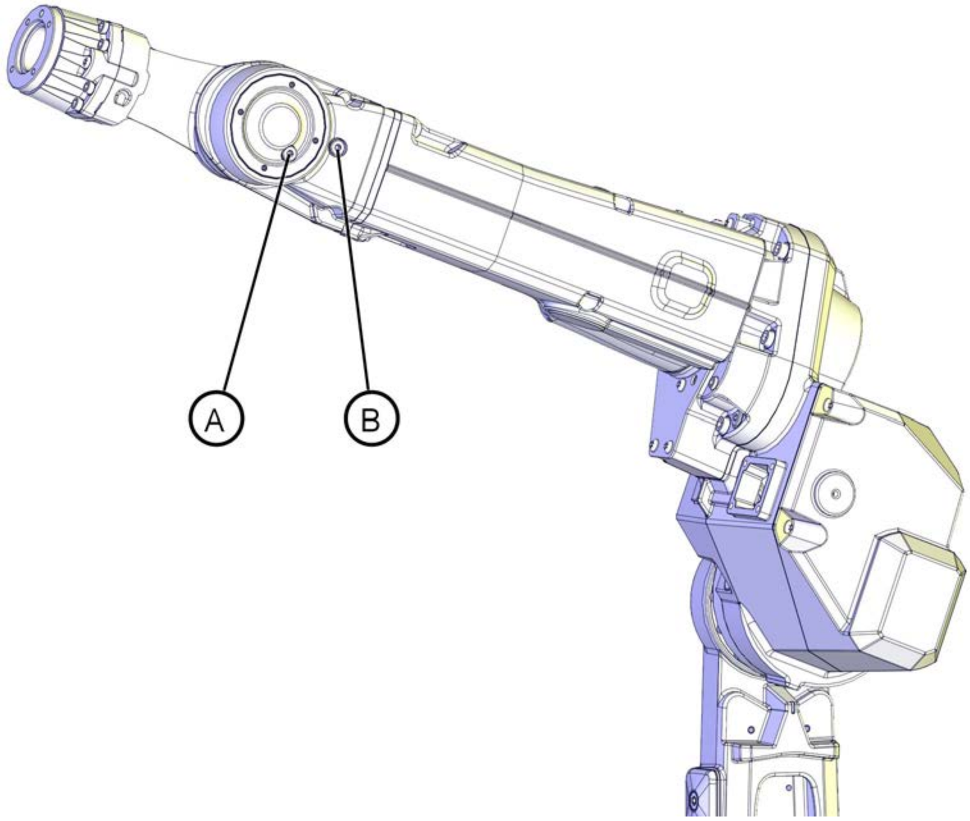
Continues on next page

	Action	Note
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
4	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5	Open the *oil plug, armhouse*.	See the figure in: • *Location of oil plugs on page 120*
6	Refill the gearbox with *lubricating oil*. **Tip** Use a funnel. **Note** The amount of oil to be filled depends on the amount previously being drained.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 109*.
7	Inspect the *oil level*.	How to inspect oil is described in section: • *Inspecting the oil level, axis 3 gearbox on page 87*
8	Refit the *oil plug*.	Tightening torque: 10 Nm

4.4.5 Changing the oil in axis 5-6 gearbox, IRB 1510ID

Location of oil plugs, axis 5-6 gearbox

The oil plugs for the axis 5-6 gearbox are located in the wrist unit as shown in the figure below.



xx1100000343

A	Oil plug, draining and filling
B	Ventilation plug

Required equipment

Equipment	Note
Lubricating oil	Information about the oil is found in *Technical reference manual - Lubrication in gearboxes*. See *Type and amount of oil in gearboxes on page 109*.
Oil collecting vessel	The capacity of the vessel must be sufficient to take the complete amount of oil.
Standard toolkit	Content is defined in section *Standard tools on page 303*.
Other tools and procedures may be required.	See references to these procedures in the step-by-step instructions below.

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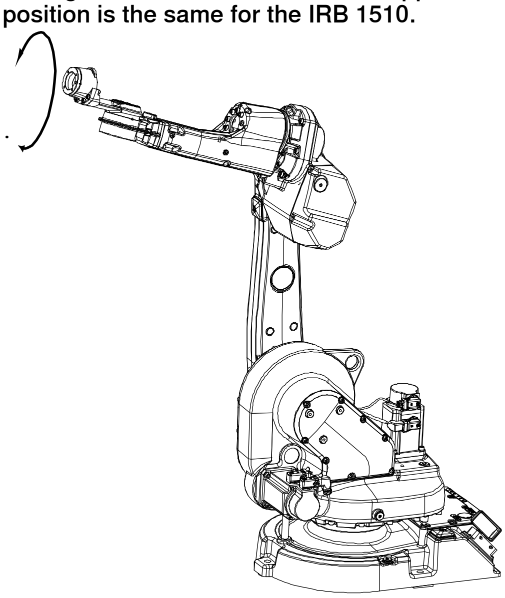
Draining, axis 5-6 gearbox

Use this procedure to drain the axis 5-6 gearbox.

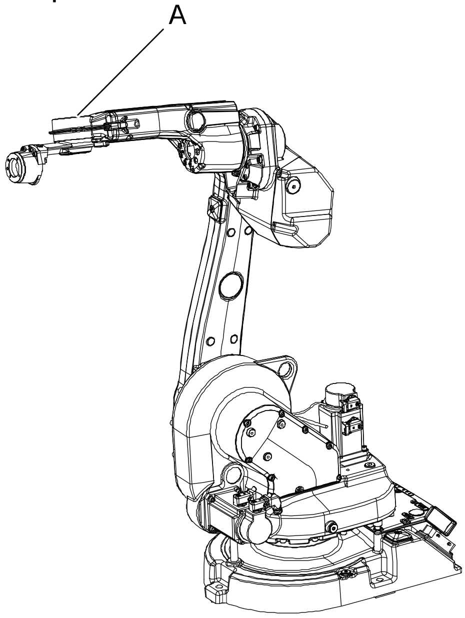
	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 30*.	
3	Position the robot as shown in the figure to the right: • upper arm: upwards for a standing robot. • axis 4: - 90º, to a position where the oil plug (A) is faced downwards. **Note** The total amount of oil will not be drained. There will remain approximately 20 ml in the wrist unit.	The capacity of the vessel must be sufficient to take the complete amount of oil. The figure shows IRB 1600 but the upper arm position is the same for the IRB 1510.  xx0700000033
4	**CAUTION** The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5	Remove the oil plug (A) and the ventilation plug (B).	Shown in figure *Location of oil plugs, axis 5-6 gearbox on page 125*.
6	Drain the wrist of oil.	

Continues on next page

	Action	Note
7	Refit the oil plugs.	Tightening torque: 3 Nm.

Filling oil, axis 5-6 gearbox

Use this procedure to fill the axis 5-6 gearbox with oil.

	Action	Note
1	Position the robot as shown in the figure to the right: • axis 4: + 90º, to a position where the oil plug (A) is faced upwards.	The figure shows IRB 1600 but the upper arm position is the same for the IRB 1510.  xx0700000034 A Oil plugs
2	Fill new oil in the wrist. Check the oil level to make sure the filled amount of oil is correct.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 109*. See *Inspecting the oil level, axis 5-6 gearbox on page 94*.
3	Refit the oil plug and the ventilation plug.	Tightening torque: 3 Nm.

4.4.6 Replacing the battery pack

Note

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

For an SMB board with 3-pole battery contact (RMU101 3HAC044168-001 or RMU102 3HAC043904-001), the lifetime of a new battery is typically 36 months.

For an SMB board with 2-pole battery contact, the typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended for longer production breaks with a battery shutdown service routine. See the operating manual for the robot controller for instructions.

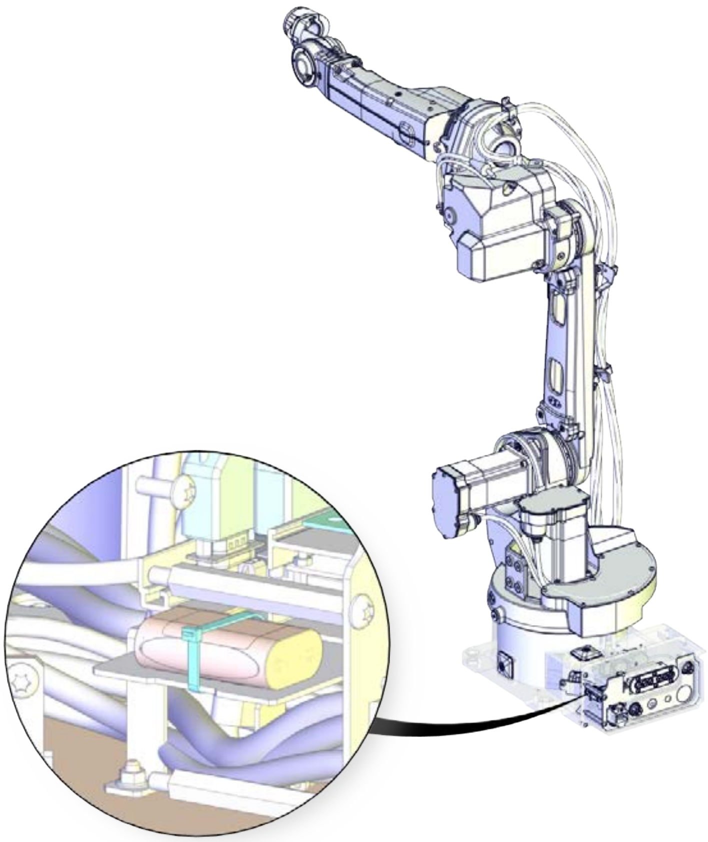
WARNING

See *Hazards related to batteries on page 32*.

Continues on next page

Location of battery pack

The battery pack for the measurement system is located inside the base of the robot, as shown in the figure below.



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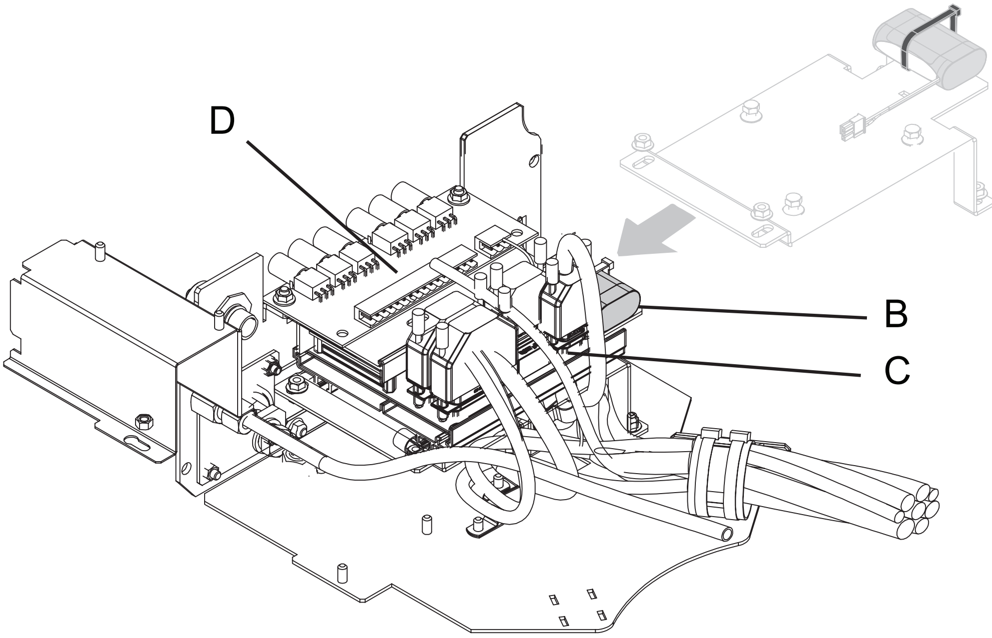
Battery pack on serial measurement unit

The battery pack is attached to the serial measurement unit as shown in the figure below.

RMU 101



xx2300001177

B	Battery pack (3-pole battery contact)
C	Serial measurement board RMU 101
D	BU unit

Required equipment

Note

There are two variants of SMB units and batteries. One with 2-pole battery contact and one with 3-pole battery contact. The variant with the 3-pole battery contact has longer lifetime for the battery.

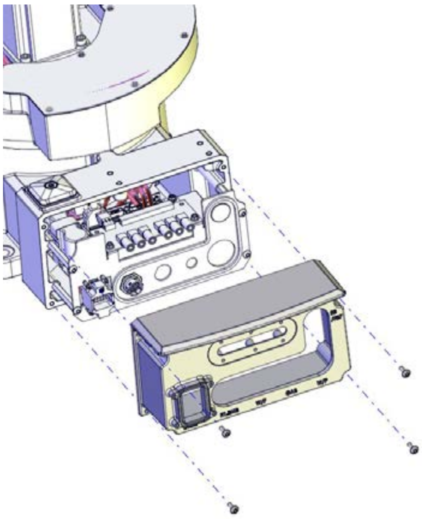
It is important that the SMB unit uses the correct battery. Make sure to order the correct spare parts. Do not replace the battery contact!

Equipment	Spare part no.	Note
Serial measurement board	See *Spare parts on page 307*.	
Battery pack	See *Spare parts on page 307*.	
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.
Circuit diagram	-	See *Circuit diagram - IRB 1510*.

Continues on next page

Replacement, battery pack

The procedure below details how to replace the battery pack.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Remove the *base cover* from the robot by unscrewing its attachment screws. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	 xx1100000315
3	Disconnect the battery from the serial measurement unit.	
4	**Valid for battery pack with 2-pole battery contact:** Open the velcro strap and remove the battery pack.	
5	**Valid for battery pack with 3-pole battery contact.** Cut the cable strap and remove the battery pack.	
6	Fit the new *battery pack* and connect it to the serial measurement unit (X3).	See *Battery pack on serial measurement unit on page 130*.
7	**Valid for battery pack with 2-pole battery contact:** Close the velcro strap around the battery pack.	
8	**Valid for battery pack with 3-pole battery contact.** Secure the battery with a cable strap.	

Continues on next page

	Action	Note
9	Refit the *base cover* to the robot.	See *Location of battery pack on page 129*.
10	Update the revolution counters.	Detailed in section *Updating revolution counters on page 283*..

4.5 Cleaning activities

4.5.1 Cleaning the IRB 1510

DANGER

Turn off all:

- electric power supply
- hydraulic pressure supply
- air pressure supply

to the robot, before entering the safeguarded space.

General

To secure high uptime it is important that the IRB 1510 is cleaned regularly. The frequency of cleaning depends on the environment in which the product works.

Different cleaning methods are allowed depending on the type of protection of the IRB 1510.

Note

Always verify the protection type of the robot before cleaning.

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 82*.
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.
- 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
Standard	Yes	Yes. With light cleaning deter-gent.	No	No

Cables

Movable cables need to be able to move freely:

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

5 Repair

5.1 Introduction

Structure of this chapter

This chapter describes repair activities for the IRB 1510. 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 1510, report to your local ABB the serial number, the article number, and the revision of both the replaced unit and the replacement unit.

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

Safety information

Make sure to read through the chapter *Safety on page 15* before commencing any service work.

Note

If the IRB 1510 is connected to power, always make sure that the IRB 1510 is connected to protective earth and a residual current device (RCD) before starting any repair work.

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Compact*

5.2 General procedures

5.2.1 Performing a leak-down test

When to perform a leak-down test

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

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

Required equipment

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

Performing a leak-down test

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

5.2.2 Mounting instructions for bearings

General

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

Equipment

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

Assembly of all bearings

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

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

Assembly of tapered bearings

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

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

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

Greasing of bearings

Note

This instruction is not valid for solid oil bearings.

Continues on next page

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

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

Grease the different types of bearings as following description:

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

5.2.3 Mounting instructions for sealings

General

This section describes how to mount different types of sealings.

Equipment

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

Rotating sealings

The following procedures describe how to fit rotating sealings.

CAUTION

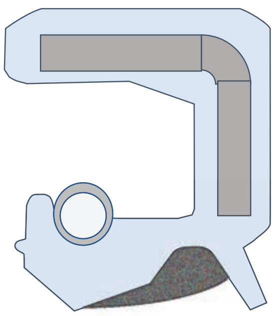
Please observe the following before commencing any assembly of sealings:

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

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

Radial sealings

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



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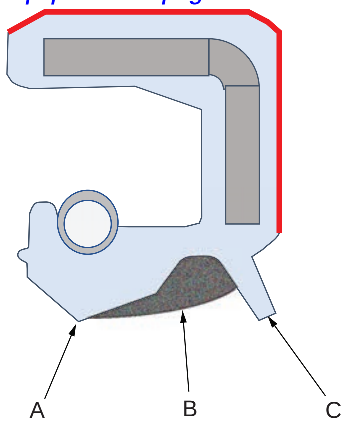
	Action	Note
1	Check the sealing to ensure that: • The sealing is of the correct type. • There is no damage on the main lip.	
2	Inspect the shaft surface before mounting. If scratches or damage are found, the shaft must be replaced since it may result in future leakage. Do not try to grind or polish the 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 139*.  xx2000000071 A Main lip B Grease C Dust lip **Note** Ensure that no grease is applied to the red marked surface.

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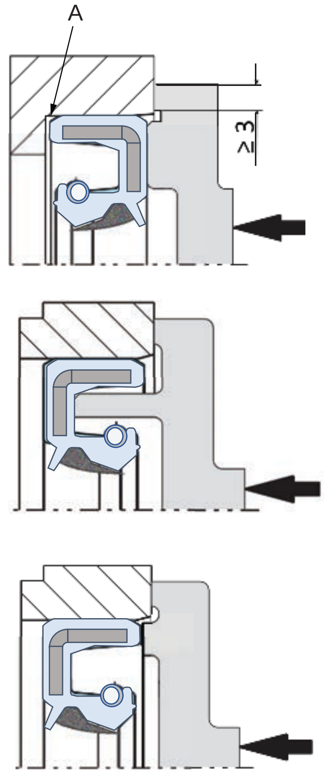
	Action	Note
4	Mount the sealing correctly with a mounting tool. Never hammer directly on the sealing as this may result in leakage.	 xx2000000072 A Gap

Flange sealings and static sealings

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

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

O-rings

The following procedure describes how to fit o-rings.

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

Continues on next page

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

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

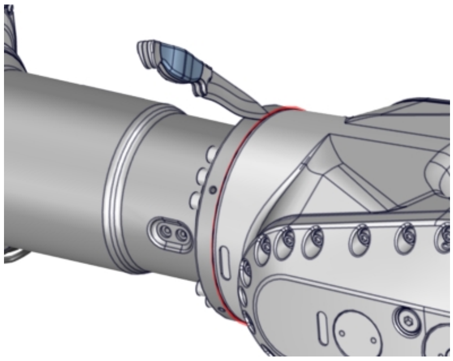
General

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

Required equipment

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

Removing

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

5.2.5 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.

5.3 Complete manipulator

5.3.1 Replacing the cable harness - lower end

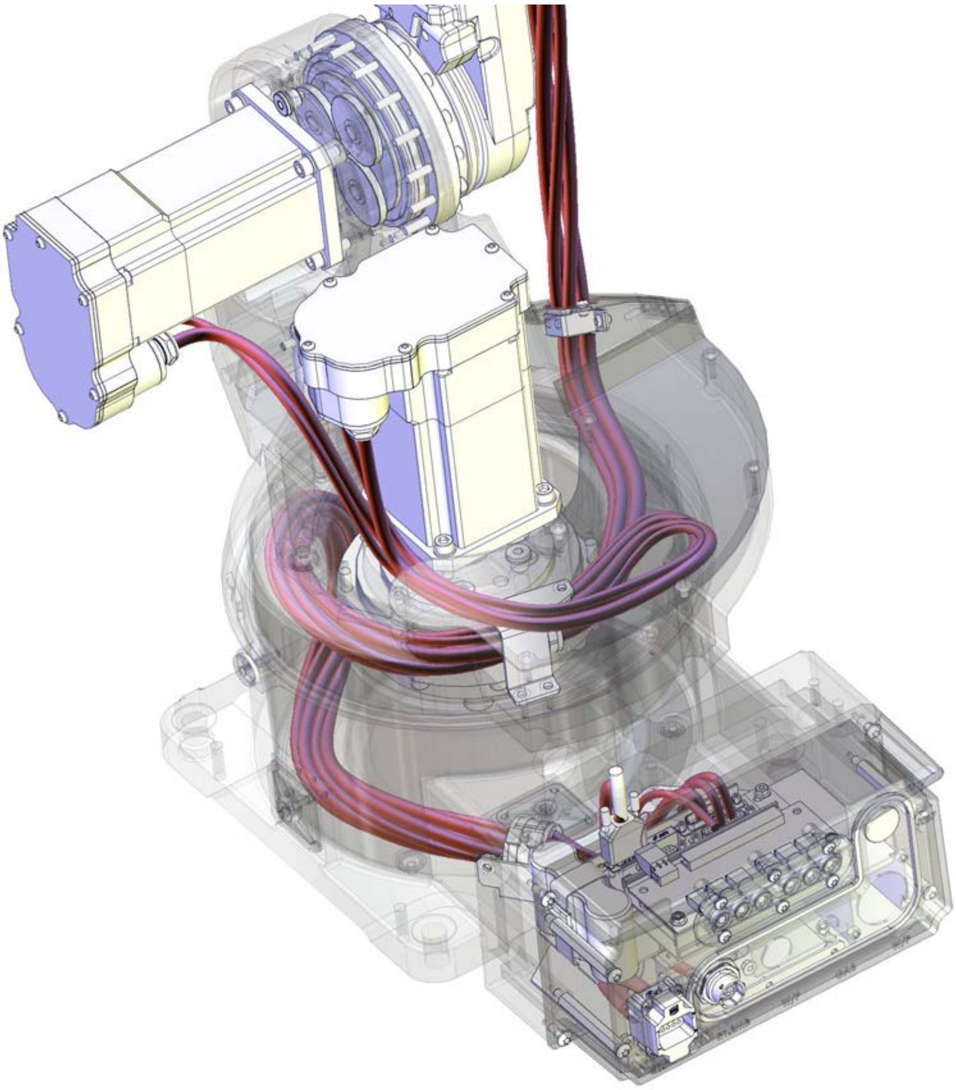
Introduction

This section describes how to replace the lower end of the cable harness.

How to replace the cable harness in the upper end is described in section *Replacing the cable harness - upper end on page 165*.

Location of cable harness - lower end

The lower end of the cable harness is located as shown in the figure.



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Required equipment

Equipment	Art. no.	Note
Cable harness	See *Spare parts on page 307*.	
Standard toolkit		Content is defined in section *Standard tools on page 303*.
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.

Removing the cable harness - lower end

Use this procedure to remove the lower end of the cable harness.

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

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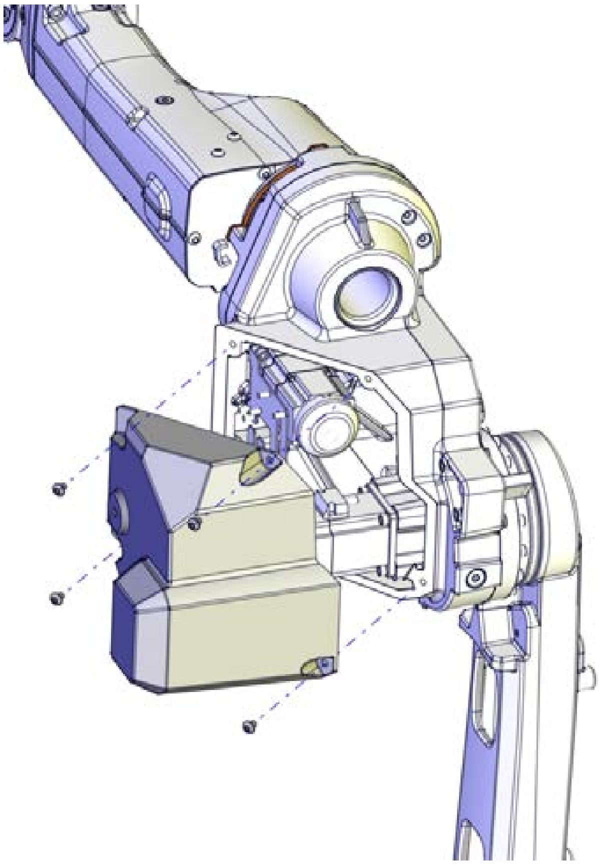
	Action	Note
3	Remove the armhouse cover.	 xx1100000349
4	Disconnect all connectors inside the armhouse. **Note** Make a note of how the cables are run on the bracket.	

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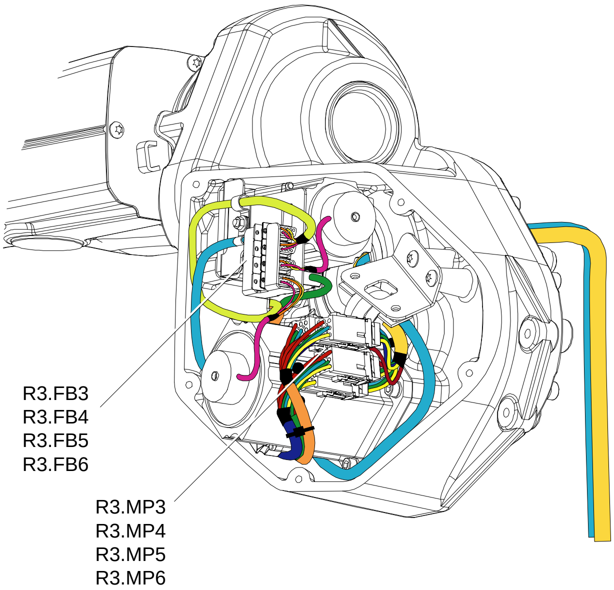
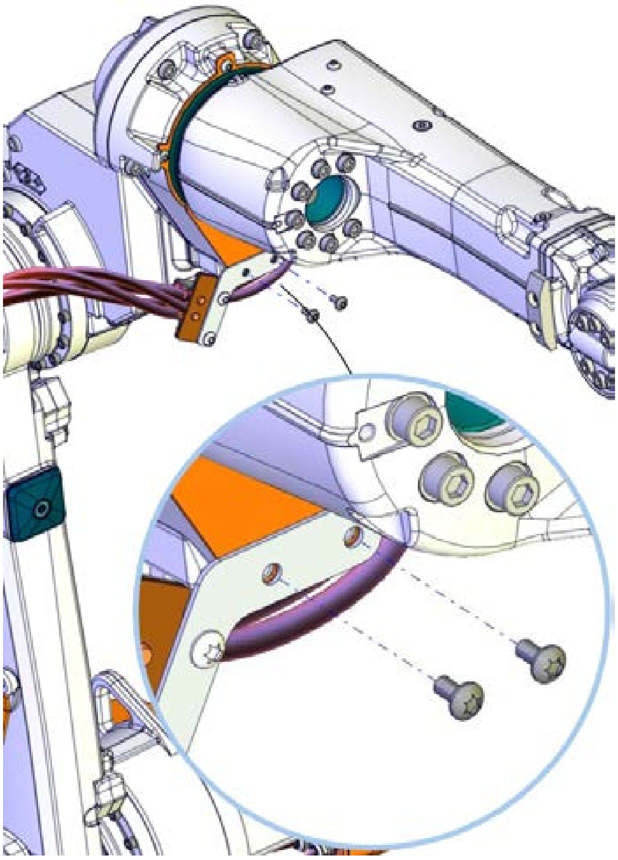
	Action	Note
5	Remove the straps and brackets that holds the cable harness in the arm-house.	 xx0700000105
6	Unscrew the attachment screws (2 pcs) that holds the bracket of the cable harness to the upper arm.	 xx1100000327

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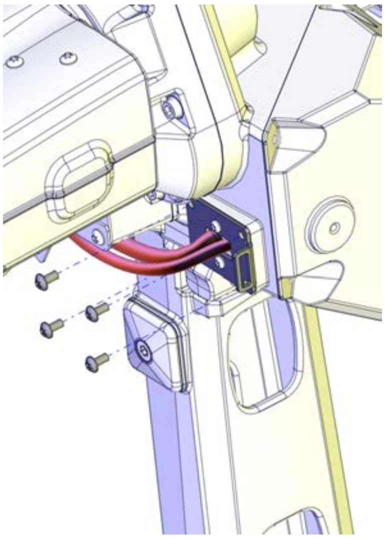
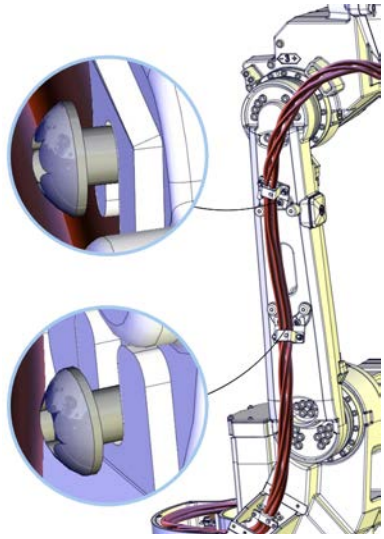
	Action	Note
7	Unscrew the attachment screws (4 pcs) of the bracket that holds the cable harness to the armhouse.	 xx1100000328
8	Unscrew the attachment screws (2 + 2 pcs) that holds the cable harness to the lower arm just enough to be able to slide the brackets of the cable harness off the screws.	 xx1100000326

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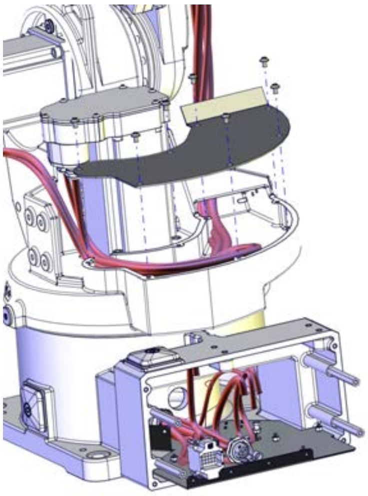
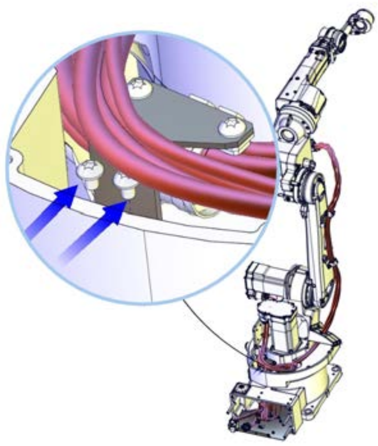
	Action	Note
9	Unscrew the attachment screws that holds the frame cover in order to reach the cable harness below.	 xx1100000322
10	Unscrew the attachment screws (2 pcs) of the bracket that holds the cable harness inside the frame.	 xx1100000323

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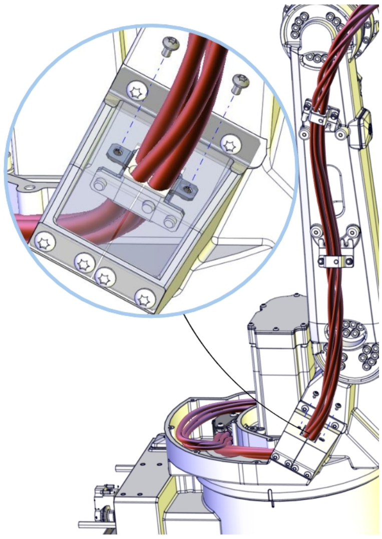
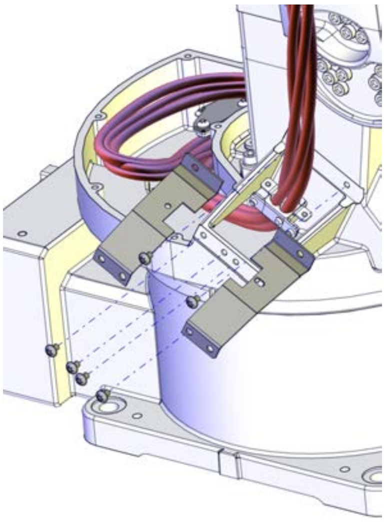
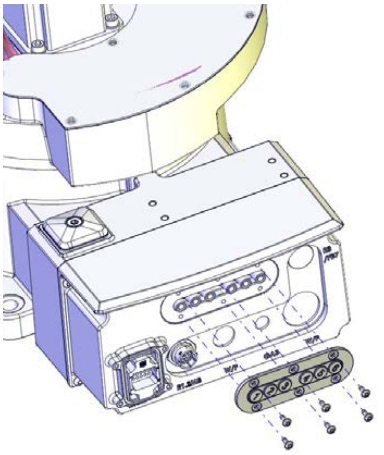
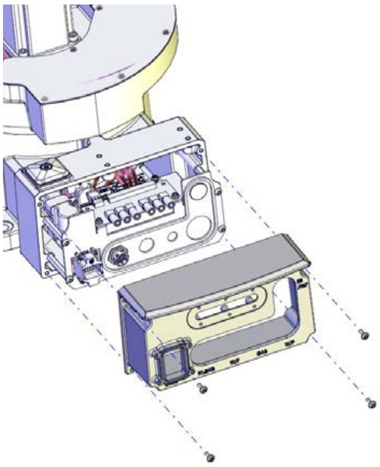
	Action	Note
11	Unscrew the attachment screws (2 pcs) that holds the bracket of the cable harness to the two covers. The bracket is under the covers.	 xx1100000324
12	Remove the two covers by unscrewing its attachment screws.	 xx1100000325
13	Remove the covers of the axes 1 and 2 motors and disconnect all connectors - R2.MP1, R2.FB1, R2.MP2 and R2.FB2,	See *Replacing motors on axis 1 and 2 on page 232*.

Continues on next page

	Action	Note
14	Remove the push button guard and centering piece. This is done in order to be able to refit the push buttons correctly later.	 xx1100000314
15	Remove the base cover.	 xx1100000315

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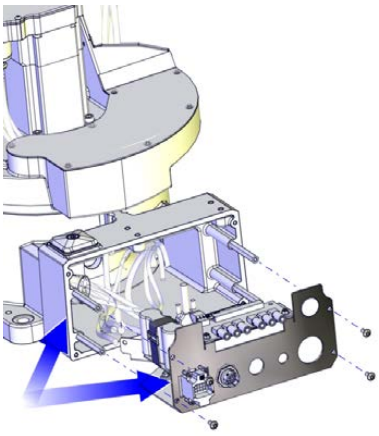
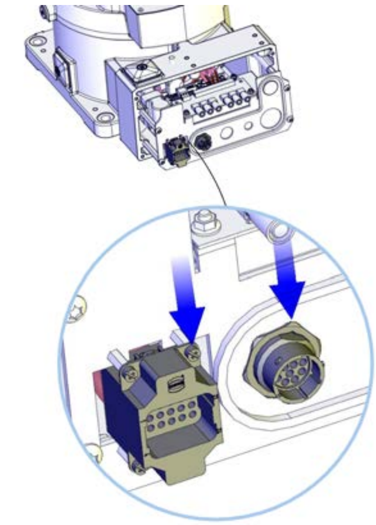
	Action	Note
16	Unscrew the attachment screws that holds the plate for connector and pull it out carefully approximately 150 mm.	 xx1100000316
17	Disconnect all connectors to the SMB and push button units.	See *Replacing the serial measurement unit on page 218*. See *Replacing the push button unit on page 225*.
18	Unscrew the two connectors on the plate for connector.	 xx1100000317

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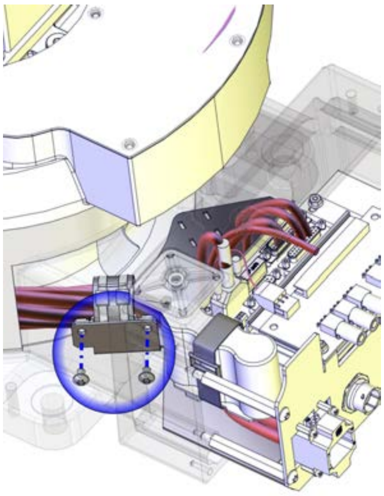
	Action	Note
19	Unscrew the attachment screws for the bracket inside the base that holds the cable harness to the fastening plate.	 xx1100000321
20	Unscrew the earth cable on the fastening plate.	
21	Unscrew all cable clamps that holds the cable harness to the fastening plate.	
22	Remove the cable harness carefully from the frame into the base and pull it out at the rear of the base.	

Refitting the cable harness - lower end

Use this procedure to refit the lower end of the cable harness.

	Action	Note
1	Apply cable grease on the plastic parts inside base and frame, if needed.	
2	Connect the earth cable to the fastening plate.	
3	Reconnect all connectors to SMB and push button units.	See *Replacing the serial measurement unit on page 218*. See *Replacing the push button unit on page 225*.

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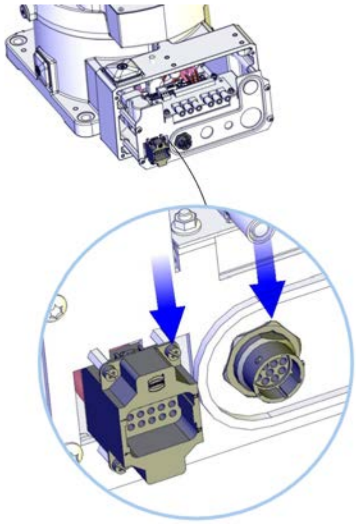
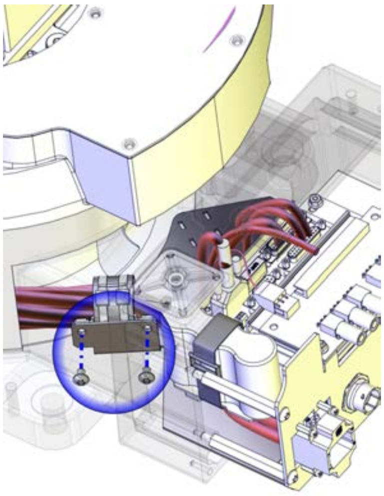
	Action	Note
4	Fit the two connectors on the plate for connector.	 xx1100000317
5	Secure the bracket of the cable harness to the fastening plate in the base with its attachment screws (2 + 2 pcs).	 xx1100000321
6	Refit all cable clamps and straps securing the cable harness to the fastening plate.	

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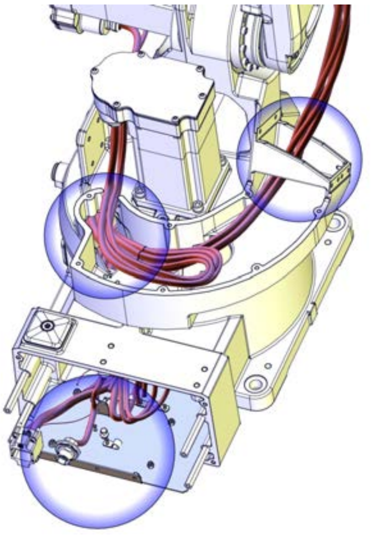
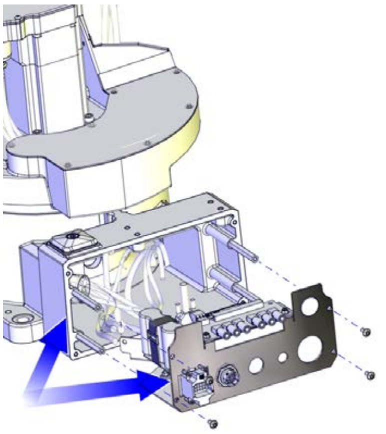
	Action	Note
7	Run the cable harness carefully into the base and frame, up through the holes in the frame and to the lower arm.	 xx1100000331
8	Push very carefully in the plate for connector and fastening plate in to the base. Check that the cable harness is placed correctly. **CAUTION** Be careful not to damage the cable harness in the process. The space is cramp.	 xx1100000316

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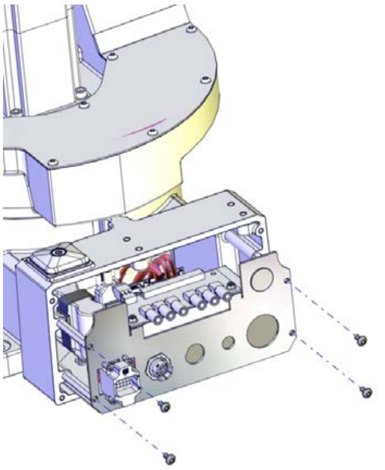
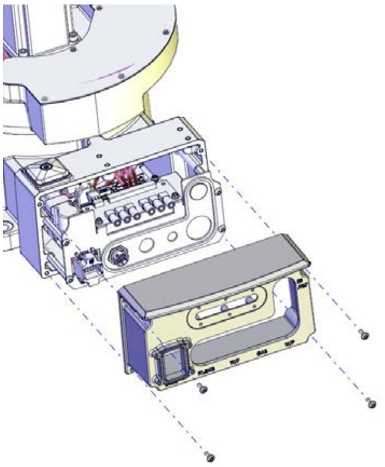
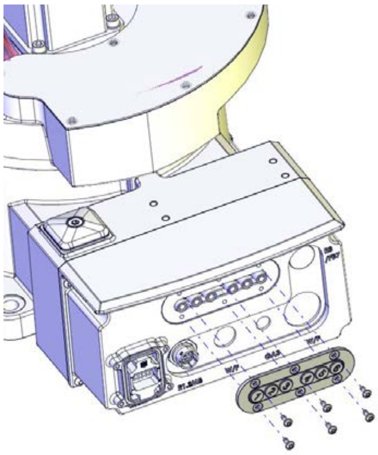
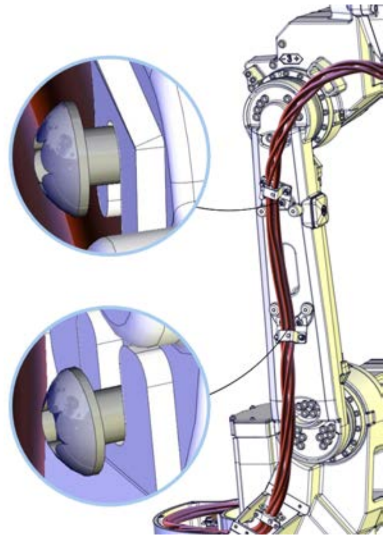
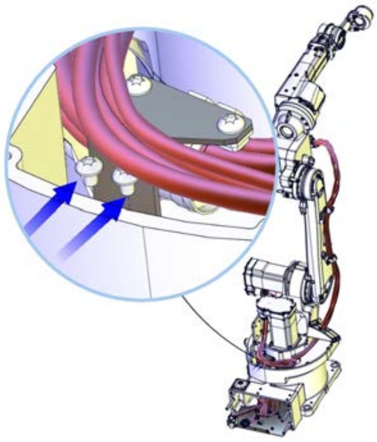
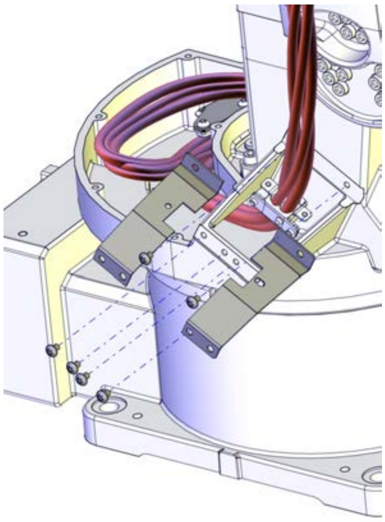
	Action	Note
9	Secure the plate for connector with its attachment screws (4 pcs).	 xx1100000329
10	Refit the base cover.	 xx1100000315

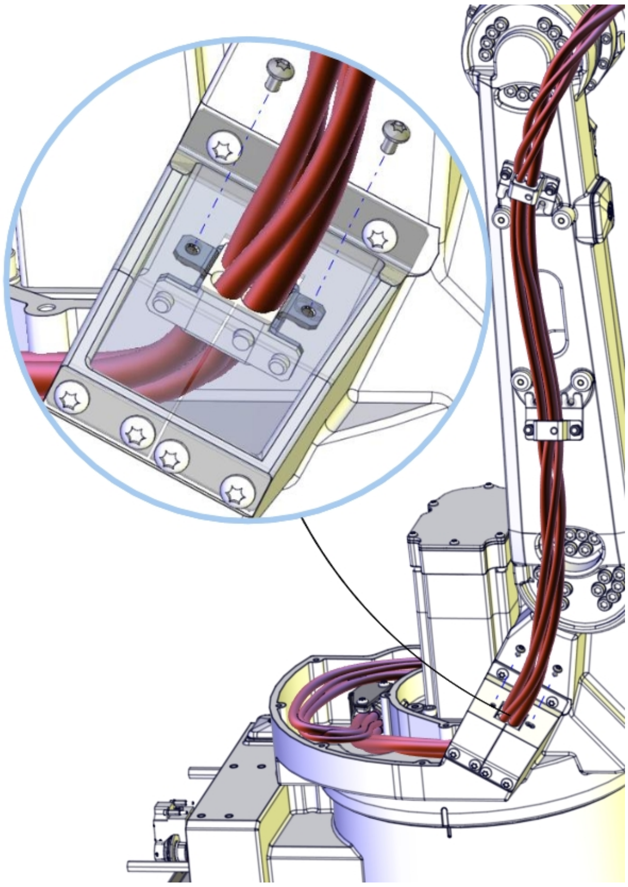
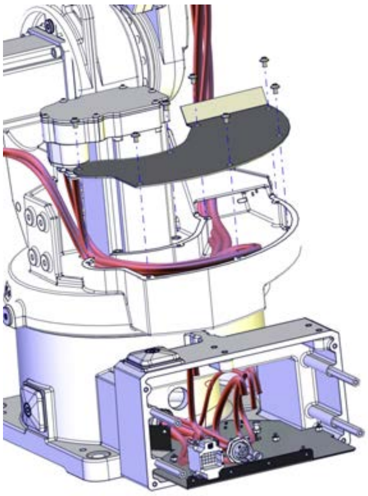
Continues on next page

	Action	Note
11	Refit the push button guard.	 xx1100000314
12	Place the brackets of the cable harness on the attachment screws (2 + 2 pcs) in the lower arm and secure the cable harness.	 xx1100000326

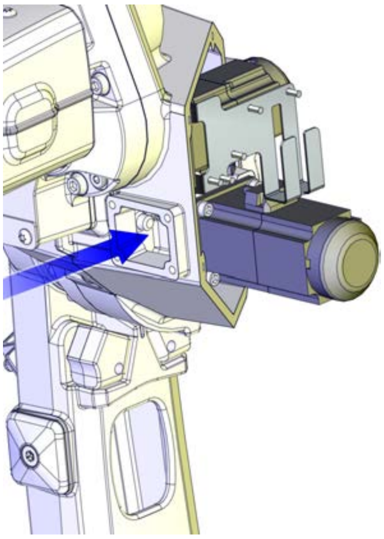
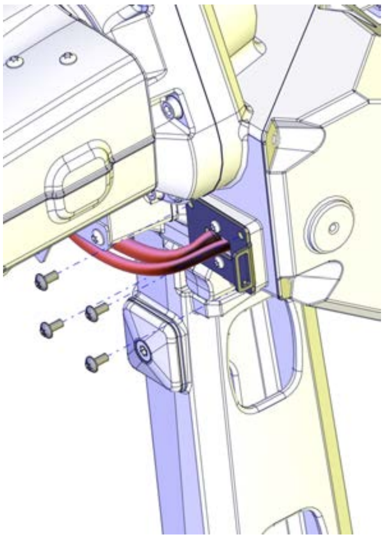
Continues on next page

	Action	Note
13	Secure the cable harness with the bracket inside the frame with its attachment screws (2 + 2 pcs).	 xx1100000323
14	Fit one of the two covers with its attachment screws.	 xx1100000325
15	Attach the bracket of the cable harness with one screw. Do not secure the screw at this point. It must be possible to match the hole for the other screw.	
16	Fit the other of the two covers with its attachment screws.	

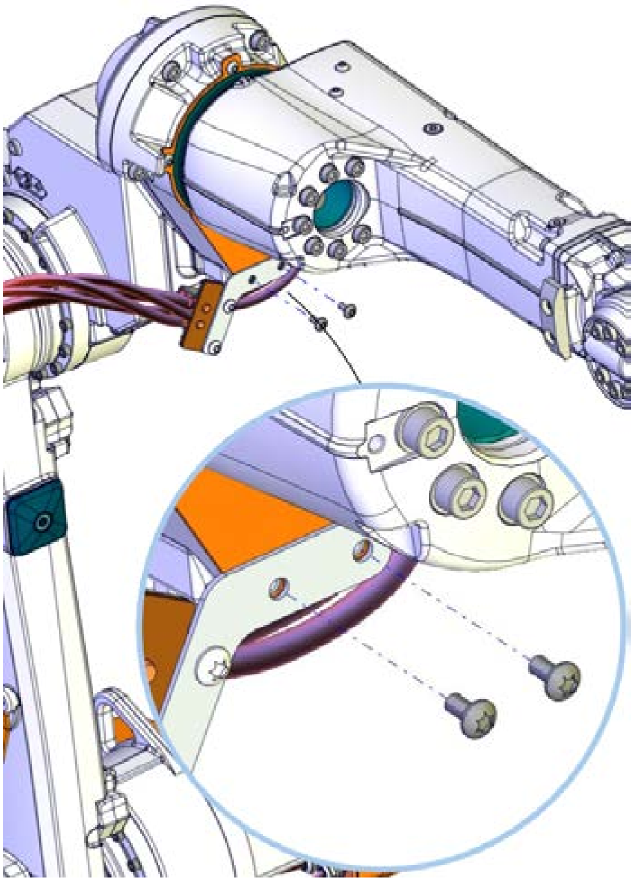
Continues on next page

	Action	Note
17	Secure the bracket of the cable harness to the two covers with its attachment screws.	 xx1100000324
18	Check that the cable harness is placed correctly in the base and frame.	See figure *Location of cable harness - lower end on page 145*.
19	Fit the cover on the frame.	 xx1100000322

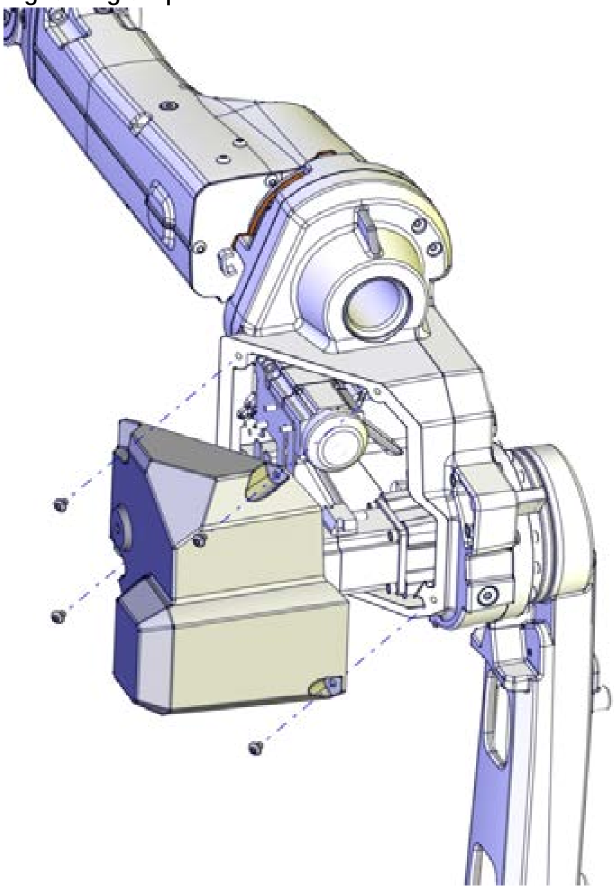
Continues on next page

	Action	Note
20	Insert the cable harness carefully through the hole in the armhouse.	 xx1100000330
21	Secure the cable harness to the armhouse by fitting the bracket with its attachment screws (4 pcs).	 xx1100000328

Continues on next page

	Action	Note
22	Secure the cable harness to the bracket in the upper arm with its attachment screws (2 pcs).	 xx1100000327
23	Reconnect the connectors to motors axes 3 and 4.	See *Replacing motors on axes 3 and 4 on page 242*.

Continues on next page

	Action	Note
24	Refit the armhouse cover.	Tightening torque: 4 Nm.  xx1100000349
25	Reconnect the connectors to the motors for axis 1 and 2.	See *Replacing motors on axis 1 and 2 on page 232*.
26	**WARNING** Before continuing any service work, please observe the safety information in section *The brake release buttons may be jammed after service work on page 144*!	
27	Recalibrate the robot.	Calibration is described in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.

Continues on next page

	Action	Note
28	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 75*.	

5.3.2 Replacing the cable harness - upper end

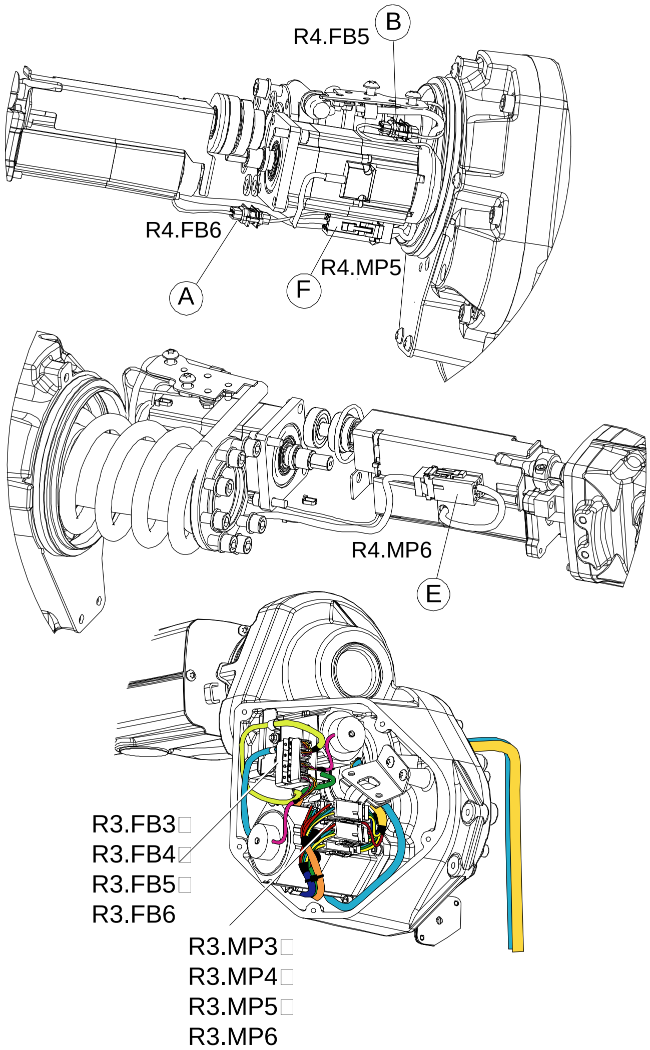
Introduction

How to remove the cable harness in the lower end see section *Replacing the cable harness - lower end on page 145*.

This section describes how to replace the upper end of the cable harness.

Location of cable harness - upper end

The upper end of the cable harness is located inside the armhouse and arm tube, as shown in the figure. The figure shows the IRB 1600ID but is also applicable to IRB 1510.



xx0700000038

Required equipment

Equipment	Art. no.	Note
Cable harness	See *Spare parts on page 307*.	

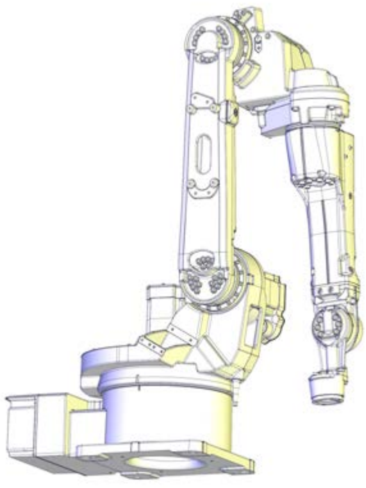
Continues on next page

Equipment	Art. no.	Note
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.
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.

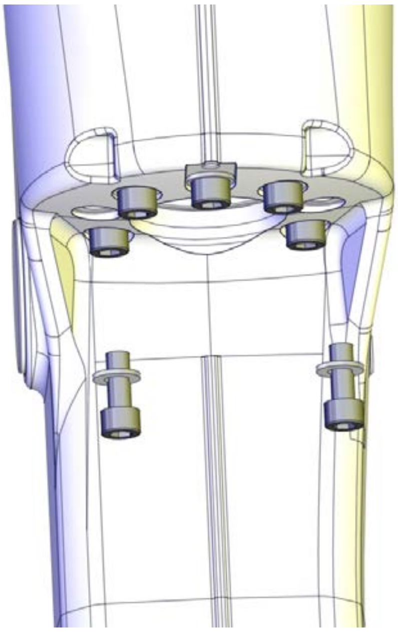
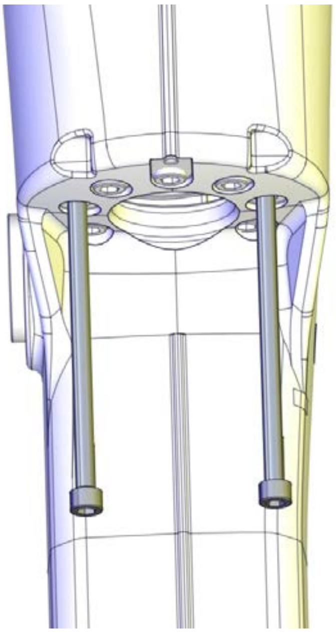
Removing the cable harness - upper end

Use these procedures to remove the upper end of the cable harness.

Preparations

	Action	Note
1	Jog the upper arm to a vertical position with the wrist pointing at the floor.	 xx1100000439
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Remove all extra equipment fitted on the upper arm and wrist.	

Continues on next page

	Action	Note
4	Unscrew two of the attachment screws holding the arm tube, diagonal to each other.	 xx1100000472
5	Fit two threaded bars (M8) with nuts fitted at the bottom end. Length: 120 mm	 xx1100000473

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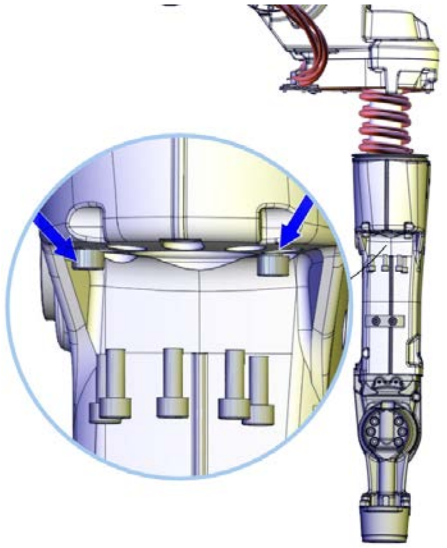
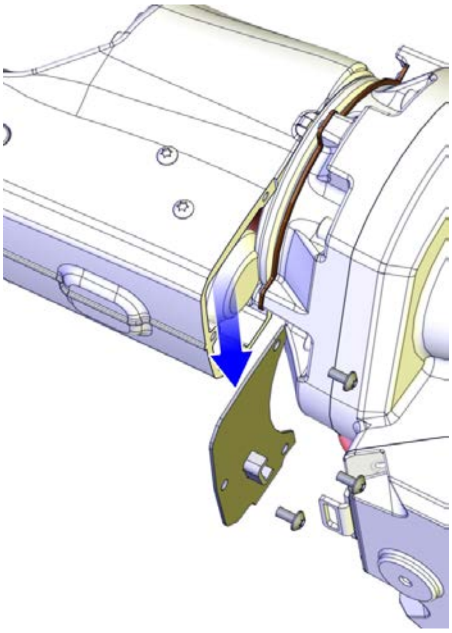
	Action	Note
6	Unscrew and remove the remaining attachment screws and let the arm tube carefully glide down on the threaded bars until it rests on the nuts.	 xx1100000474
7	Unscrew the attachment screws (3 pcs) holding the cover with mechanical stop and remove the cover.	 xx1100000411

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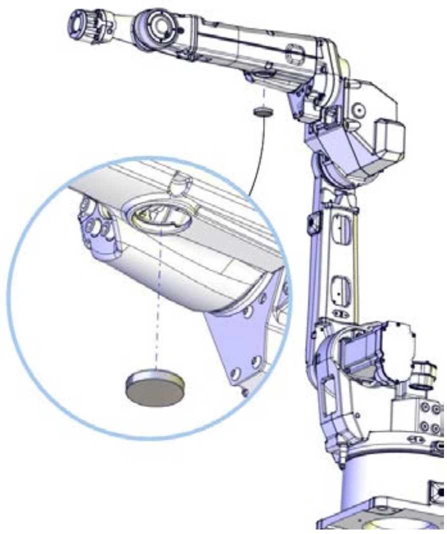
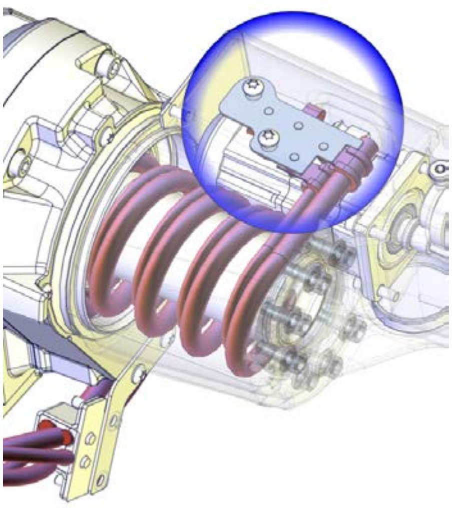
Removing motor cables and arm tube

	Action	Note
1	Remove the VK cover on the arm tube.	 xx1100000394
2	Disconnect the connectors of the axis 6 motor through the hole for the VK cover. **Note** It is *not* needed to remove the motor.	
3	Disconnect the connectors of the axis 5 motor. **Note** It is *not* needed to remove the motors.	
4	Carefully pull out the cables of the axes 5 and 6 motors from the arm tube.	
5	Remove the support ring and V-ring from the arm tube and place them temporarily on the cable harness spiral.	

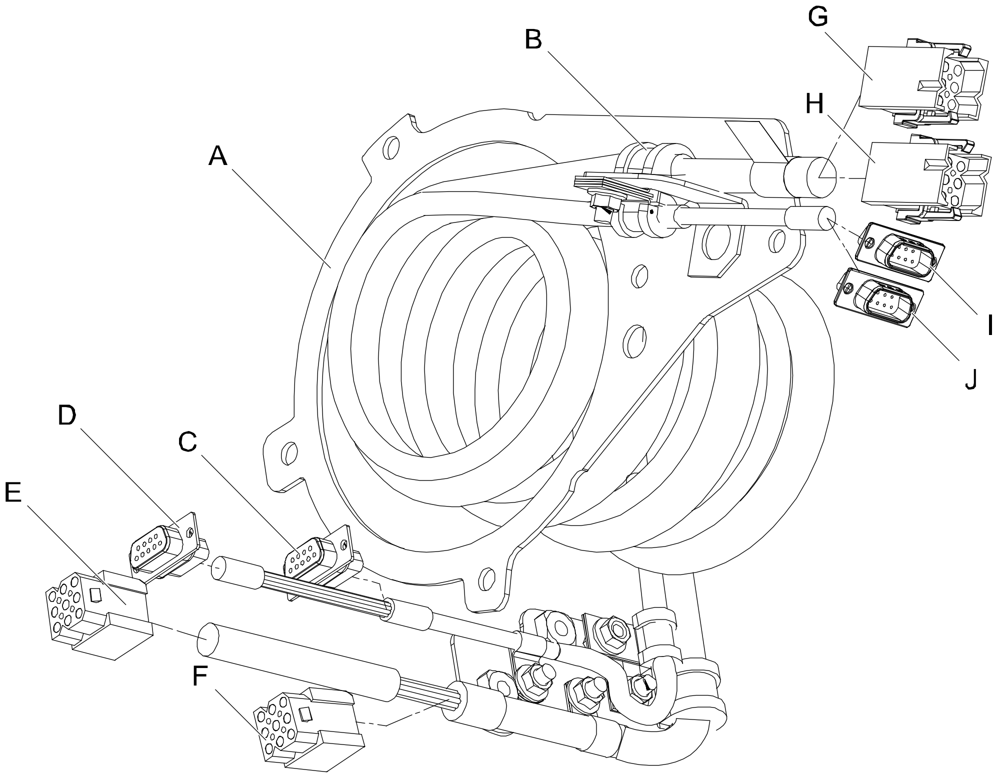
Continues on next page

	Action	Note
6	Unscrew the attachment screws (2 pcs) on top of the arm tube, that holds the bracket which secures the cable harness inside the arm tube.	 xx1100000410
7	Carefully lift the cable harness out off the arm tube.	
8	Hold the arm tube and unscrew the two threaded bars (M8).	
9	Carefully lower the arm tube without causing any damage to the cable harness and put it somewhere safe.	
10	Remove the support ring and V-ring.	

Continues on next page

Removing the cable harness spiral

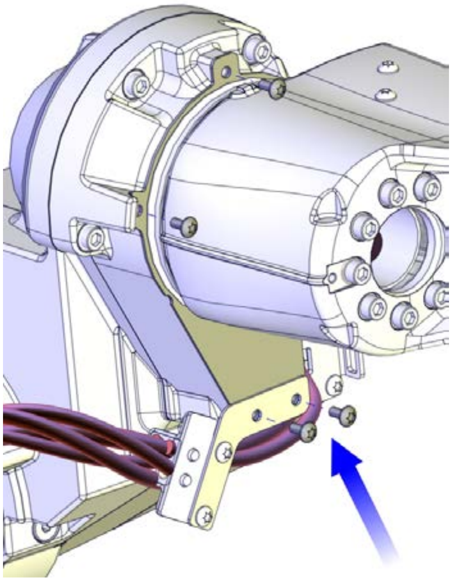
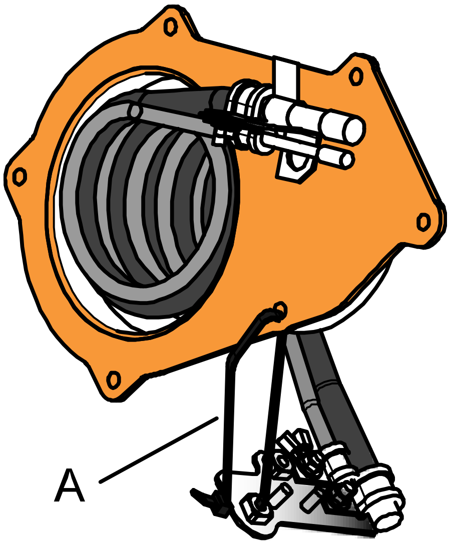
The cable harness spiral is shown in the figure:

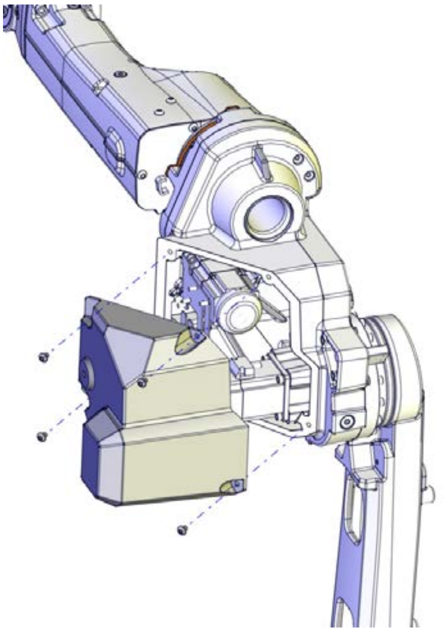
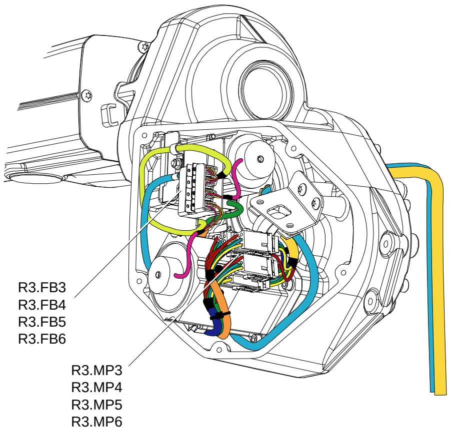
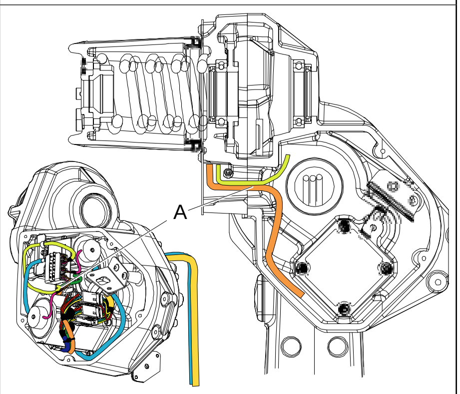


xx0700000099

A	Cover plate
B	Clamp
C	R4.FB5
D	R4.FB6
E	R4.MP6
F	R4.MP5
G	R3.MP5
H	R3.MP6
I	R3.FB5
J	R3.FB6

Continues on next page

	Action	Note
1	Remove the attachment screws (6 pcs) that holds the cover of the cable harness spiral on the armhouse. **Note** The lower attachment screws (2 pcs) also holds the bracket of the cable harness	 xx1100000420
2	Secure the spiral of the cable harness with a cable strap or similar as shown in the figure, in order to keep the spiral in position.	 xx1000001004 **A: Cable strap**

	Action	Note
3	Remove the cover on the armhouse.	 xx1100000349
4	Disconnect the connectors in the armhouse that need to be disconnected in order to remove the cable harness in the upper arm. **Note** Make a note of how the cables are run on the bracket.	 xx0700000105
5	Wrap the connectors with some plastic film and tape in order to protect them from contamination.	
6	Pull the cable harness carefully out off the armhouse.	 xx0700000114

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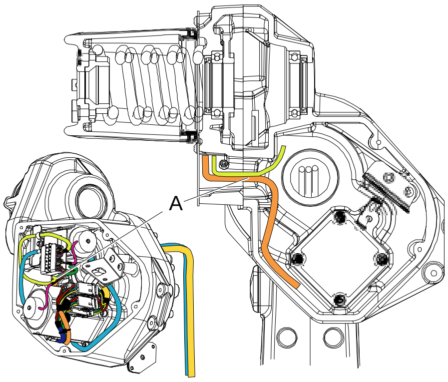
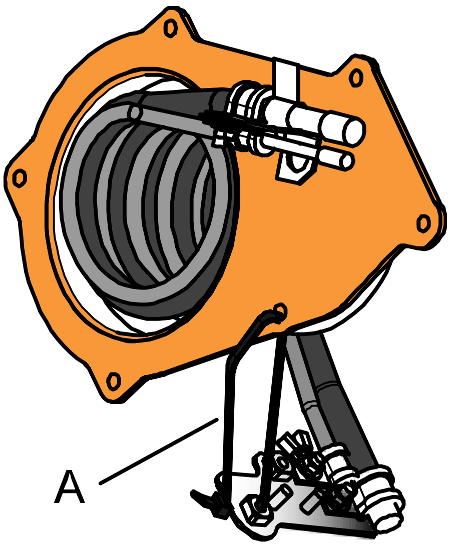
	Action	Note
7	Remove the cable harness carefully.	

Refitting the cable harness - upper end

Use these procedures to refit the upper end of the cable harness.

Preparations

	Action	Note
1	Wipe clean the area behind the cover inside the armhouse, from old residues of grease.	
2	Wrap the connectors with some plastic film and tape, in order to protect them from contamination.	
3	Run the cable harness into the armhouse through the passage (A).	 xx0700000114
4	Apply cable grease on the cables inside the armhouse.	
5	Place the cover and the cable harness spiral into its position. **Note** Do *not* remove the cable strap at this point!	 xx1000001004 **A: Cable strap**

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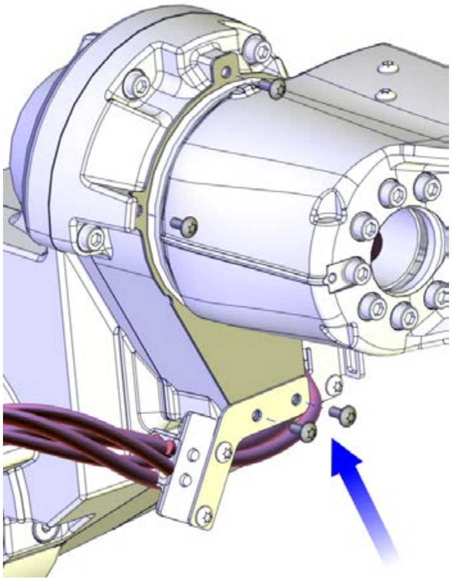
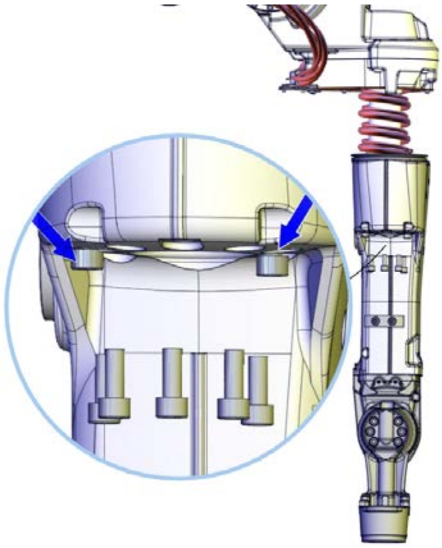
	Action	Note
6	Refit the cover with its attachment screws except the one where the cable strap is fitted. **Note** The two lower attachment screws also holds the bracket securing the cable harness to the armhouse. Refit the bracket at the same time.	 xx1100000420

Refitting the cable harness spiral - part 1

	Action	Note
1	Place the support ring and V-ring temporarily on the cable harness spiral.	
2	Fit two threaded bars (M8) in two of the attachment holes diagonal to each other.	
3	Lift the arm tube on to the threaded bars and fit the nuts at the end of the bars.	
4	Lower the arm tube carefully and let it rest on the nuts.	 xx1100000474

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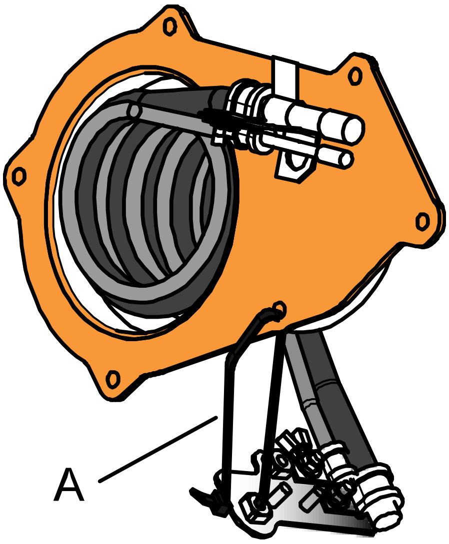
	Action	Note
5	**CAUTION** When the spiral of the cable harness is arranged check that: • none of the cables are twisted • the two cables running in the spiral runs parallel to each other all the way • the cables are not arranged too tight or too loose.	
6	Hold the cable harness spiral with one hand and cut the cable strap. **CAUTION** When the cable strap is cut, the spiral of the cable harness can unwind and the cables can start to cross each other.	 xx1000001004 • A: Cable strap
7	Wind the cable harness spiral carefully in a tight fitting and then release it 3/4 of a revolution. **Note** Check that the cable harness spiral is fitted correctly. The two cables must not cross each other!	

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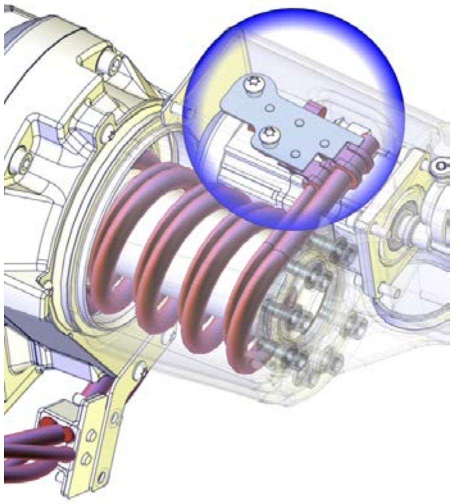
	Action	Note
8	Without causing the cable harness spiral to unwind, fit the bracket holding the cable harness to the arm tube.	 xx1100000410

Refitting the cable harness spiral - part 2

	Action	Note
1	Run the cable harness to the axes 5 and 6 motors down into the arm tube.	
2	Pull out the motor cables to the axis 6 motor through the hole for the VK-cover.	
3	Reconnect the connectors to the axis 5 motor.	
4	Reconnect the connectors to the axis 6 motor.	
5	Secure the FB connectors on the axes 5 and 6 motors with cable straps.	**Note** When reconnecting the connectors R4.FB6 and R4.MP6, make sure to push the connectors towards the wrist as far away from the axis 5-6 cable spiral as possible, to avoid grease to accumulate on the resolver connector.

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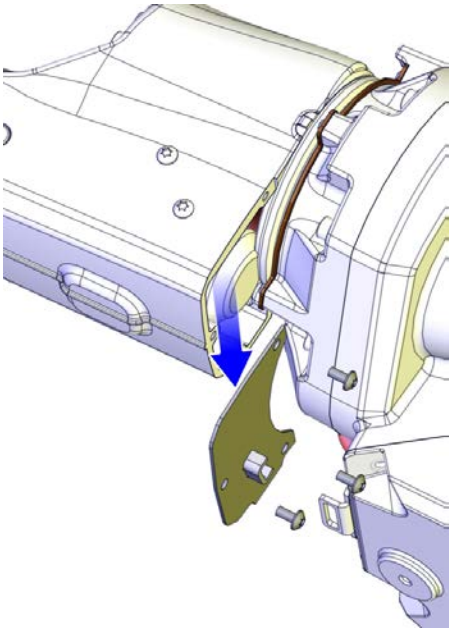
	Action	Note
6	Refit the cover with the mechanical stop.	 xx1100000411
7	Refit the support ring and V-ring in the arm tube.	
8	Check that the cable harness spiral still is correctly fitted. If not, refit the spiral.	
9	Apply cable grease on the cable harness spiral.	
10	Fit the remaining attachment screw where the cable strap earlier was fitted.	

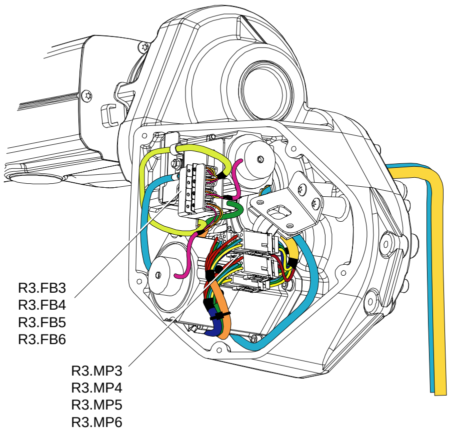
Refitting the arm tube

	Action	Note
1	Lift the arm tube carefully while at the same time check that the position of the cable harness is correct.	
2	Check that the sealing ring and V-ring are in the correct position in the arm tube.	
3	Secure the arm tube with the attachment screws possible to fit at this point.	Tightening torque: 24 Nm.
4	In order to release the brakes for axis 4 see *Manually releasing the brakes on page 54*.	

Continues on next page

	Action	Note
5	Move axis 4 manually very gently to each end position and check that the cable harness can move correctly without being stretched too much. **CAUTION** Too much force when turning axis 4 can result in damage to the cable harness! **Note** It is very important to check that the cable harness spiral is not stretched to much! If stretched too much there is a risk of damage to the cable harness!	
6	**Note** If axis 4 is not running correctly the spiral of the cable harness must be refitted!	

Concluding refitting

	Action	Note
1	Reconnect the connectors in the armhouse.	 xx0700000105

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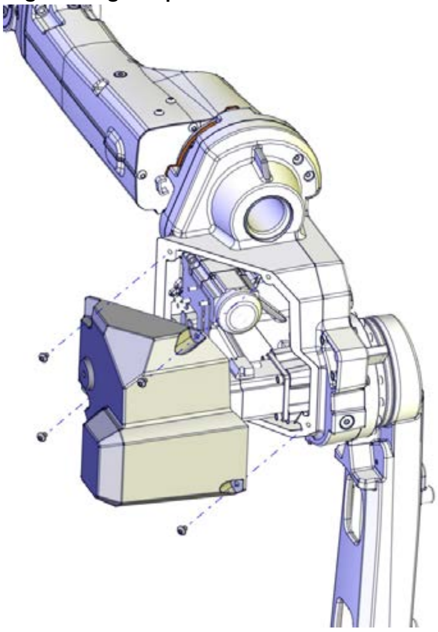
	Action	Note
2	Refit the armhouse cover.	Tightening torque: 4 Nm.  xx1100000349
3	Recalibrate the robot.	Calibration is described in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.
4	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 75*.	

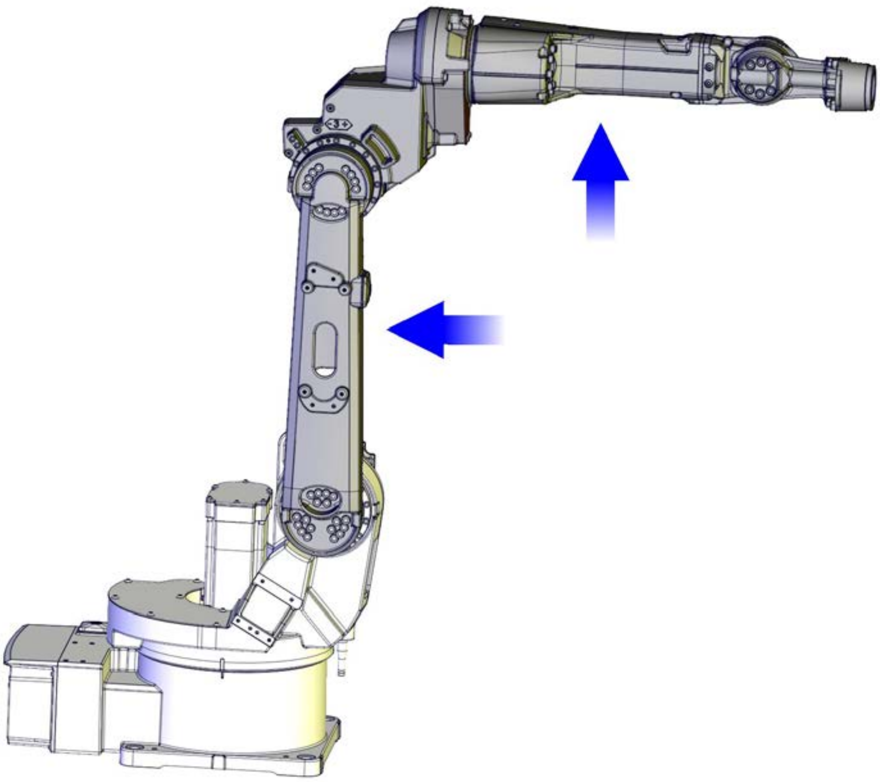
5.3.3 Replacing the complete arm system

Introduction

The complete arm system consists of the complete upper and lower arms.

Location of the complete arm system

The complete armsystem is located as shown in the figure.



xx1100000438

Required equipment

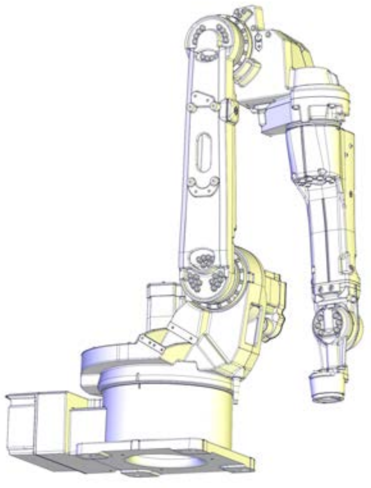
Equipment	Art. no.	Note
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.

Continues on next page

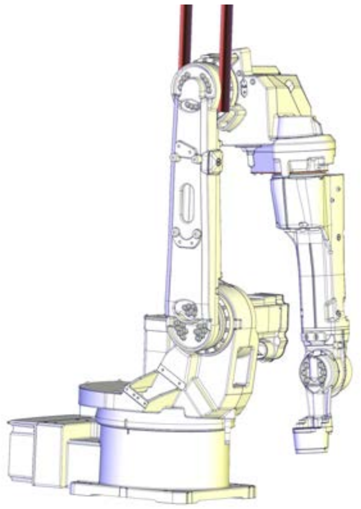
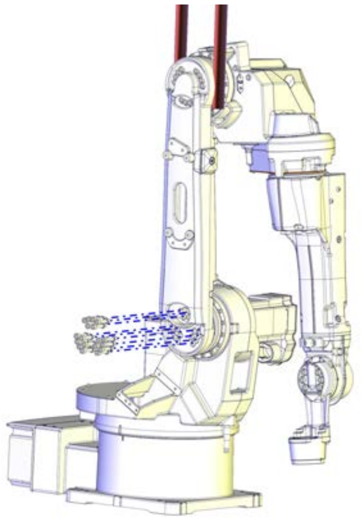
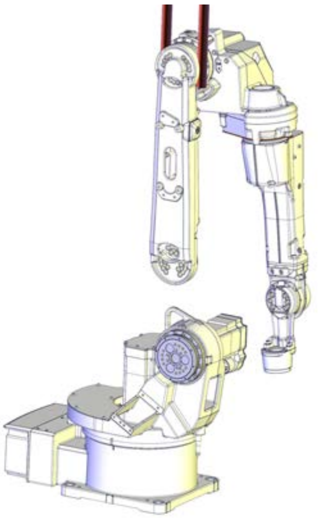
Equipment	Art. no.	Note
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	-	These procedures include references to the tools required.

Removing the complete arm system

Use this procedure to remove the complete arm system.

	Action	Note
1	Jog the robot to a vertical position as shown in the figure. The upper arm shall be placed with the wrist pointing at the floor.	 xx1100000439
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Remove the cable harness from armhouse and lower arm.	See *Replacing the cable harness - lower end on page 145*.
4	**CAUTION** The robot arm system weighs 55 kg. All lifting accessories used must be sized accordingly!	

Continues on next page

	Action	Note
5	Secure the weight of the complete arm system with a roundsling in an overhead crane or similar as shown in the figure.	 xx1100000442
6	Unscrew the attachment screws (18 pcs) and washers holding the lower arm to gearbox axis 2.	 xx1100000440
7	Carefully lift away the complete arm system and put it somewhere safe.	 xx1100000441

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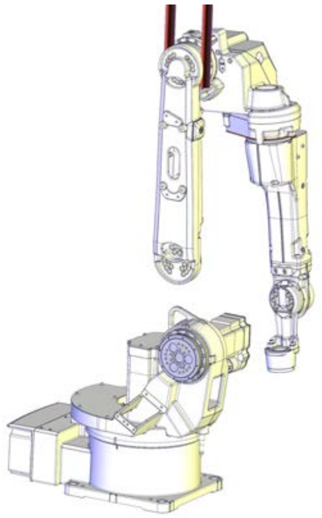
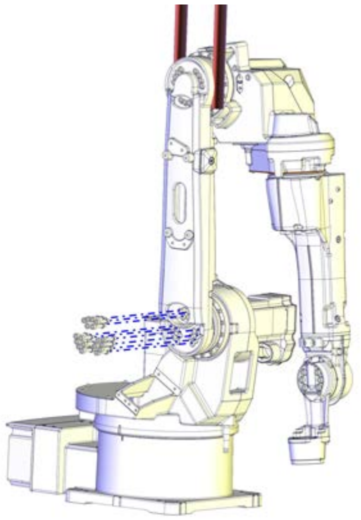
Refitting the complete arm system

Use this procedure to refit the complete arm system.

	Action	Note
1	Wipe clean all mating surfaces on lower arm and frame with isopropanol.	
2	**CAUTION** The robot arm system weighs 55 kg. All lifting accessories used must be sized accordingly!	
3	Secure the weight of the complete arm system with a roundsling in an overhead crane or similar as shown in the figure.	 xx1100000441
4	Secure the complete arm system to the gearbox axis 2 with its attachment screws and washers.	 xx1100000440 Tightening torque: 34 Nm. M8x40 (18 pcs)
5	Refit the cable harness in the lower arm and armhouse.	See *Replacing the cable harness - lower end on page 145*.

Continues on next page

	Action	Note
6	Recalibrate the robot.	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.
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 75*.	

5.4 Upper and lower arm

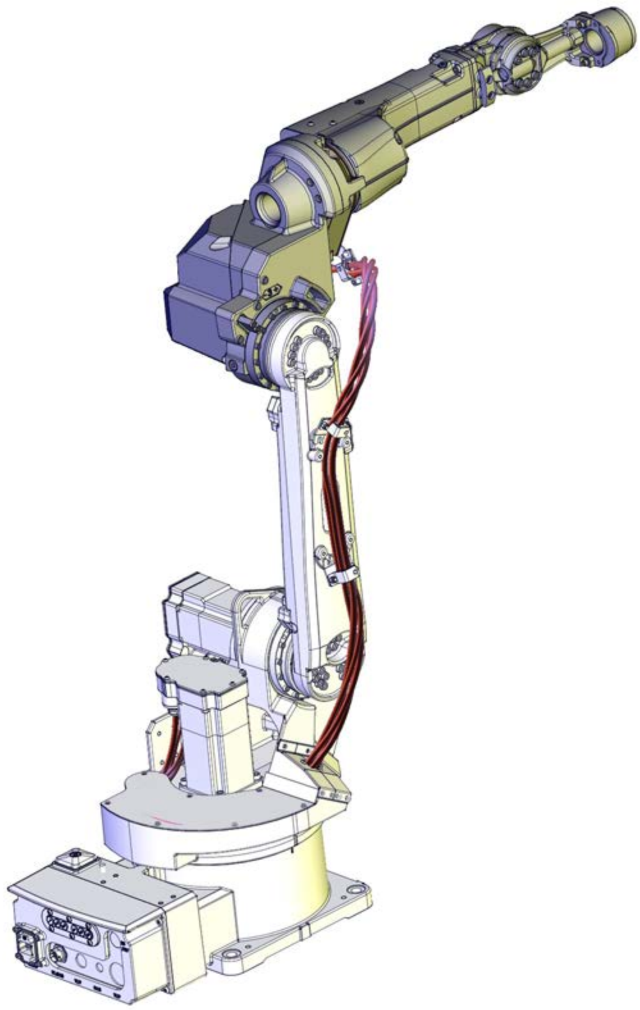
5.4.1 Replacing the complete upper arm, IRB 1510ID

Note

Recalibration of robot axis 3-6 is required after replacement of upper arm.

Location of the complete upper arm

The complete upper arm is located as shown in the figure.



xx1100000347

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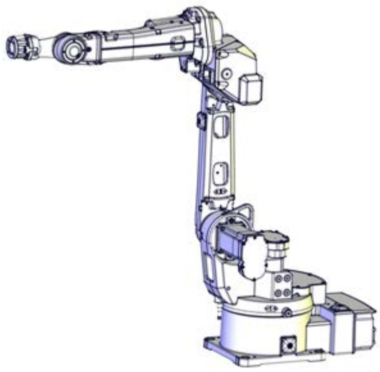
Required equipment

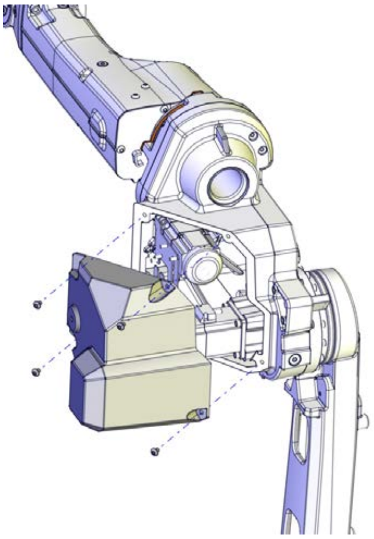
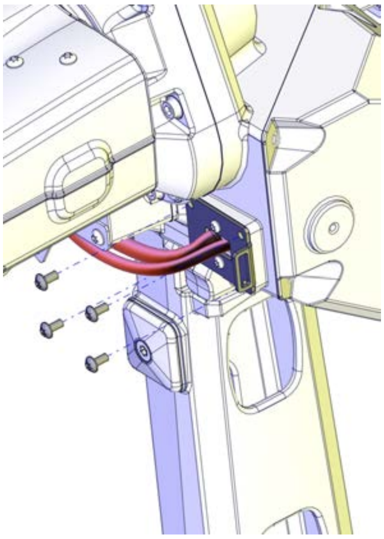
Equipment	Art. no.	Note
Upper arm, spare	For spare part number, see: • *Spare parts on page 307*.	Includes the wrist unit. All gearboxes are filled with oil at delivery.
Torx pan head screw	3HAC080811-001	M6 x 12 (glue)
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.

Removing the complete upper arm

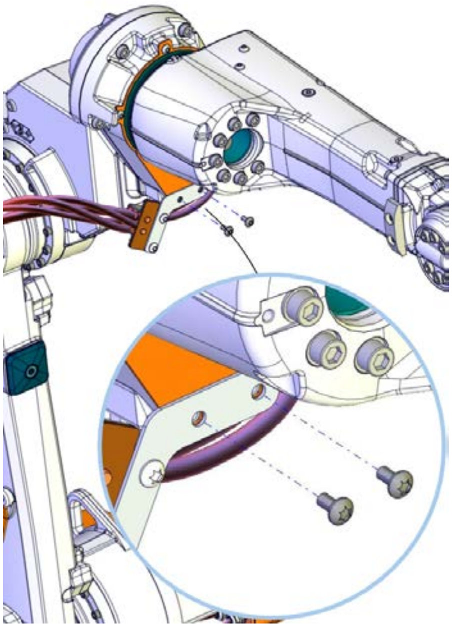
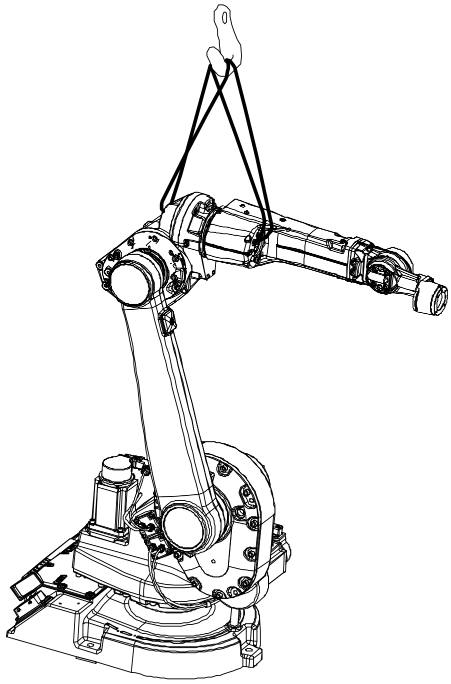
Use this procedure to remove the complete upper arm.

	Action	Note
1	Jog the axis 3 to -90°.	
2	Drain the axis 3 gearbox.	See *Changing the oil, axis-3 gearbox on page 120*.
3	Jog the robot to the synchronization position.	 xx1100000348
4	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	

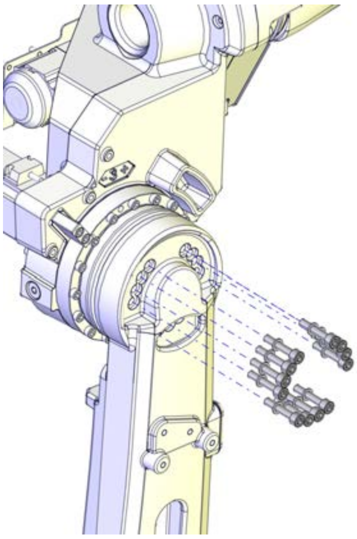
Continues on next page

	Action	Note
5	Remove the armhouse cover.	 xx1100000349
6	Disconnect all connectors inside the armhouse and loosen the cabling from straps and brackets.	See *Replacing the cable harness - upper end on page 165*.
7	Remove the bracket holding the cable harness to the armhouse and pull out the cable harness.	 xx1100000328

Continues on next page

	Action	Note
8	Unscrew the screws securing the cable harness to the bracket.	 xx1100000327
9	**CAUTION** The robot upper arm weighs 35 kg. All lifting accessories used must be sized accordingly!	
10	Secure the weight of the upper arm with a roundsling. Apply the roundsling through the hole in the upper arm. See figure!	 xx0700000060 The figure shows IRB 1600ID but the way to secure the upper arm with the roundsling is the same on IRB 1510.

Continues on next page

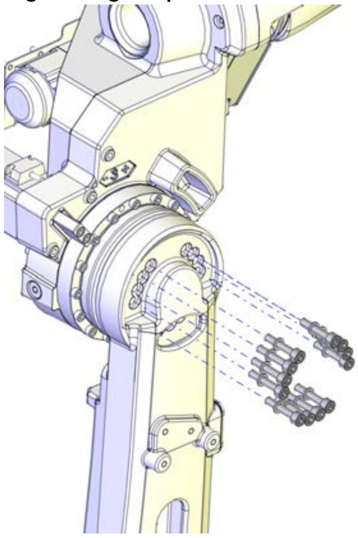
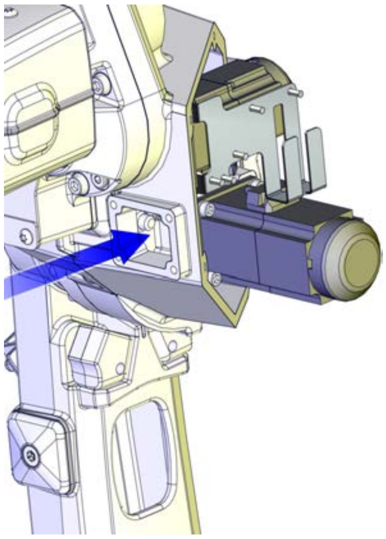
	Action	Note
11	Remove the axis 3 motor.	See *Replacing motors on axes 3 and 4 on page 242*.
12	Remove the attachment screws that secure the axis 3 gearbox to the lower arm.	 xx1100000350
13	Carefully lift away the upper arm and put it somewhere safe.	

Refitting the complete upper arm

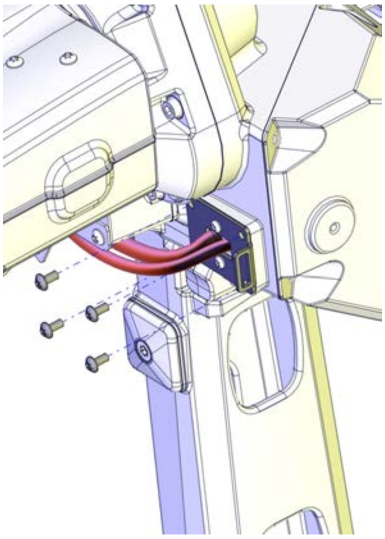
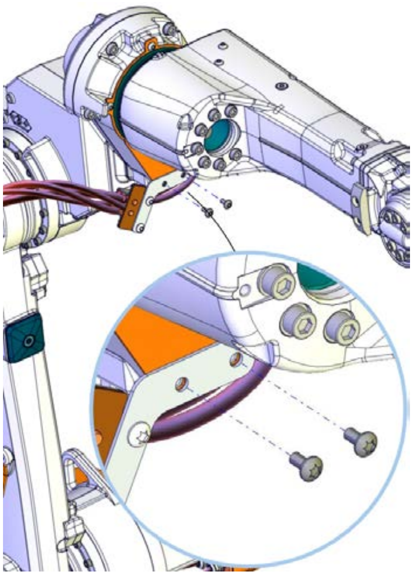
Use this procedure to refit the complete upper arm.

	Action	Note
1	Wipe the contact surfaces clean on both the upper and lower arm.	
2	**CAUTION** The robot upper arm weighs 35 kg. All lifting accessories used must be sized accordingly!	
3	Attach a roundsling to the upper arm and lift it.	
4	Move the upper arm to the mounting position.	

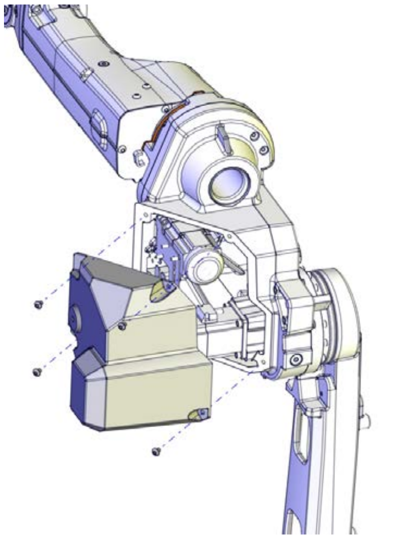
Continues on next page

	Action	Note
5	Secure the upper arm to the lower arm with its attachment screws and washers.	Tightening torque: 34 Nm.  xx1100000350 Hex socket head cap screw M8x40 quality 12.9 Gleitmo (12 pcs)
6	Refit the motor.	See *Replacing motors on axes 3 and 4 on page 242*.
7	Insert the cable harness through the hole and into the armhouse.	 xx1100000330

Continues on next page

	Action	Note
8	Secure the cable harness to the armhouse with the bracket.	 xx1100000328
9	Refit the cable harness to the bracket.	 xx1100000327
10	Connect all the connectors in the armhouse and secure the cabling with brackets and straps.	See *Replacing motors on axes 3 and 4 on page 242*, *Replacing motor on axis 5 on page 249* and *Replacing the axis 6 motor on page 253*.
11	Check the gaskets in the armhouse cover. Replace if damaged!	

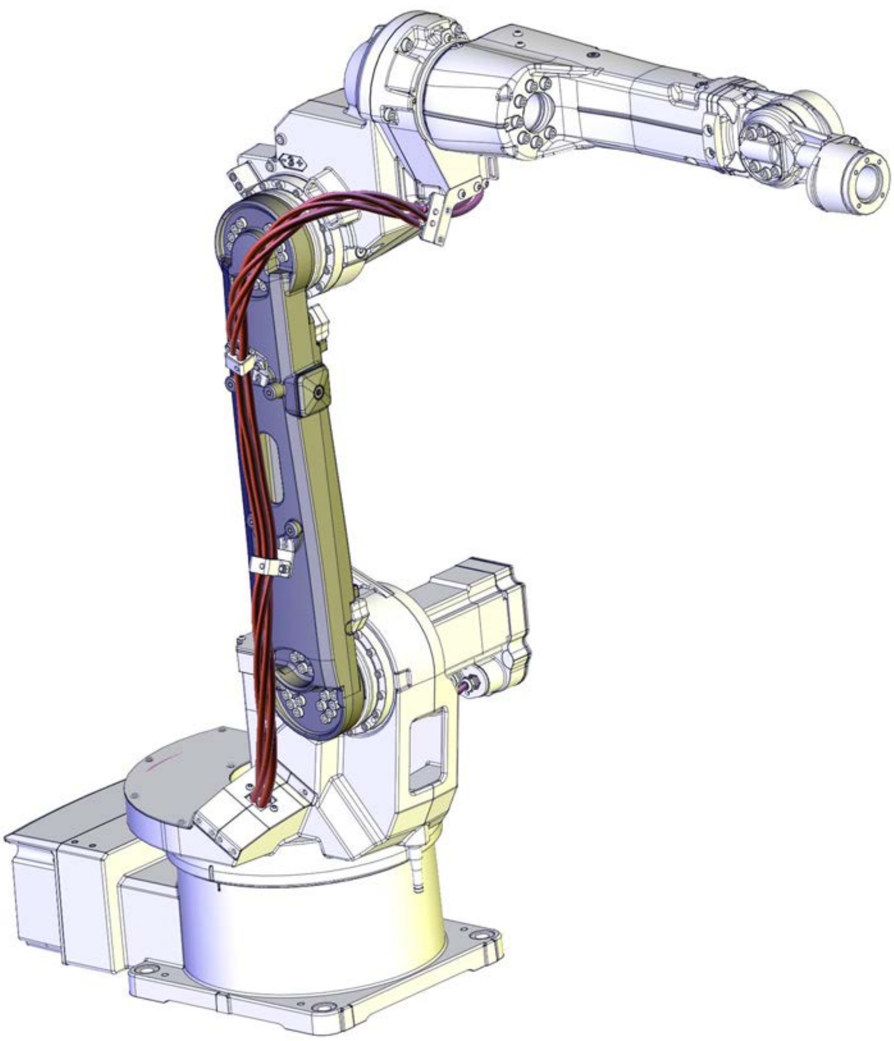
Continues on next page

	Action	Note
12	Refit the armhouse cover. Tightening torque: 1 Nm.	 xx1100000349
13	Refill the axis 3 gearbox with oil.	See *Changing the oil, axis-3 gearbox on page 120*.
14	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.
15	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 75*.	

5.4.2 Replacing the complete lower arm

Location of lower arm

The lower arm is located on the robot as shown in the figure.



xx1100000352

Required equipment

Equipment	Art. no.	Note
Lower arm	See *Spare parts on page 307*.	
Isopropanol	-	Used to clean the mating surfaces.
Locking liquid	-	Loctite 574
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.

Continues on next page

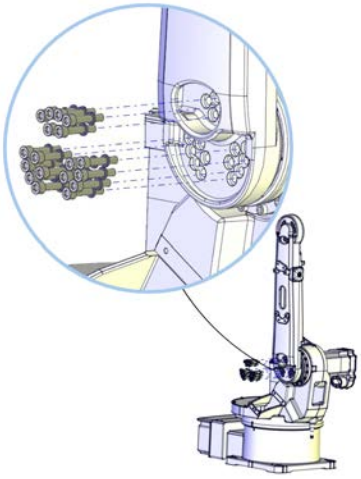
Equipment	Art. no.	Note
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Removing the lower arm

Use this procedure to remove the lower arm.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Disconnect the connectors of the cable harness to the lower end in the armhouse.	See *Replacing the cable harness - lower end on page 145*.
3	Pull out the cable harness from the armhouse.	
4	Remove the cable harness from the lower arm.	See *Replacing the cable harness - lower end on page 145*.
5	Remove the complete upper arm.	See section *Replacing the complete upper arm, IRB 1510ID on page 186*.
6	**CAUTION** The robot lower arm weighs 20 kg. All lifting accessories used must be sized accordingly!	
7	Secure the weight of the lower arm with a roundsling in an overhead crane or similar.	

Continues on next page

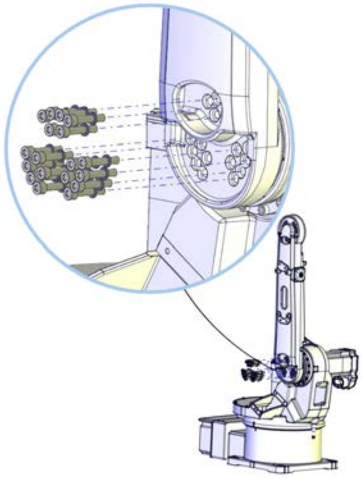
	Action	Note
8	Unscrew the attachment screws and washers securing the lower arm to gearbox axis 2.	 xx1100000353
9	Lift away the lower arm in a way that the cable harness is not damaged and put it somewhere safe.	

Refitting the lower arm

Use this procedure to refit the complete lower arm.

	Action	Note
1	Wipe the contact surfaces clean on both the lower arm and gearboxes on axes 2 and 3 with isopropanol.	
2	**CAUTION** The robot lower arm weighs 20 kg. All lifting accessories used must be sized accordingly!	
3	Secure the weight of the lower arm with a roundsling in an overhead crane or similar and lift it in position.	

Continues on next page

	Action	Note
4	Secure the lower arm to gearbox axis 2 with its attachment screws and washers.	 xx1100000353 Hex socket head cap screw M8x40 quality 12.9 Gleitmo (18 pcs) Tightening torque: 34 Nm.
5	Refit the cable harness on the lower arm.	See *Replacing the cable harness - lower end on page 145*.
6	Refit the upper arm.	See section *Replacing the complete upper arm, IRB 1510ID on page 186*.
7	Refit the lower end of the cable harness in the armhouse and reconnect the connectors.	See *Replacing the cable harness - lower end on page 145*.
8	Recalibrate the robot!	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.
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 75*.	

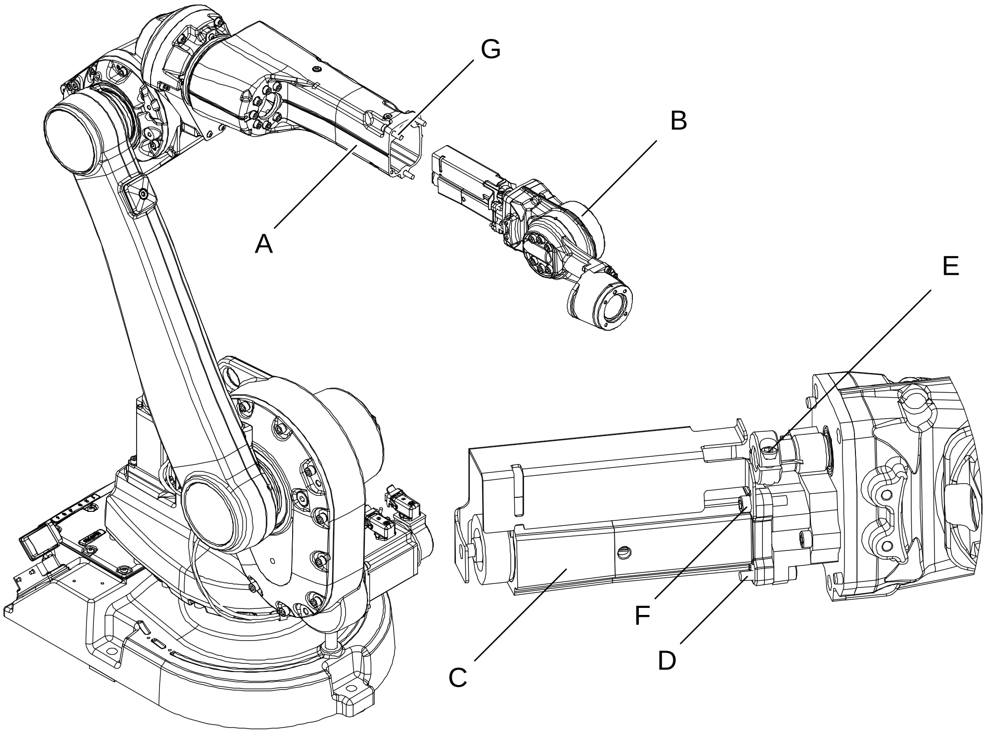
5.4.3 Replacing the wrist unit, IRB 1600ID

Note

After replacement of motors/motor or gearbox in a manipulator, recalibration is required.

Location of wrist unit

The wrist unit is located in the frontmost part of the upper arm.



xx0700000025

The figure shows the IRB 1600ID but the wrist unit, as shown, is also valid for IRB 1510.

A	Upper arm
B	Wrist
C	Motor axis 6
D	Hexagon socket head screw M5x25
E	Hexagon socket head screw M5X16 (10.9) (Short head)
F	Hexagon socket head screw M5x25
G	Hexagon socket head screw M8x35

Required equipment

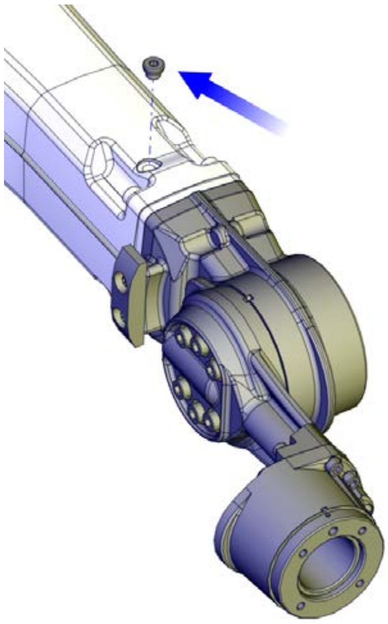
Equipment	Art. No.	Note
Wrist, ID	See *Spare parts on page 307*.	

Continues on next page

Equipment	Art. No.	Note
O-ring		
Grease	3HAC3537-1	For lubricating the o-ring sealing plate.
Standard toolkit		Content is defined in section *Standard tools on page 303*.
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.

Removing the wrist unit

Use this procedure to remove the complete wrist unit.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Remove all extra equipment fitted on upper arm and wrist.	
3	Remove the plug covering the attachment screw below.	 xx1100000354

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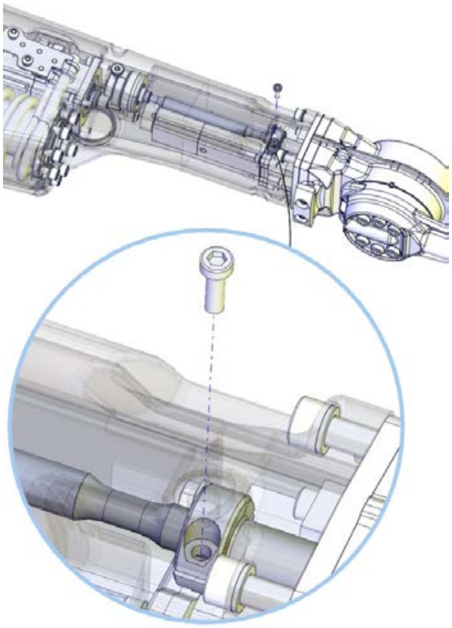
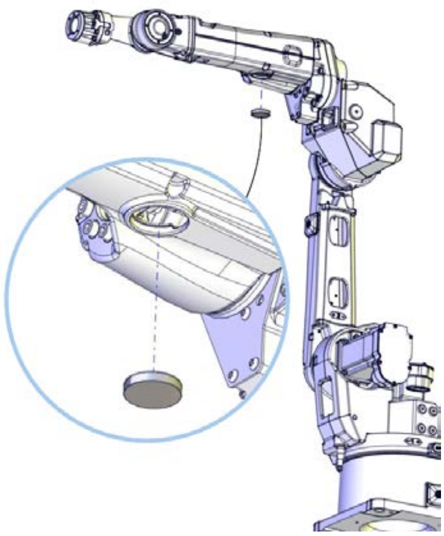
	Action	Note
4	Open the flexible coupling securing the wrist to the driving shaft for motor axis 5, by unscrewing the attachment screw.	 xx1100000355
5	Remove the VK-Cover.	 xx1100000394
6	Gently pull the cables out through the hole for the VK- cover in the armtube.	

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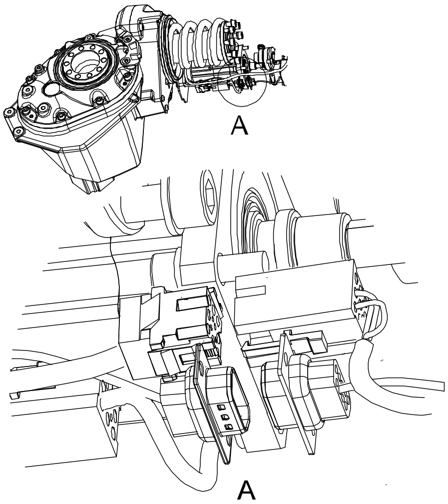
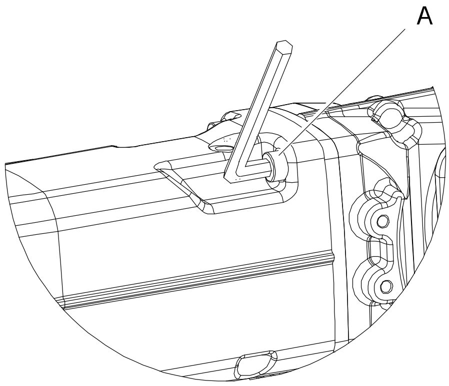
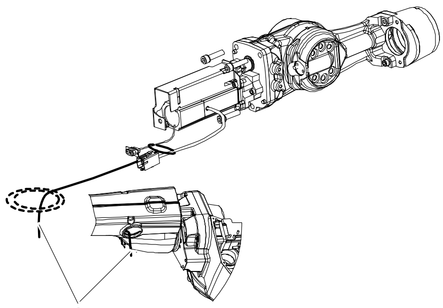
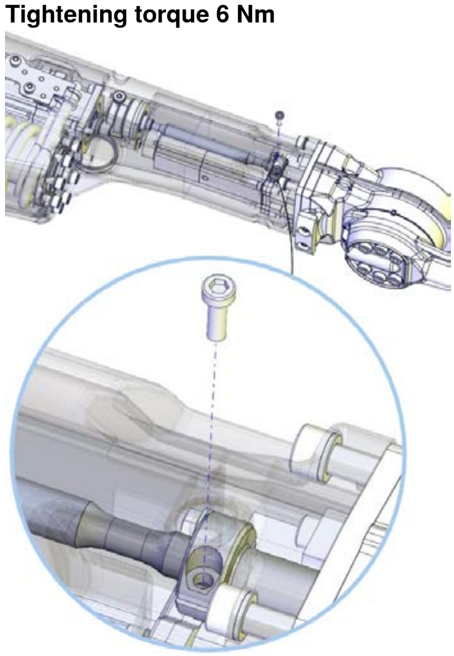
	Action	Note
7	Disconnect the connectors R4.FB6 and R4.MP6 to motor axis 6, through the hole for the VK cover.	 xx0700000053 • A: Connectors R4.FB6 & R4.MP6
8	Remove the attachment screws securing the wrist.	 xx0700000052 • A: Hex socket head cap screw M8x35 quality 8.8-A2F (3 pcs)
9	Remove the wrist with motor 6 from the upper arm tube and put it on a work bench or similar.  **CAUTION** Be careful when handling the wrist. Always hold on the casting, do not hold on the wrist cover. This can damage the sealing which will cause oil leakage.	

Refitting the wrist unit

Use this procedure to refit the complete wrist unit.

	Action	Note
1	Move the wrist (with the axis 6 motor fitted) to the mounting site.	
2	Apply a string or similar to the cable harness and run it out through the hole for the VK cover.	

Continues on next page

	Action	Note
3	Carefully fit the wrist (with motor axis 6 fitted) to the upper arm tube, using the string to pull the cable harness back through the hole for the VK cover.	 xx0700000093 A: String
4	Secure the wrist with its attachment screws and washers.	M8x35 8.8-A2F (3 pcs) **Tightening torque 24 Nm**
5	Reconnect connectors R4.FB6 and R4.MP6, through the hole for the VK cover.	**Note** When reconnecting the connectors R4.FB6 and R4.MP6, make sure to push the connectors towards the wrist as far away from the axis 5-6 cable spiral as possible, to avoid grease to accumulate on the resolver connector.
6	Secure the flexible coupling with the M5x16 screw.	**Tightening torque 6 Nm**  xx1100000355

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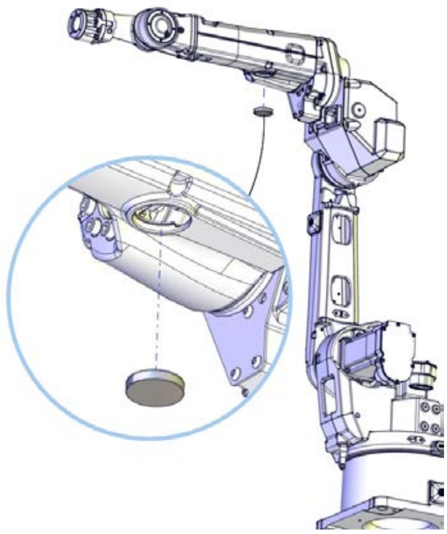
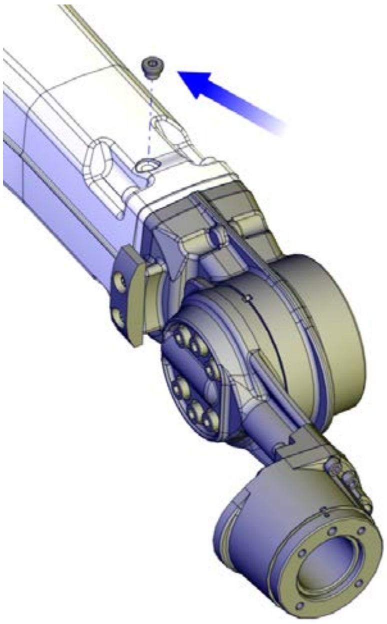
	Action	Note
7	Refit the VK cover.	 xx1100000394
8	Refit the plug. **Tightening torque 6 Nm**	 xx1100000354
9	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.

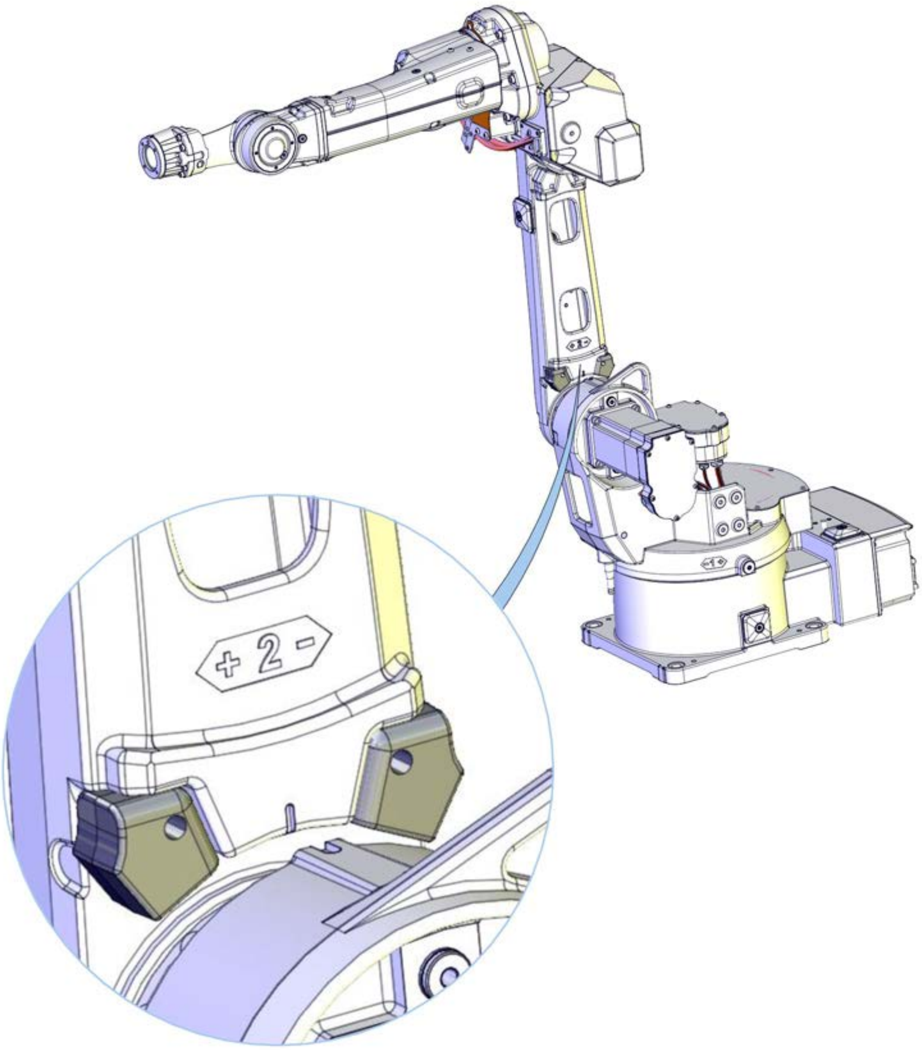
Continues on next page

	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 75*.	

5.4.4 Replacing the damper, axis 2

Location of damper, axis 2

The dampers are located as shown in the figure.



xx1100000356

Required equipment

Equipment, etc.	Art. no.	Note
Damper, axis 2	See *Spare parts on page 307*.	
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.
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.

Continues on next page

Removing the damper

Use this procedure to remove the damper.

	Action	Note
1	Run the robot to a position where it is best to enable access to the attachment screw of the damper.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Remove the damper by unscrewing the attachment screw and washer.	

Refitting the damper

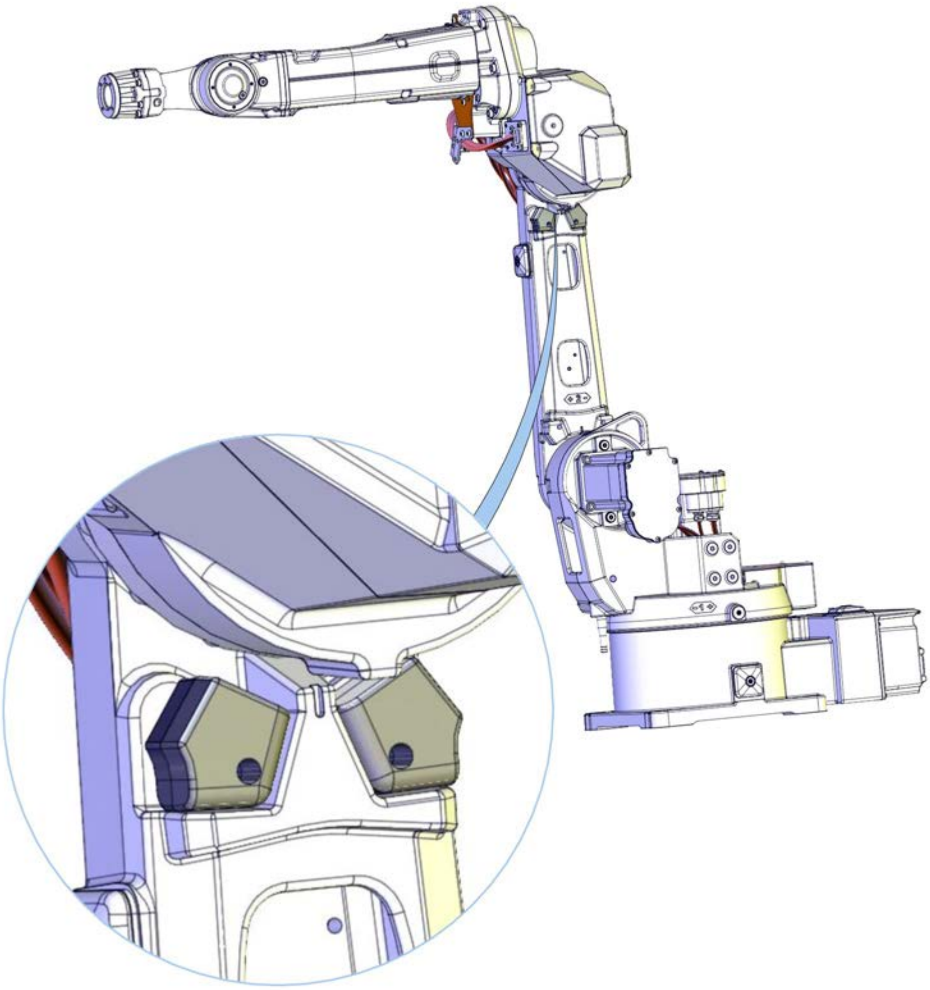
Use this procedure to refit the damper.

	Action	Note
1	Run the robot to a position where it is best to enable access to the attachment screw of the damper.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Secure the damper with the attachment screw and washer.	M6x60 quality 8.8-A2F
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 75*.	

5.4.5 Replacing the damper, axis 3

Location of damper, axis 3

The dampers are located as shown in the figure.



xx1100000357

Required equipment

Equipment, etc.	Art. no.	Note
Damper, axis 3	See *Spare parts on page 307*.	
Standard toolkit		Content is defined in section *Standard tools on page 303*.

Continues on next page

Removing the damper axis 3

Use this procedure to remove the damper.

	Action	Note
1	Run the robot to a position where it is best to enable access to the attachment screw of the damper.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Remove the damper by unscrewing the attachment screw and washer.	

Refitting the damper axis 3

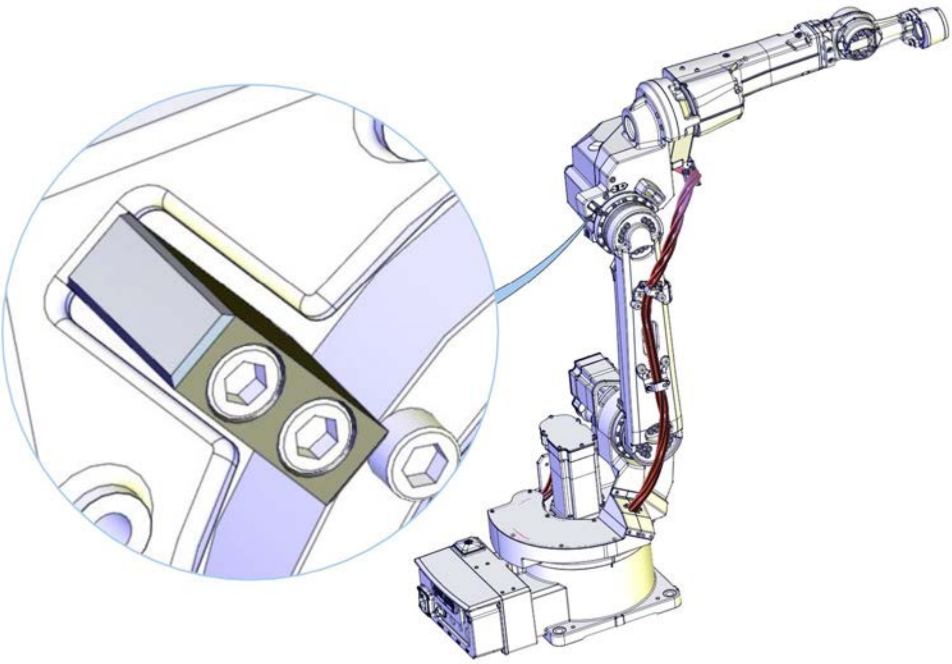
Use this procedure to refit the damper.

	Action	Note
1	Run the robot to a position where it is best to enable access to the attachment screw of the damper.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Secure the damper with the attachment screw and washer.	M6x60 quality 8.8-A2F
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 75*.	

5.4.6 Replacing the mechanical stop axis 3, IRB 1510ID

Location of the mechanical stop axis 3

The mechanical stop axis 3 is located as shown in the figure.



xx1100000358

Required equipment

Equipment	Art. no.	Note
Mechanical stop	See *Spare parts on page 307*.	
Standard tools		Content is defined in section *Standard tools on page 303*.

Continues on next page

Removing the mechanical stop axis 3

Use this procedure to remove the mechanical stop.

	Action	Note
1	Run the robot to a position that enables access to the mechanical stop.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Remove the mechanical stop.	

Refitting the mechanical stop axis 3

Use this procedure to refit the mechanical stop.

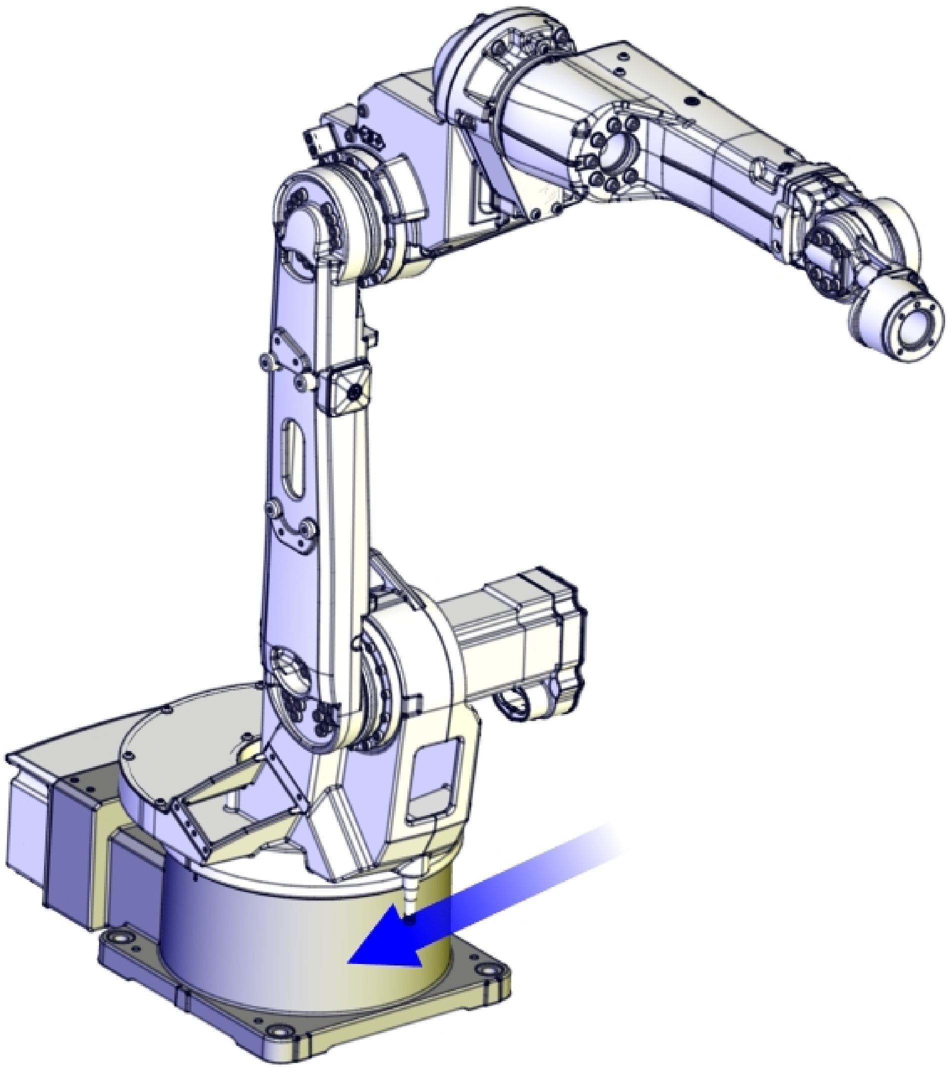
	Action	Note
1	Refit the mechanical stop with its attachment screws.	Attachment screws: M6x35 quality 8.8-A2F (2 pcs)
2	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 75*.	

5.5 Frame and base

5.5.1 Replacing the base

Location of the base

The location of the base is shown in the figure.



xx1100000437

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Required equipment

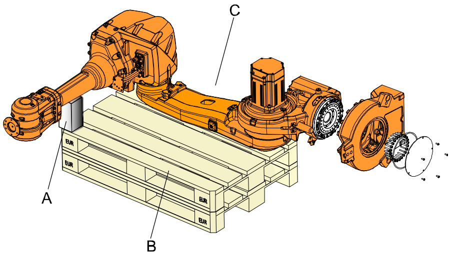
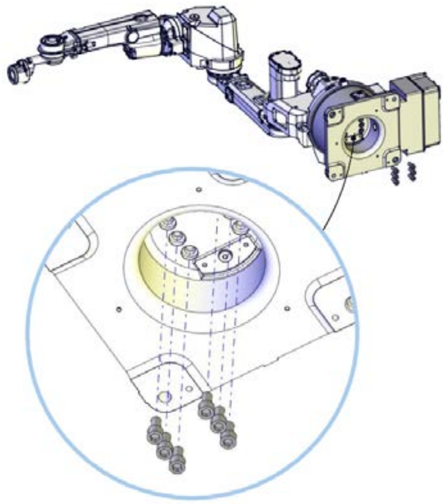
Equipment	Art. No.	Note
Base	See *Spare parts on page 307*.	
O-rings	See *Spare parts on page 307*.	
Guide pins	3HAC039940-001	Always use the guide pins in pairs.
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	-	These procedures include references to the tools required.

Removing the base

Use this procedure to remove the base.

	Action	Note
1	Jog the robot to the calibration position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Drain the axis 1 gearbox.	See *Draining, axis 1 gearbox on page 113*.
4	Remove the cable harness in base and frame.	See *Replacing the cable harness - lower end on page 145*
5	Pull out the cable harness from the base and frame and place it in a way that it will not be damaged in the continued procedure.	
6	**CAUTION** The IRB 1510 robot weighs 170 kg. All lifting accessories used must be sized accordingly!	See *Lifting robot with roundslings on page 51*.
7	Secure the weight of the robot with a roundsling in an overhead crane or similar.	
8	Unscrew the bolts securing the robot to the foundation.	

Continues on next page

	Action	Note
9	Lift the robot and put it safely on its side on some pallets or similar. Let it rest on the lower arm. See figure!	The figure shows IRB 4600 but the principle is the same for IRB 1510.  xx0800000352 • A: Support for upper arm • B: Loading pallets • C: Robot
10	**CAUTION** The robot base weighs 42 kg. All lifting accessories used must be sized accordingly!	
11	Secure the weight of the base in a roundsling in an overhead crane or similar.	
12	Unscrew the oil drain hose from the base.	
13	Unscrew the attachment screws (6 pcs) securing the base to the axis 1 gearbox.	 xx1100000389

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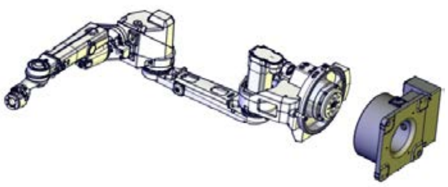
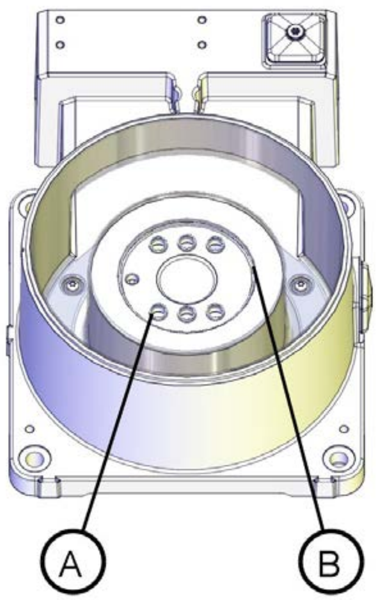
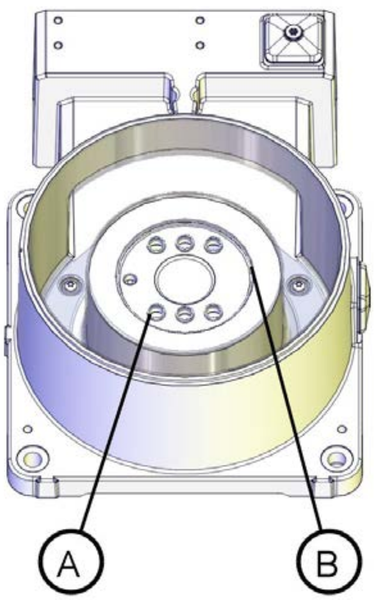
	Action	Note
14	Remove the base.	 xx1100000388
15	Check the o-rings! Replace if damaged.	 xx1100000536 • A: O-rings, 6 pcs (15.5x1.5) • B: O-ring, 1 pc (131x2)
16	Unscrew the attachment screws holding the base cable protection and remove it.	Keep it in a clean place. It will be refitted on the new base.

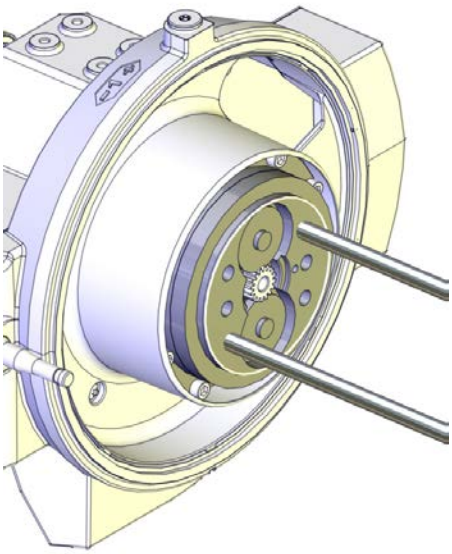
Continues on next page

Refitting the base

Use this procedure to refit the base.

	Action	Note
1	Wipe clean the mating surfaces on the base and gearbox with isopropanol.	
2	Fit the base cable protection in the base with its attachment screws.	Tightening torque: 4 Nm. M6x8 (3 pcs)
3	 **CAUTION** The robot base weighs 42 kg. All lifting accessories used must be sized accordingly!	
4	Secure the weight of the base with round-slings and lift it to the mounting site.	
5	Lift up the base into a vertical position.	
6	Apply grease on the big o-ring (131x2) and fit it in position to its groove in the base. Replace if damaged!	 xx1100000536 • A: O-ring, 6 pcs (15.5x1.5) • B: O-ring, 1 pc (131x2)

Continues on next page

	Action	Note
7	Fit two guide pins in opposite holes, diagonal to each other.	Guide pins are specified in *Required equipment on page 212*.  xx1100000535
8	Apply grease and fit the six o-rings into the grooves at the screw holes in the base. Replace o-rings if damaged!	
9	Put four attachment screws into the holes of the base. Do not put screws in the holes where the guide pins are fitted in the frame.	
10	Place the base very carefully on the guide pins, in order to keep screws and o-rings in position.	
11	Fasten the four attachment screws carefully but do not tighten them yet. It must still be possible to remove the guide pins and replace them with the remaining attachment screws.	Replace the o-rings if needed!
12	Remove the guide pins and replace them with the remaining attachment screws.	
13	Secure the base to gearbox axis 1 with its attachment screws.	Tightening torque: 150 Nm M14x25 (6 pcs)
14	Refit the oil drain hose to the base.	
15	Secure the oil tube with cable straps inside the base.	
16	**CAUTION** The IRB 1510 robot weighs 170 kg. All lifting accessories used must be sized accordingly!	

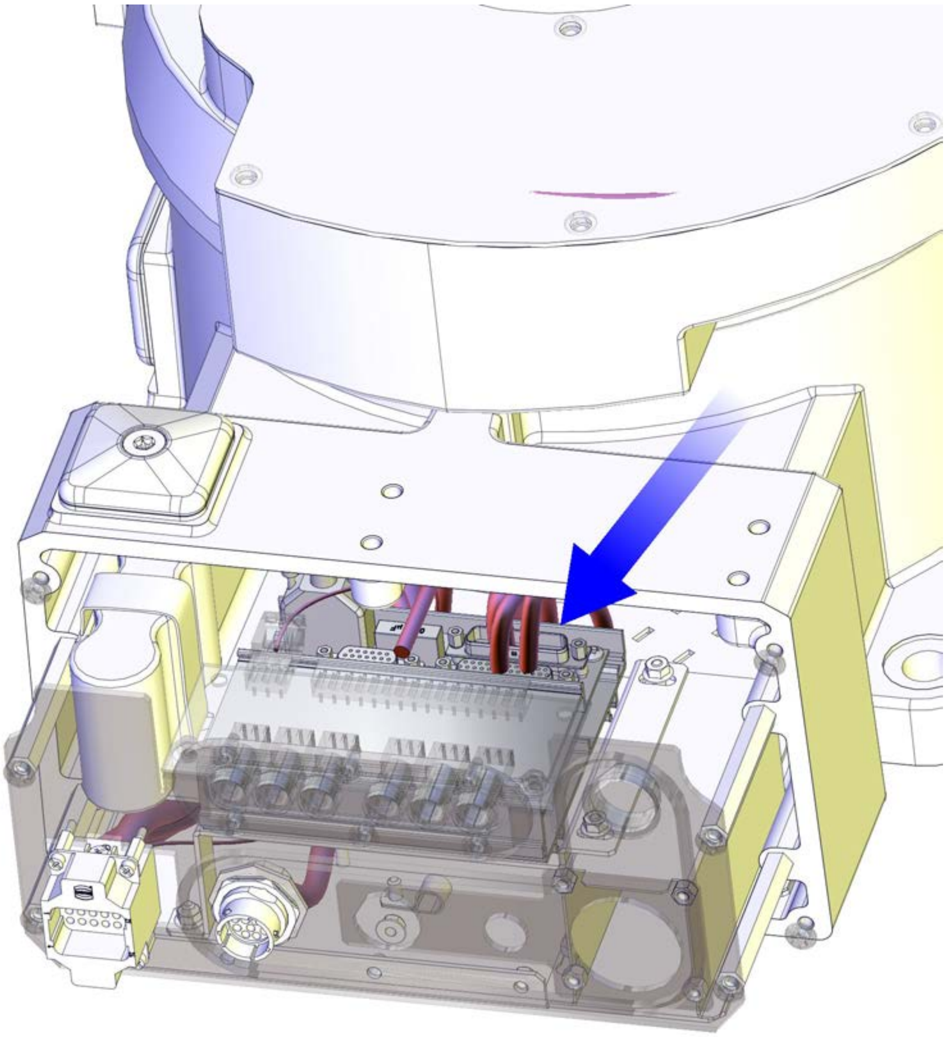
Continues on next page

	Action	Note
17	Secure the weight of the robot with round-slings and lift it carefully up from the pallets.	
18	Refit the robot to the foundation with its bolts.	
19	Refit the cable harness in frame and base.	See *Replacing the cable harness - lower end on page 145*
20	Refit the base cover with its attachment screws.	
21	Perform a leak-down test!	See *Performing a leak-down test on page 136*.
22	Fill axis 1 gearbox with oil.	See *Filling oil, axis 1 gearbox on page 115*.
23	Recalibrate the robot.	Calibration is described in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.
24	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 75*.	

5.5.2 Replacing the serial measurement unit

Location of serial measurement unit

The serial measurement unit is located inside the base of the robot, as shown in the figure.



xx1100000332

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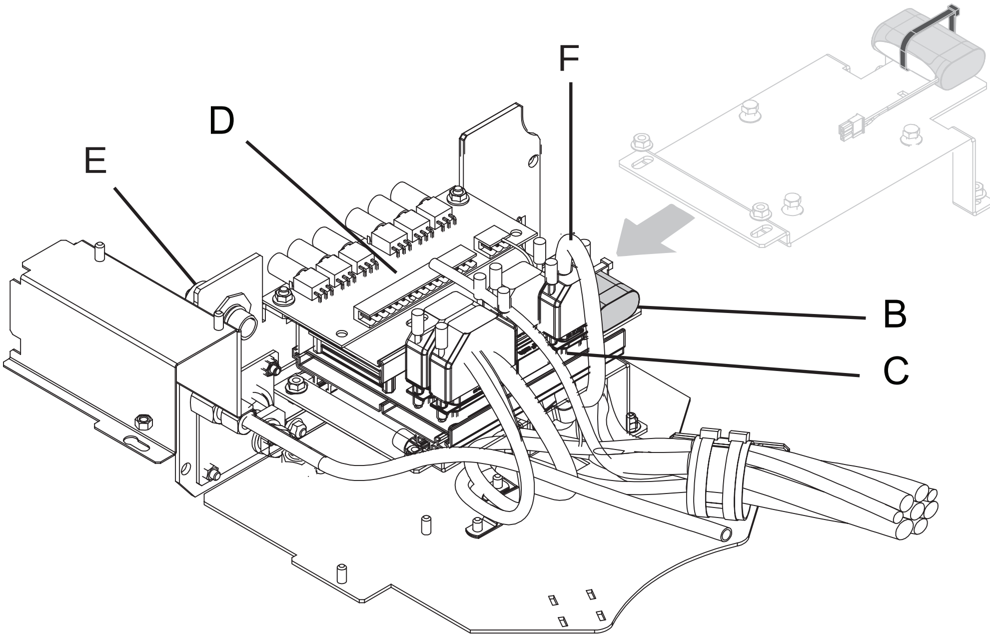
Serial measurement unit layout

The complete spare part of the serial measurement unit is shown in the figure.

RMU 101



xx1300000330

B	Battery pack (3-pole battery contact)
C	Serial measurement board RMU 101
D	BU unit
E	Battery cable connector

Required equipment

Note

There are different variants of SMB units and batteries. The variant with the 3-pole battery contact has longer lifetime for the battery.

It is important that the SMB unit uses the correct battery. Make sure to order the correct spare parts. Do not replace the battery contact!

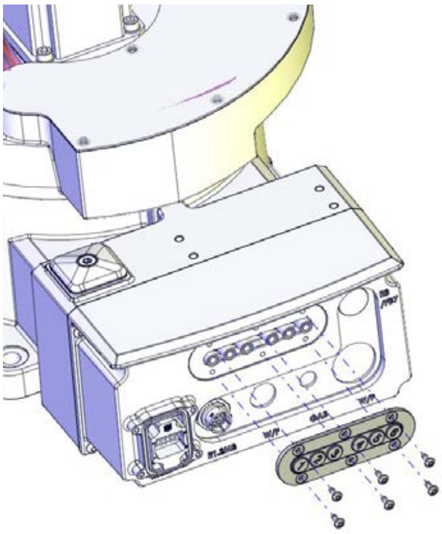
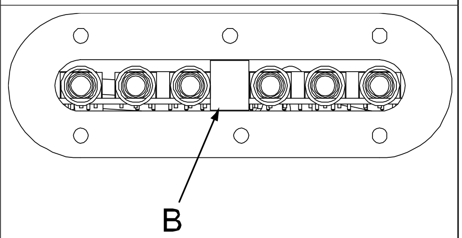
Equipment	Art. no.	Note
Serial measurement unit	See *Spare parts on page 307*.	
Battery pack	See *Spare parts on page 307*.	
Gasket, base cover	See *Spare parts on page 307*.	
Centering piece	3HAC025815-001	Fitted to the push button unit in order to align it correctly. Replace if damaged.
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.

Continues on next page

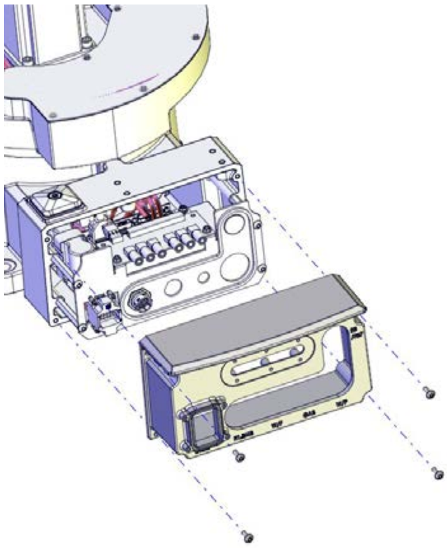
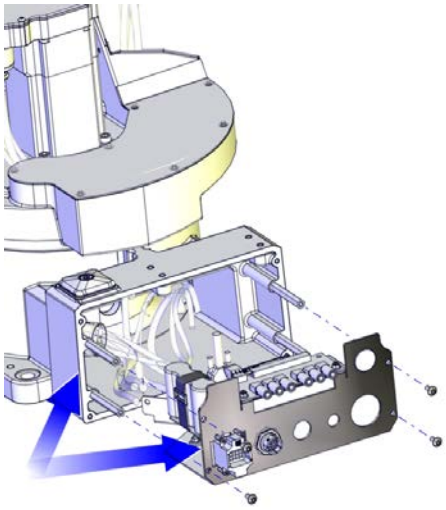
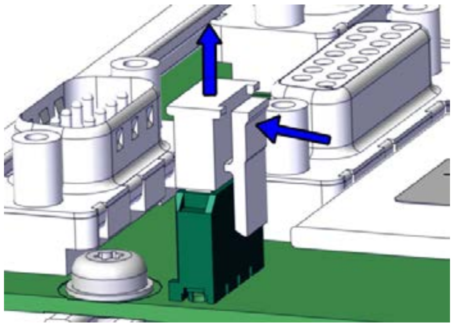
Equipment	Art. no.	Note
Circuit diagram	-	See *Circuit diagram - IRB 1510*.

Removing the serial measurement unit

Use this procedure remove the serial measurement unit.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Remove the push button guard from the base.	The push button guard must be removed to ensure a correct refitting of the push buttons.  xx1100000314
3	Remove the centering piece from the push button unit.	 xx0600002776 • B: Centering piece

Continues on next page

	Action	Note
4	Remove the *base cover*. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	 xx1100000315
5	Unscrew the attachment screws that holds the plate for connector (with SMB and push button units) and pull it carefully out approximately 150 mm.	 xx1100000316
6	Disconnect the battery cable by pressing down the upper lip of the R2.G connector to release the lock while pulling the connector upwards.	 xx1700000993

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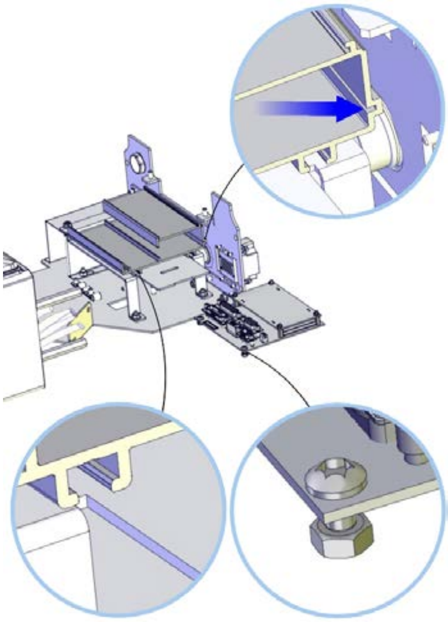
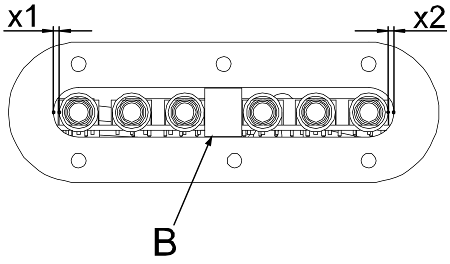
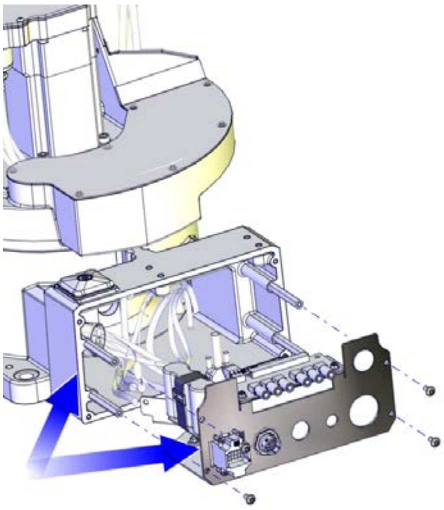
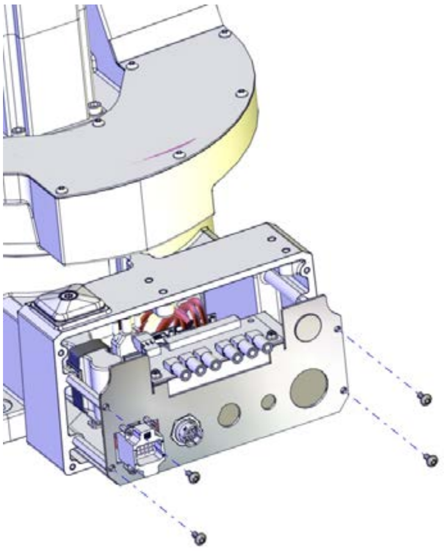
	Action	Note
7	Disconnect all remaining connectors to the serial measurement unit and push button units.	
8	Unscrew the two nuts that holds the push button guard.	
9	Unscrew the nuts (4 pcs) on the plate of the SMB and remove it.	
10	Turn over the plate with the SMB unit fitted and unscrew the attachment screws that holds the SMB unit and remove it.	

Refitting the serial measurement unit

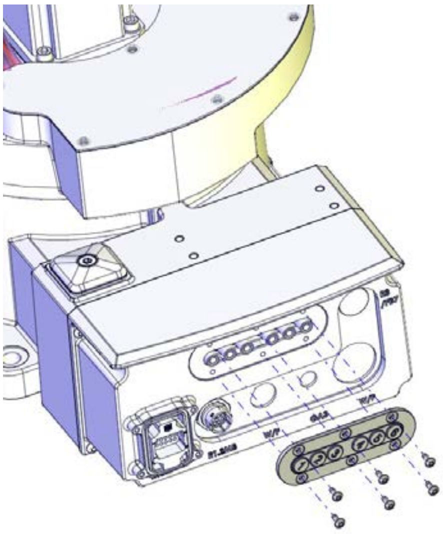
Use this procedure refit the serial measurement unit.

	Action	Note
1	Fit the SMB to the plate with its attachment screws (3 pcs).	 xx1100000335
2	Secure the SMB fitted on the plate with its attachment screws (4 pcs).	
3	Refit the push button unit with its nuts (2 pcs).	Make sure the unit is placed as straight as possible. The push buttons can otherwise get jammed.
4	Reconnect all the *connectors*. Make sure the lock on the battery cable connector R2.G snaps into place during refitting.	Shown in the figure *Serial measurement unit layout on page 219*.

Continues on next page

	Action	Note
5	Refit the centering piece (B) to the push button unit in order to align it vertically. Also make sure that the unit is correctly aligned sideways: the measurements x1 and x2 in the figure to the right should not differ more than 1 mm from each other!	 xx0600002777 Art. no. for the centering piece is specified in *Required equipment on page 219*.
6	Push the plate for connector (with SMB and push button units fitted) carefully into the base. Be careful not to damage any of the components or cable harness in the process!	 xx1100000316
7	Secure the plate for connector with its attachment screws.	 xx1100000329

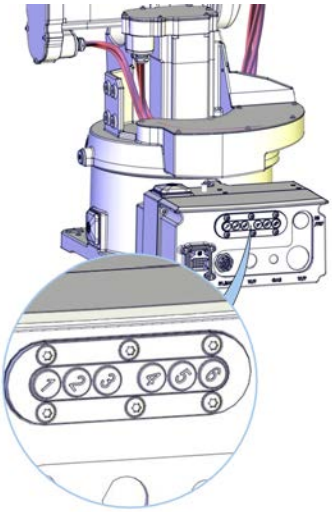
Continues on next page

	Action	Note
8	Check the *gasket* of the base cover. Replace it if damaged.	
9	Refit the *base cover*.	Shown in the figure *Location of serial measurement unit on page 218*.
10	**WARNING** Before continuing any service work, follow the safety procedure in section *The brake release buttons may be jammed after service work on page 144*!	
11	Refit the push button guard to the robot base.	 xx1100000314
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	Update the revolution counters!	Detailed in section *Updating revolution counters on page 283*..

5.5.3 Replacing the push button unit

Location of push button unit

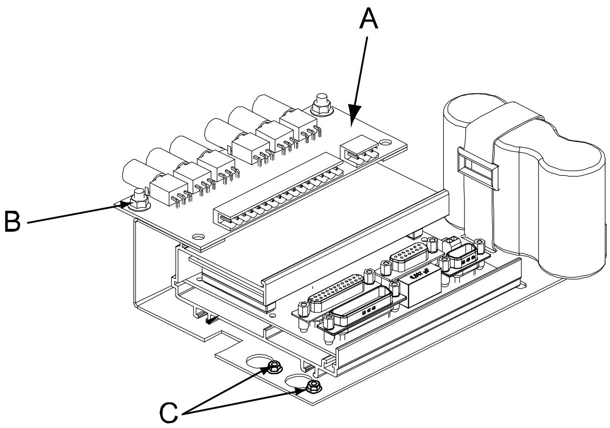
The push button unit for brake release is located inside the base of the robot.



xx1100000312

Push button unit on serial measurement unit

The push button unit is attached to the serial measurement unit as shown in the figure.



xx0500001394

A	Push button unit
B	Hexagon nuts (2 pcs)
C	Hexagon nuts, SMB unit (4 pcs). Only the outer ones are used.

Required equipment

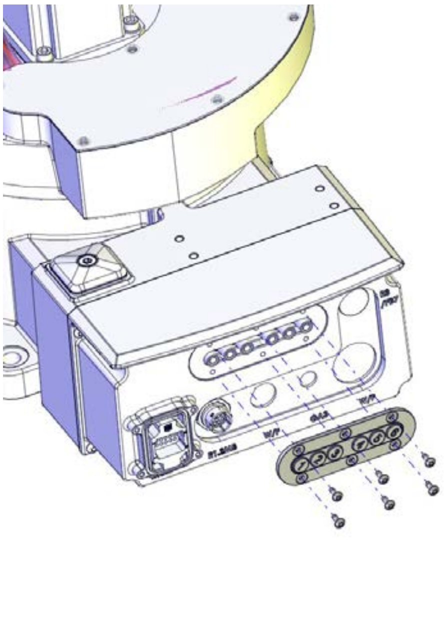
Equipment	Article number	Note
Brake release board/Push button unit	3HAC064944-001	DSQC1054
Gasket, base cover	3HAC022047-001	

Continues on next page

Equipment	Article number	Note
Centering piece	3HAC025815-001	Fitted to the push button unit in order to align it correctly. Replace if damaged.
Standard toolkit		Content is defined in section *Standard tools on page 303*.

Removing the push button unit

Use this procedure to remove the push button unit.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	**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 50*.	
3	Remove the push button guard from the base.	The push button guard must be removed to ensure a correct refitting of the push button unit.  xx1100000314

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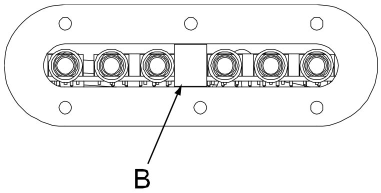
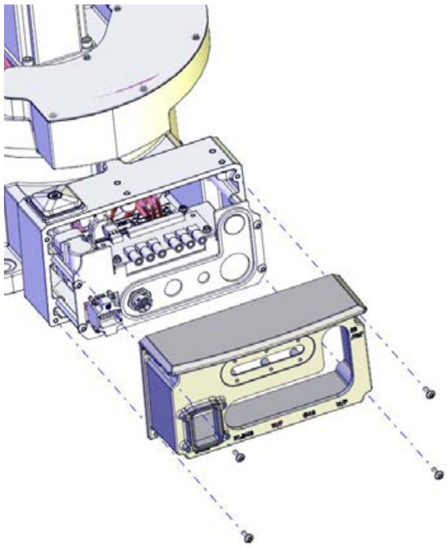
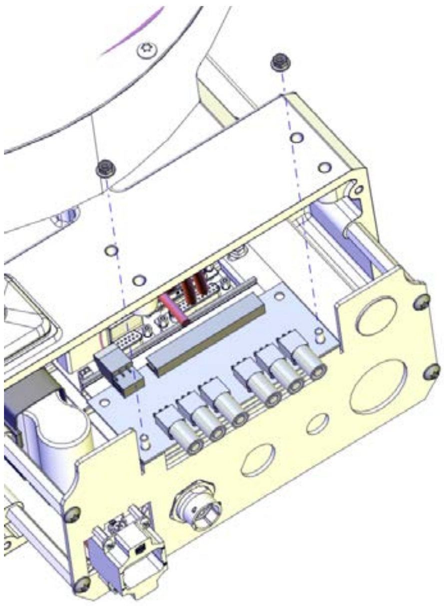
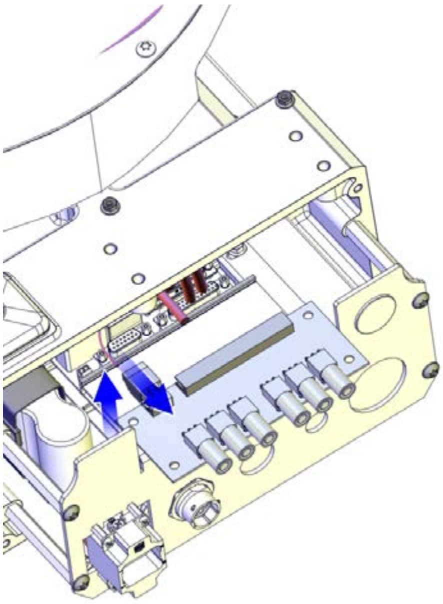
	Action	Note
4	Remove the centering piece from the push button unit.	 xx0600002776 • B: Centering piece
5	Remove the *base cover* from the robot. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	 xx1100000315
6	Take a picture or make notes of how the robot cabling is positioned in regard to the push button unit.	
7	Unscrew the nuts securing the push button unit to the SMB unit.	 xx1100000345

Continues on next page

	Action	Note
8	Lift the push button unit up and pull it carefully out a little in order to be able to disconnect the connectors. Disconnect the connectors from the *brake release board.* Do not stretch the cables!	 xx1100000344
9	Remove the push button unit by lifting it up.	

Refitting the push button unit

Use this procedure to refit the push button unit.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	**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 50*.	

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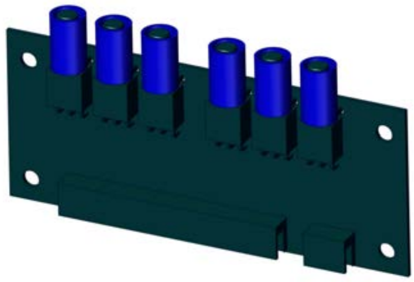
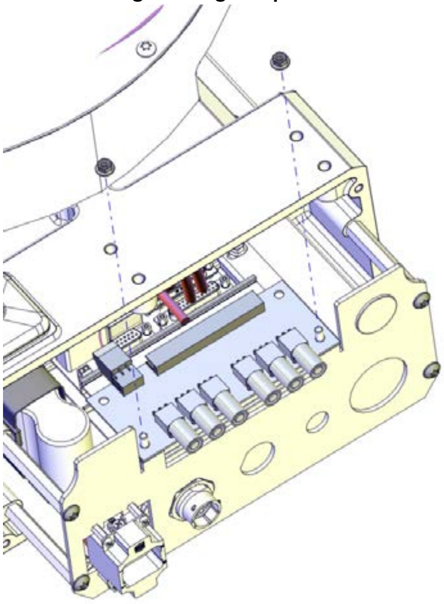
	Action	Note
3	Reconnect all connectors to the push button unit. Be careful not to damage the sockets or pins. Make sure the connector and its locking arms are snapped down properly.	 xx1800000171
4	Fit the push button unit to the serial measurement unit in the robot base and secure with the two hexagon nuts.	Maximum tightening torque: 5 Nm.  xx1100000345
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 *gasket* of the base cover. Replace it if damaged.	

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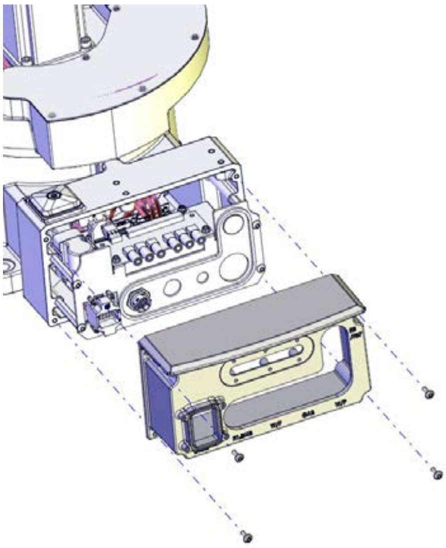
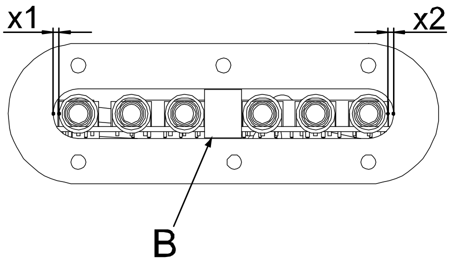
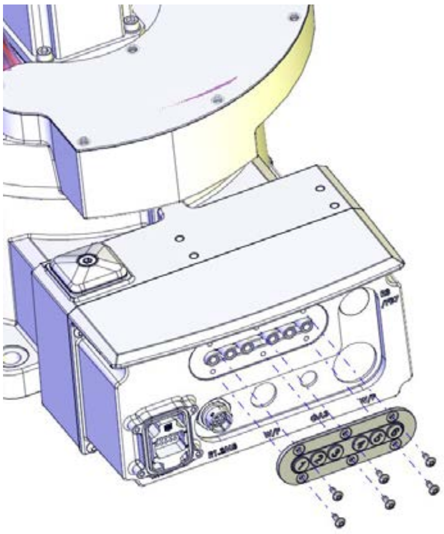
	Action	Note
7	Refit the base cover.	 xx1100000315
8	Refit the centering piece (B) to the push button unit in order to align it vertically. Also make sure that the unit is correctly aligned sideways: the measurements x1 and x2 in the figure to the right should not differ more than 1 mm from each other!	 xx0600002777
9	**WARNING** Before continuing any service work, follow the safety procedure in section *The brake release buttons may be jammed after service work on page 144*!	

Continues on next page

	Action	Note
10	Refit the push button guard to the robot base.	 xx1100000314
11	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.	
12	Update the revolution counters!	Detailed in section *Updating revolution counters on page 283*..
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 75*.	

5.6 Motors

5.6.1 Replacing motors on axis 1 and 2

Introduction

This section describes how to replace motors on axes 1 and 2.

How to replace motors on axes 3 and 4 see section *Replacing motors on axes 3 and 4 on page 242*.

How to replace the motor on axis 5 see section *Replacing motor on axis 5 on page 249*.

How to replace the motor on axis 6 see section *Replacing the axis 6 motor on page 253*.

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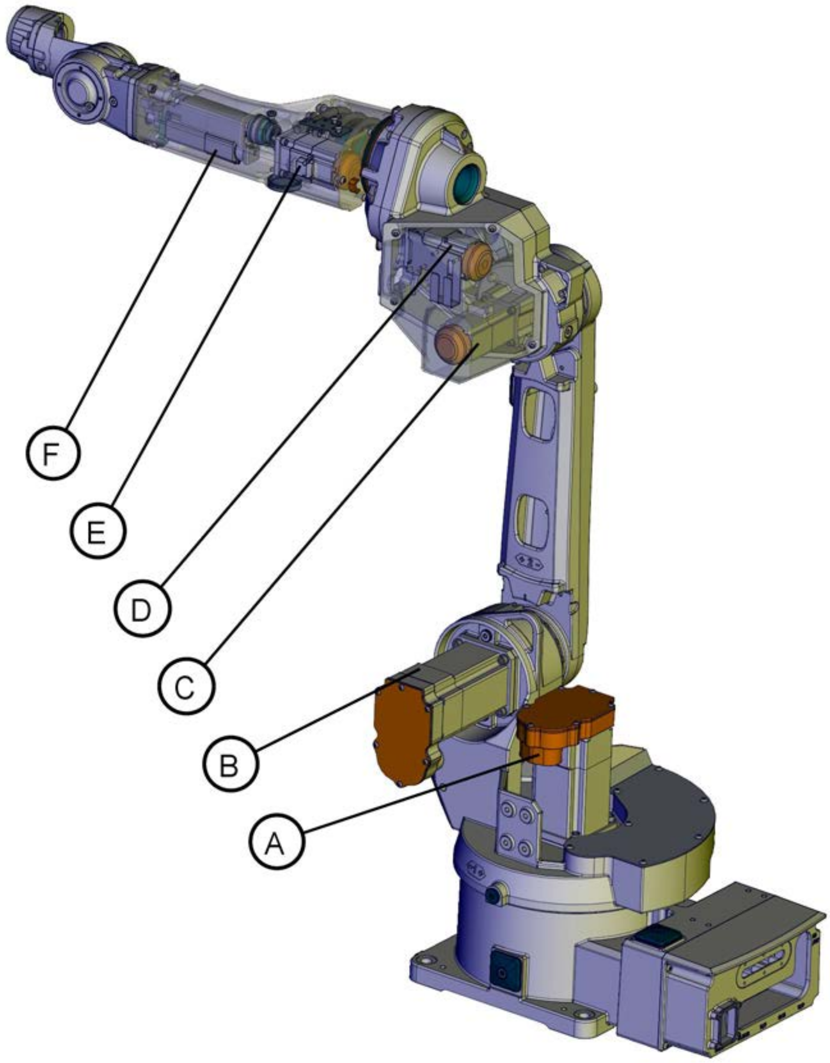
Location of motors on axes 1 and 2

The motors are located as shown in the figure.



xx1100000282

A	Motor axis 1
B	Motor axis 2
C	Motor axis 3 (inside armhouse)
D	Motor axis 4 (inside armhouse)
E	Motor axis 5 (inside upper arm)
F	Motor axis 6 (inside upper arm)

Required equipment

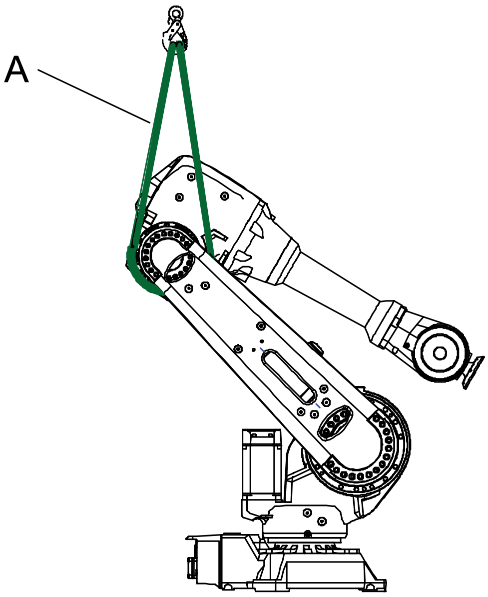
Equipment	Art. no.	Note
Motor	See *Spare parts on page 307*.	

Continues on next page

Equipment	Art. no.	Note
O-ring, motor	See *Spare parts on page 307*.	
Connection box	See *Spare parts on page 307*.	
Motor cover	See *Spare parts on page 307*.	Includes o-rings.
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.
Special toolkit	-	Content is defined in section *Special tools on page 304*.
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.

Position of the robot

Place the robot in the recommended position in order to facilitate replacement of motors.

Motor	Position
Axis 1 motor	Calibration position.
Axis 2 motor	Jog the robot to the position shown in the figure until it almost rests on the damper of axis 3. **DANGER** Secure the weight of the lower arm properly before releasing the brakes of motor, axis 2! When releasing the holding brakes of the motor, the lower arm will be movable and may fall down!  xx0800000391 The figure shows the IRB 4600 but the principle is the same for IRB 1510.

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Draining gearboxes

The table specifies if the oil needs to be drained from the gearboxes.

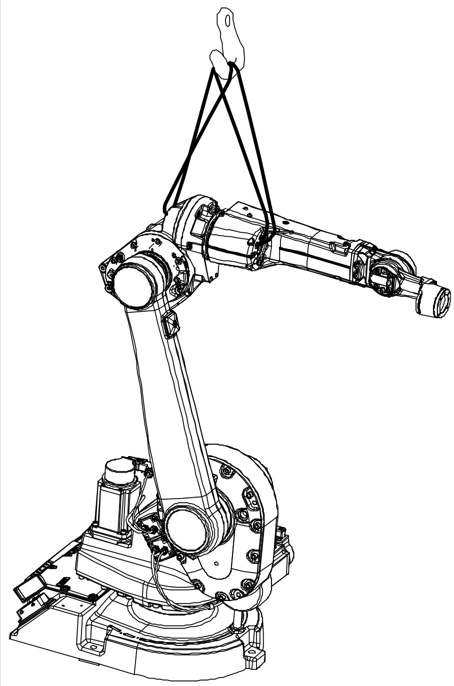
Note

These recommendations are valid if the method how to position the robot described above, is followed.

Motor	Action
Axis 1 motor	Draining is not needed provided that the recommended procedure for removal is followed.
Axis 2 motor	Drain the axis 2 gearbox as described in *Changing the oil, axis-2 gearbox on page 116*.

Removing the axes 1 and 2 motors

Use this procedure to remove the axes 1 and 2 motors.

	Action	Note
1	Jog the robot to the position described above depending on which motor shall be replaced.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	**Only applicable to the axis 2 motor!** **DANGER** Secure the weight of the lower arm properly before releasing the brakes of motor, axis 2! When releasing the holding brakes of the motor, the lower arm will be movable and may fall down!	 xx0700000060

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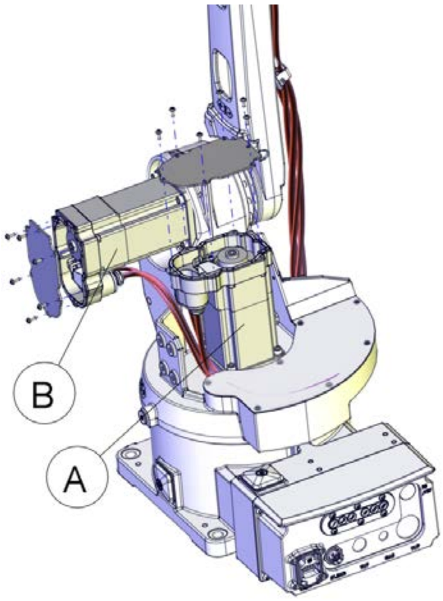
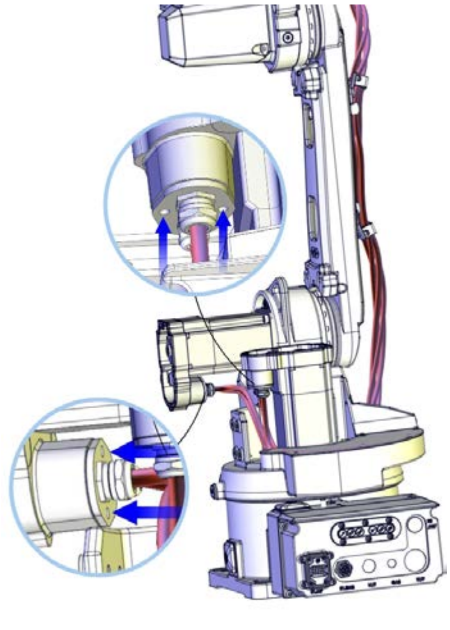
	Action	Note
4	**Only applicable to the axis 2 motor!** Drain the axis 2 gearbox.	See *Changing the oil, axis-2 gearbox on page 116*.
5	Remove the motor cover in order to reach the connectors.	 xx1100000375 • A: Axis 1 motor • B: Axis 2 motor
6	Disconnect the connectors inside.	
7	Unscrew the attachment screws that holds the motor plate.	 xx1100000376

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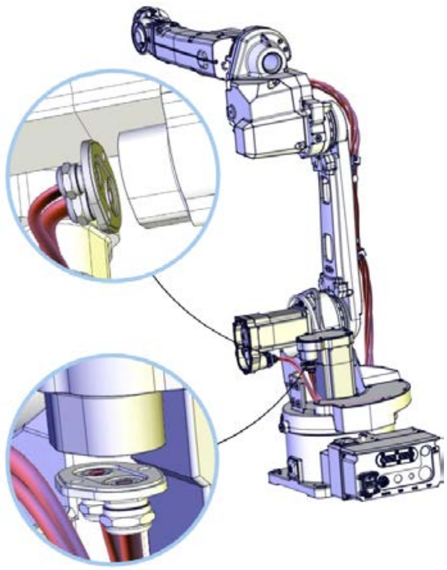
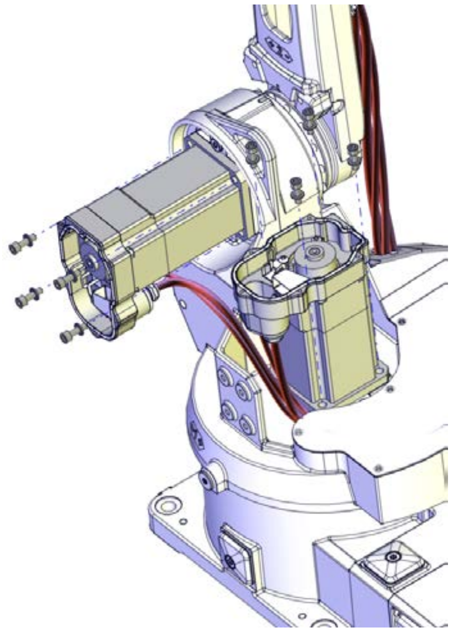
	Action	Note
8	Pull carefully out the motor cables.	 xx1100000377
9	Remove the connection box.	
10	Unscrew the attachment screws securing the motor. Use a 300 mm extension for bits 1/2".	 xx1100000378
11	**Only applicable to the axis 2 motor!** Fit two guide pins in opposite holes.	

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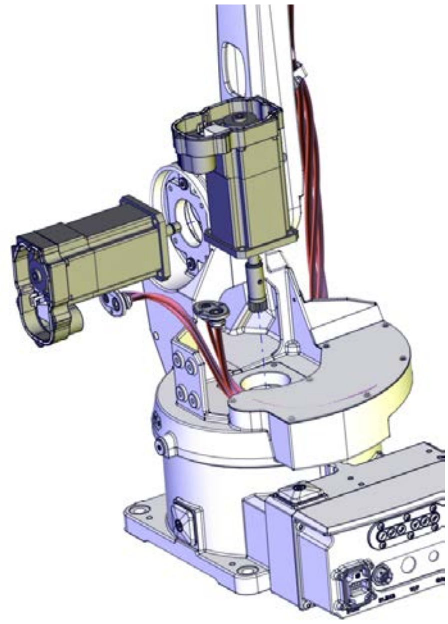
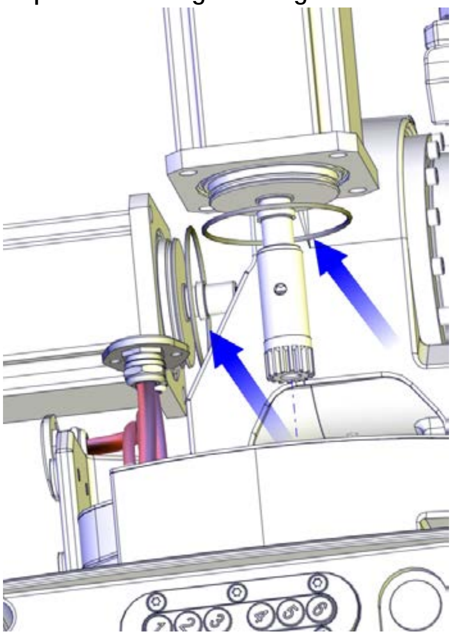
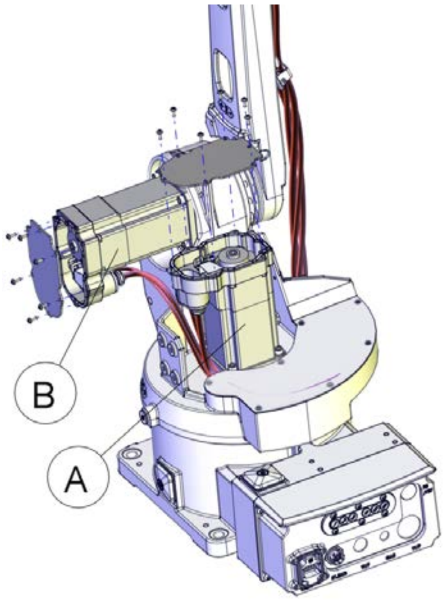
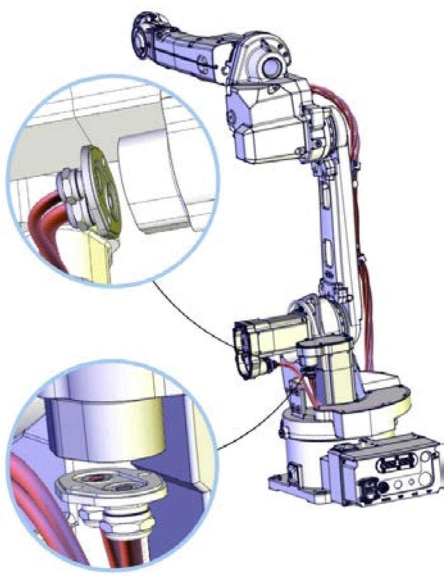
	Action	Note
12	Remove the motor by lifting it out carefully, making sure the motor pinion is not damaged while moving it away from the gear.	 xx1100000379

Refitting the axes 1 and 2 motors

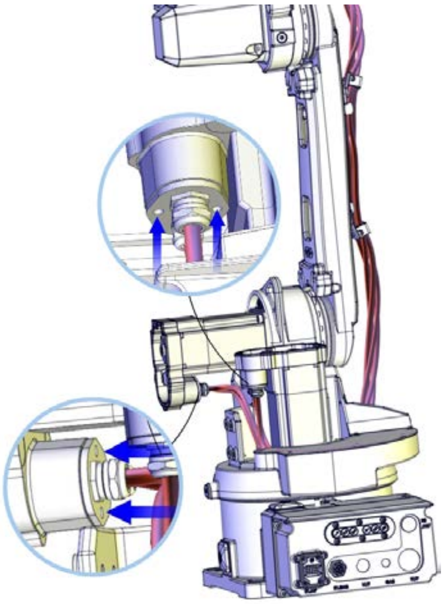
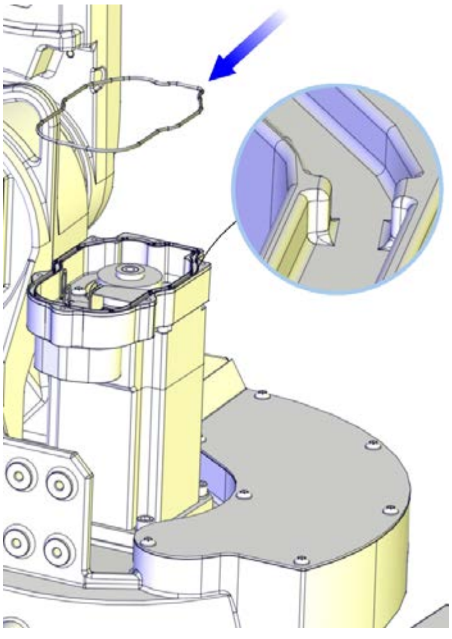
Use this procedure to refit the axes 1 and 2 motors.

	Action	Note
1	Wipe clean all assembly surfaces!	
2	**Only applicable to the axis 2 motor!** Fit two guide pins in opposite holes.	
3	Make sure the o-ring on the circumference of the motor is seated properly.	Replace the o-ring if damaged!  xx1100000380

Continues on next page

	Action	Note
4	Lubricate the o-ring with grease.	
5	**Only applicable to the axis 2 motor!** Place the motor on the guide pins.	
6	Fit the motor carefully, making sure the pinion is properly mated to the gears.	
7	Fit the connection box with its attachment screws.	
8	Secure the motor with its attachment screws. Use a 300 mm extension for bits 1/2". Tightening torque axis 1 motor: 20 Nm Tightening torque axis 2 motor: 20 Nm	 xx1100000375 • A: Axis 1 motor • B: Axis 2 motor
9	Carefully insert the motor cables through the connection box of the motor.	 xx1100000377

Continues on next page

	Action	Note
10	Refit the motor plate to the connection box.	 xx1100000376
11	Connect all connectors.	
12	Check the o-ring on the motor cover. Replace if damaged!	 xx1100000285
13	**Only applicable to the axis 2 motor!** Perform a leak-down test of the axis 2 gearbox!	See *Performing a leak-down test on page 136*.
14	**Only applicable to the axis 2 motor!** Refill the axis 2 gearbox with oil.	See *Changing the oil, axis-2 gearbox on page 116*.
15	Refit the motor cover.	

Continues on next page

	Action	Note
16	Recalibrate the robot.	Calibration is described in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.
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 75*.	

5.6.2 Replacing motors on axes 3 and 4

Introduction

This section describes how to replace motors on axes 3 and 4.

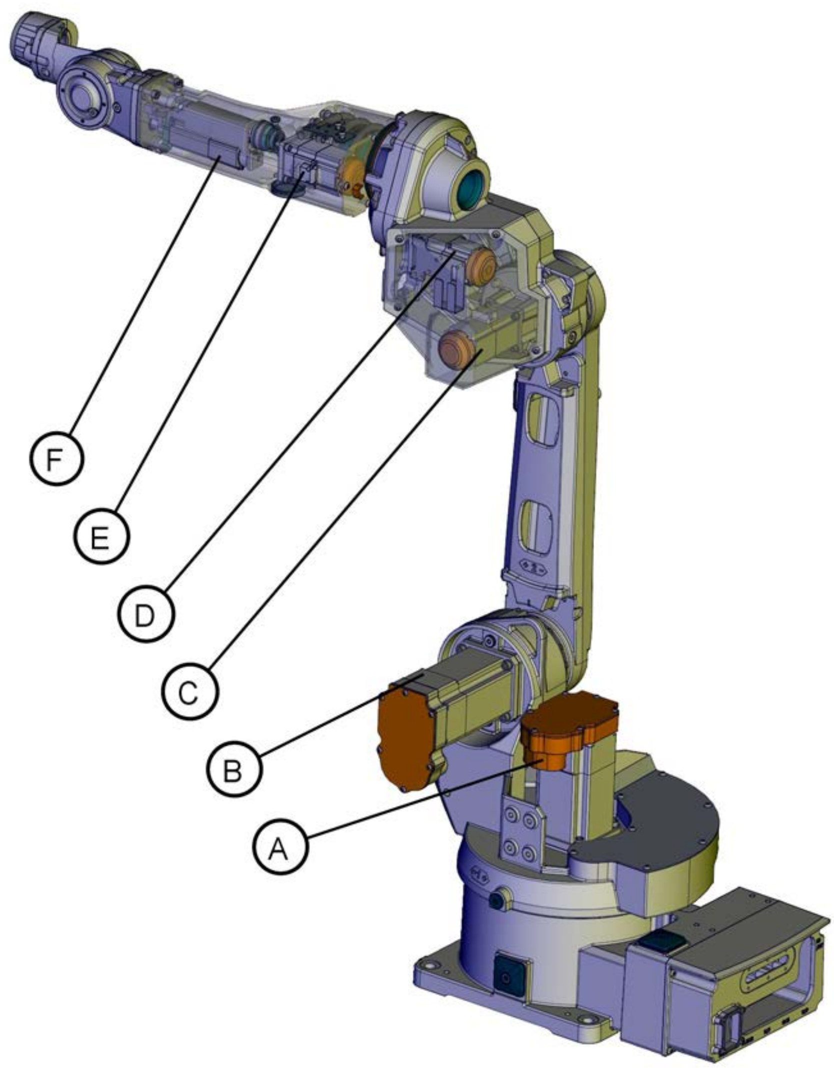
How to replace motors on axes 1 and 2 see section *Replacing motors on axis 1 and 2 on page 232*.

How to replace the motor on axis 5 see section *Replacing motor on axis 5 on page 249*.

How to replace the motor on axis 6 see section *Replacing the axis 6 motor on page 253*.

Location of motors on axes 3 and 4

The motors are located as shown in the figure.



xx1100000282

Continues on next page

A	Axis 1 motor
B	Axis 2 motor
C	Axis 3 motor
D	Axis 4 motor
E	Axis 5 motor
F	Axis 6 motor

Required equipment

Equipment	Art. no.	Note
Motor	See *Spare parts on page 307*.	
O-ring, motor	See *Spare parts on page 307*.	
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.
Special tools	-	Content is defined in section *Special tools on page 304*.
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.

Position of robot

Place the robot in the position recommended in order to fascilitate replacing of motors.

DANGER

Secure the arm system before removing any motor! The brake is located in the motor and is therefore released when the motor is removed!

Motor	Position
Axis 3 motor	Jog the upper arm to a vertical position with the wrist pointing at the floor after the oil is drained.
Axis 4 motor	Jog the upper arm to a vertical position with the wrist pointing at the floor.

Draining gearboxes

The table specifies if the oil needs to be drained from the gearboxes.

Note

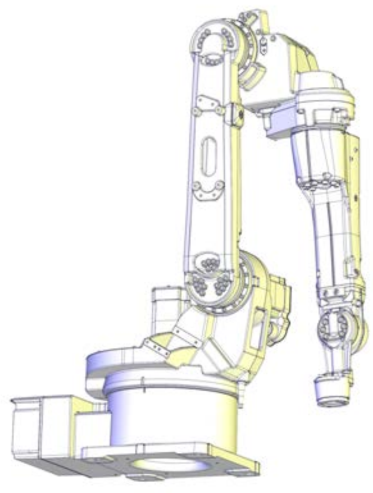
These recommendations are valid if the method how to position the robot described above, is followed.

Continues on next page

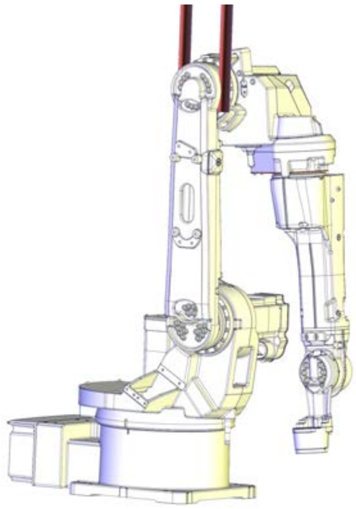
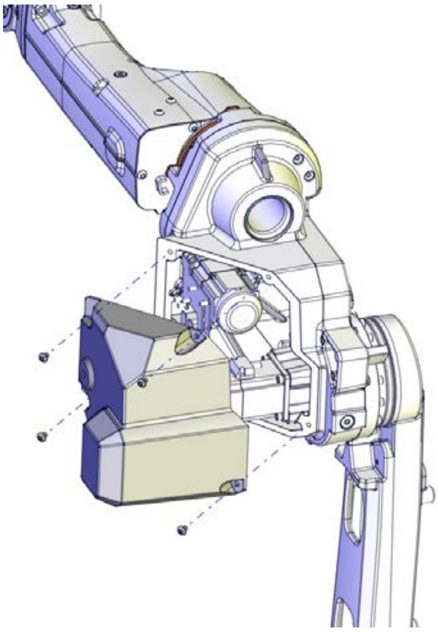
Motor	Action
Axis 3 motor	Drain the axis 3 gearbox as described in *Changing the oil, axis-3 gearbox on page 120*.
Axis 4 motor	Draining is not needed provided that the recommended procedure for removal is followed.

Removing the axes 3 and 4 motors

Use this procedure to remove the axes 3 and 4 motors.

	Action	Note
1	**Only applicable to the axis 3 motor!** Drain the oil from the gearbox.	Drain the axis 3 gearbox as described in *Changing the oil, axis-3 gearbox on page 120*.
2	Jog the upper arm to vertical position with the wrist pointing at the floor.	 xx1100000439
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	

Continues on next page

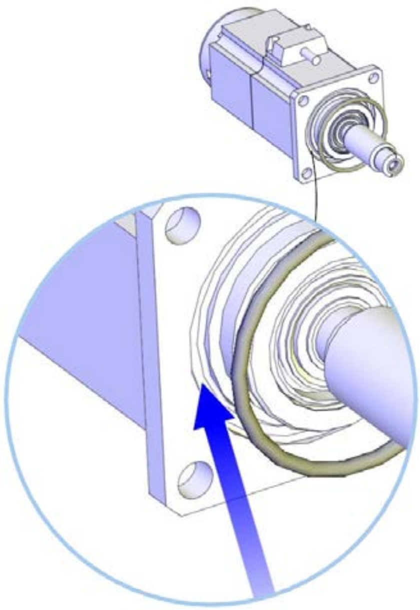
	Action	Note
4	**DANGER** Secure the arm system before removing any motor! The brake is located in the motor and is therefore released when the motor is removed!	 xx1100000442
5	Remove the armhouse cover.	 xx1100000349
6	Remove the strap and disconnect the motor connectors.	
7	Unscrew the attachment screws securing the motor. Use a 300 mm extension for bits 3/8".	
8	Remove the motor by lifting it carefully straight out, making sure the motor pinion is not damaged while moving it away from the gear.	

Continues on next page

Refitting the axes 3 and 4 motors

Use this procedure to refit the axes 3 and 4 motors.

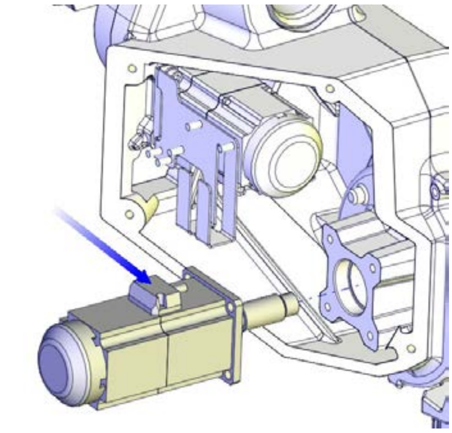
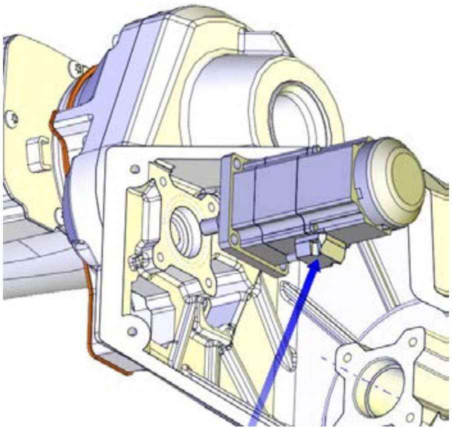
Preparations

	Action	Note
1	Wipe clean all assembly surfaces with isopropanol.	
2	Make sure that motor pinion is not damaged or scratched.	
3	Make sure the o-ring on the circumference of the motor is seated properly. Replace if damaged!	 xx1100000479
4	Lubricate the o-ring with grease.	

Continues on next page

Refitting the axes 3 and 4 motors

Use this procedure to refit the axes 3 and 4 motors.

	Action	Note
1	Make sure the motor is turned the correct way, that is that the cable inlet is positioned as shown in the figures.	 xx1100000497  xx1100000498
2	Place the motor carefully in its mounting position, making sure the motor pinion is properly mated to the gear.	
3	Secure the motor with its attachment screws and plain washers. Use a 300 mm extension for bits 3/8".	Tightening torque motor axis 3: 8 Nm. M6x25 (4 pcs) Tightening torque motor axis 4: 10 Nm. M6x20 (4 pcs)
4	Reconnect the connectors.	
5	Refit the cables inside the armhouse.	
6	**Only applicable to the axis 3 motor!** Perform a leak-down test of the axis 3 gearbox!	See *Performing a leak-down test on page 136*.
7	**Only applicable to the axis 3 motor!** Refill the axis 3 gearbox with oil.	See *Changing the oil, axis-3 gearbox on page 120*.

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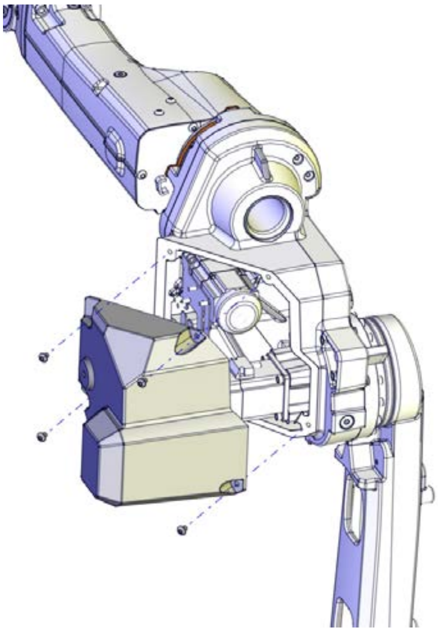
	Action	Note
8	Refit the armhouse cover. Tightening torque: 14 Nm.	 xx1100000349
9	Recalibrate the robot.	Calibration is described in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.
10	 **DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 75*.	

5.6.3 Replacing motor on axis 5

Introduction

This section describes how to replace motor on axis 5.

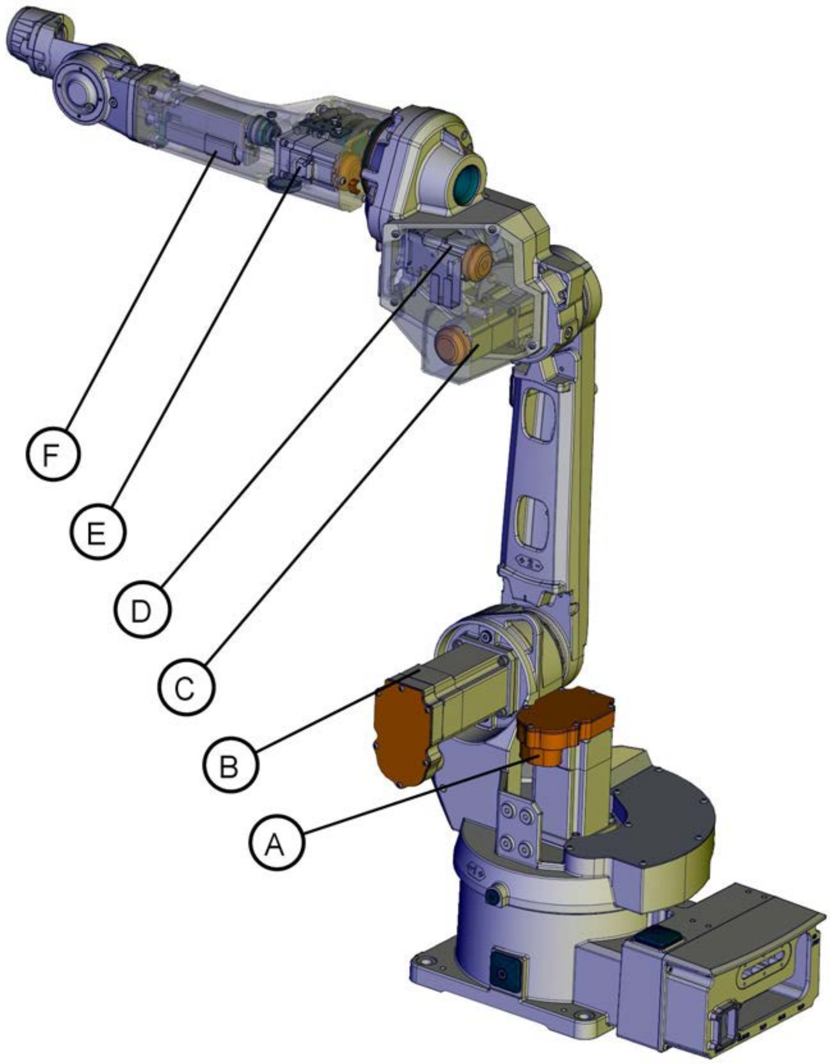
How to replace the motors on axes 1 and 2 see section *Replacing motors on axis 1 and 2 on page 232*.

How to replace the motors on axes 3 and 4 see section *Replacing motors on axes 3 and 4 on page 242*.

How to replace the motor on axis 6 see section *Replacing the axis 6 motor on page 253*.

Location of the axis 5 motor

The motors are located as shown in the figure.



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A	Axis 1 motor
B	Axis 2 motor
C	Axis 3 motor
D	Axis 4 motor
E	Axis 5 motor
F	Axis 6 motor

Required equipment

Equipment	Art. no.	Note
Motor	See *Spare parts on page 307*.	
O-ring, motor	See *Spare parts on page 307*.	
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.
Special toolkit	-	Content is defined in section *Special tools on page 304*.
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.

Position of robot

Place the robot in the position recommended in order to fascilitate replacing of motors.

Motor	Position
Axis 5 motor	Jog the upper arm to a vertical position with the wrist pointing at the floor.

Draining gearbox

The table specifies if the oil needs to be drained from the gearbox.

Note

These recommendations are valid if the method how to position the robot described above, is followed.

Motor	Action
Axis 5 motor	Draining is not needed provided that the recommended procedure for removal is followed.

Removing the axis 5 motor

Use this procedure to remove the axis 5 motor.

	Action	Note
1	Jog the robot to the recommended position.	

Continues on next page

	Action	Note
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Remove the cables to the motor.	The armtube (with the wrist fitted) need to be opened as described in *Replacing the cable harness - upper end on page 165*.
4	Unscrew the attachment screws securing the motor.	
5	Remove the motor by lifting it out carefully, making sure the motor pinion or gear are not damaged while lifting it away.	

Refitting the axis 5 motor

Use this procedure to refit the axis 5 motor.

Preparations

	Action	Note
1	Wipe clean all assembly surfaces.	
2	Make sure that the pinion is not damaged or scratched.	
3	Make sure that the o-ring on the circumference is seated properly. Replace if damaged!	
4	Lubricate the o-ring with some grease.	
5	Make sure that the motor will be fitted in the correct position.	

Refitting the axis 5 motor

	Action	Note
1	Place the motor carefully in its mounting position.	
2	Secure the motor with its attachment screws.	Tightening torque: 10 Nm.
3	Refit the cables to the axis 5 motor.	Follow the instructions in section *Replacing the cable harness - upper end on page 165* in order to refit cables and arm tube.
4	Recalibrate the robot.	Calibration is described in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.

Continues on next page

	Action	Note
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 75*.	

5.6.4 Replacing the axis 6 motor

Introduction

This section describes how to replace motor on axis 6.

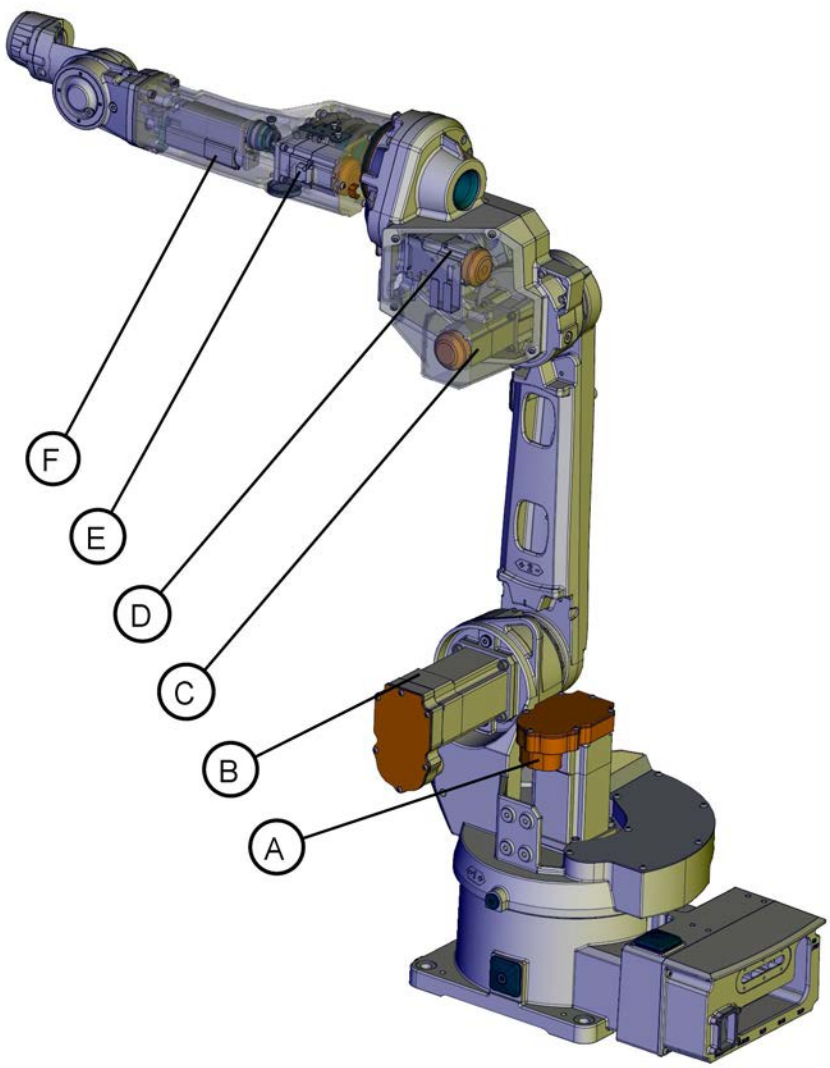
How to replace the motors on axes 1 and 2 see section *Replacing motors on axis 1 and 2 on page 232*.

How to replace the motors on axes 3 and 4 see section *Replacing motors on axes 3 and 4 on page 242*.

How to replace the motor on axis 5 see section *Replacing the axis 6 motor on page 253*.

Location of the axis 6 motor

The motors are located as shown in the figure.



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Continues on next page

A	Axis 1 motor
B	Axis 2 motor
C	Axis 3 motor
D	Axis 4 motor
E	Axis 5 motor
F	Axis 6 motor

Required equipment

Equipment	Art. no.	Note
Motor	See *Spare parts on page 307*.	
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.
Special toolkit	-	Content is defined in section *Special tools on page 304*.
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.

Position of robot

Place the robot in the position recommended in order to fascilitate replacing of motors.

Motor	Position
Axis 6 motor	Jog the robot the the calibration position.

Draining gearbox

The table specifies if the oil needs to be drained from the gearboxes.

Note

These recommendations are valid if the method how to position the robot described above, is followed.

Motor	Action
Axis 6 motor	Draining is not needed provided that the recommended procedure for removal is followed.

Releasing the brakes

Connect the 24 VDC power supply for brake release to R1.MP.

Connect to pins:

	Pin
0V	Pin 12
24V	Pin 13

Continues on next page

Removing the axis 6 motor

Use this procedure to remove the axis 6 motor.

	Action	Note
1	Jog the robot to the recommended position.	
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Remove the wrist.	See *Replacing the wrist unit, IRB 1600ID on page 198*.
4	Move the wrist to a workbench and place it with the axis 6 motor pointing upwards.	Placing the wrist in this position will make it possible to replace the motor without draining the oil from the gearbox.
5	In order to release the brakes connect the 24VDC power supply to the motor.	
6	**Note** Do not move the gears in the wrist when the motor is removed! When refitting the motor the gears in the wrist shall be in the same position as they were before the removal.	
7	Open the flexible coupling securing the motor.	
8	Unscrew the attachment screws securing the motor. **Note** Do not remove the attachment screws securing the bracket!	
9	Remove the motor by lifting it out carefully, making sure the motor pinion or gear are not damaged while lifting it away.	

Refitting the axis 6 motor

Use this procedure to refit the axis 6 motor.

Preparations

	Action	Note
1	Wipe clean all assembly surfaces.	
2	Make sure that the pinion is not damaged or scratched.	

Continues on next page

	Action	Note
3	Make sure that the o-ring on the circumference is seated properly. Replace if damaged!	
4	Lubricate the o-ring with some grease.	
5	Make sure that the motor will be fitted in the correct position.	

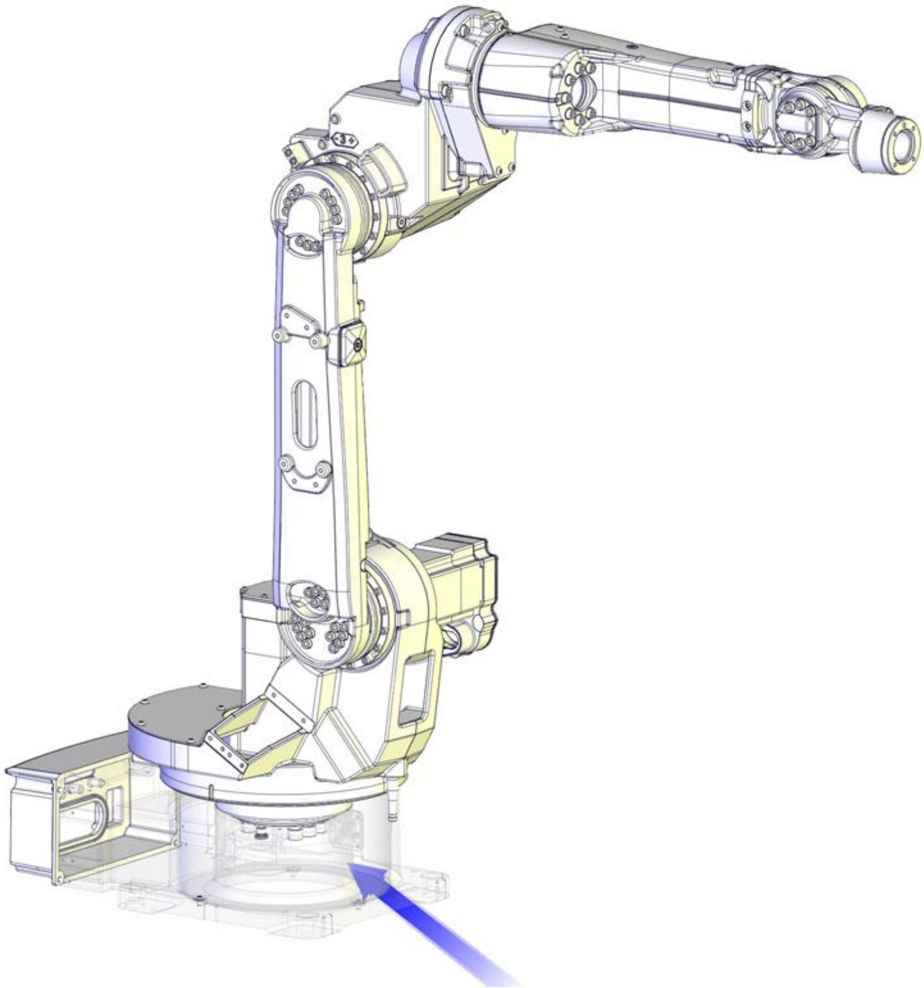
Refitting the axis 6 motor

	Action	Note
1	Place the motor carefully in its mounting position with the wrist still placed on a workbench. **Note** Do not move the gears in the wrist when the motor is removed! When refitting the motor the gears in the wrist shall be in the same position as they were before the removal.	
2	In order to release the brakes connect the 24VDC power supply to the motor.	
3	Secure the motor with its attachment screws.	Tightening torque: 6 Nm M5x25
4	Refit the flexible coupling securing the axes 6 motor to the rod.	
5	Refit the wrist.	See *Replacing the wrist unit, IRB 1600ID on page 198*.
6	Recalibrate the robot.	Calibration is described in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.
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 75*.	

5.7 Gearboxes

5.7.1 Replacing the axis 1 gearbox

Location of axis 1 gearbox



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Required equipment

Equipment	Art. no.	Note
Gearbox, axis 1	See *Spare parts on page 307*.	
O-rings	See *Spare parts on page 307*.	
Base	See *Spare parts on page 307*.	
Guide pins	3HAC15520-1	M8 x 100 Always use guide pins in pairs!
Lifting accessories	-	
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.

Continues on next page

Equipment	Art. no.	Note
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.

Removing the axis 1 gearbox

Use this procedure to remove the axis 1 gearbox from the base.

	Action	Note
1	Jog the robot to the calibration position.	
2	Drain the gearbox.	See *Changing the oil, axis 1 gearbox on page 111*.
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
4	**CAUTION** The IRB 1510 robot weighs 170 kg. All lifting accessories used must be sized accordingly!	
5	Remove the base. **Note** The referred instructions for how to replace the base includes how to put the robot in a position best suited to facilitate the removal of base and axis 1 gearbox.	See *Replacing the base on page 211*.

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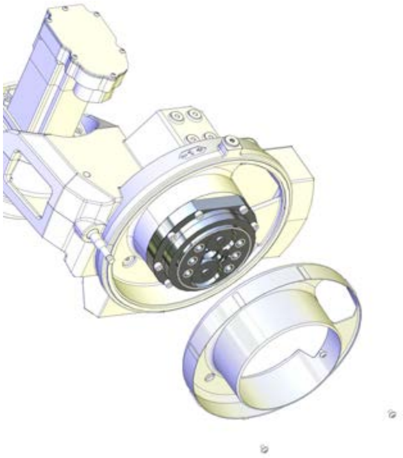
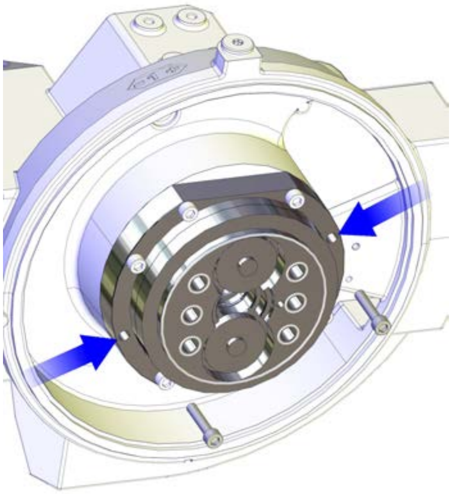
	Action	Note
6	Unscrew the attachment screws holding the frame cable protection and remove it.	 xx1100000435
7	Unscrew two attachment screws securing the gearbox and fit two guide pins in opposite holes.	Guide pins are specified in *Required equipment on page 257*.  xx1100000450 Always use guide pins in pairs!
8	Unscrew the remaining attachment screws securing the gearbox.	

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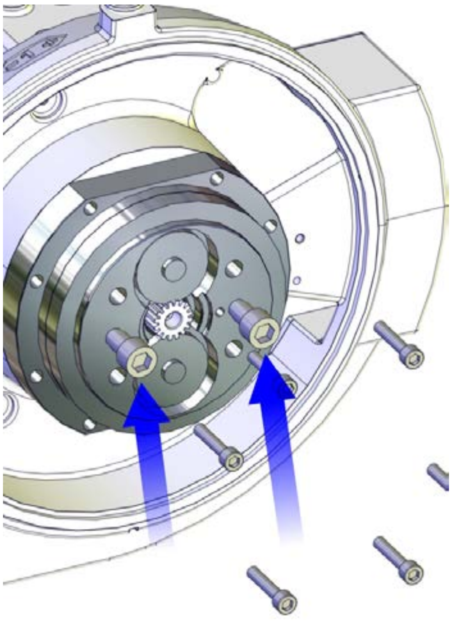
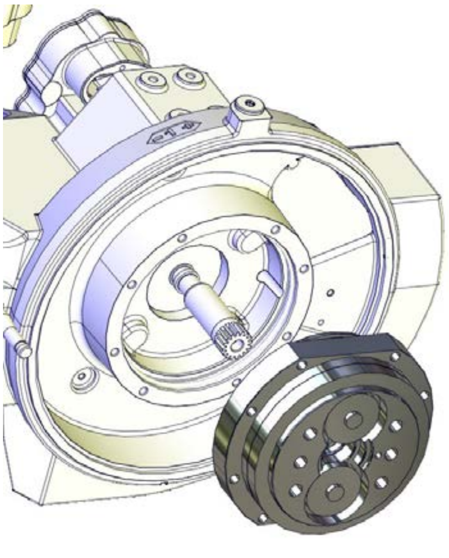
	Action	Note
9	Apply two of the M14 screws.	 xx1100000451
	CAUTION Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	
10	Remove the gearbox carefully in order not to damage the motor pinion.	 xx1100000452

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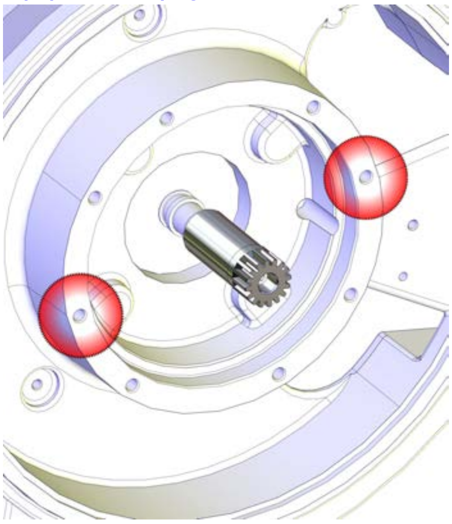
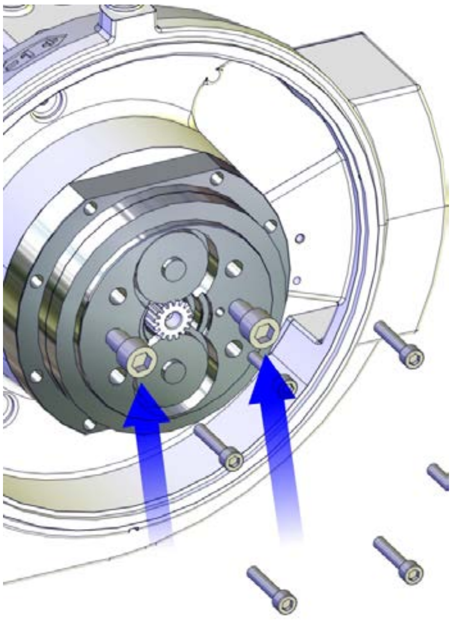
Refitting the axis 1 gearbox

Use this procedure to refit the axis 1 gearbox.

	Action	Note
1	Wipe all contact surfaces clean on the gear-box and on the robot with isopropanol.	
2	Fit two guide pins in opposite holes in the frame.	Guide pins are specified in *Required equipment on page 257*.  xx1100000453
3	Fit two M14 screws diagonally in the gearbox screw holes, to be used as handles.	 xx1100000451
4	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	

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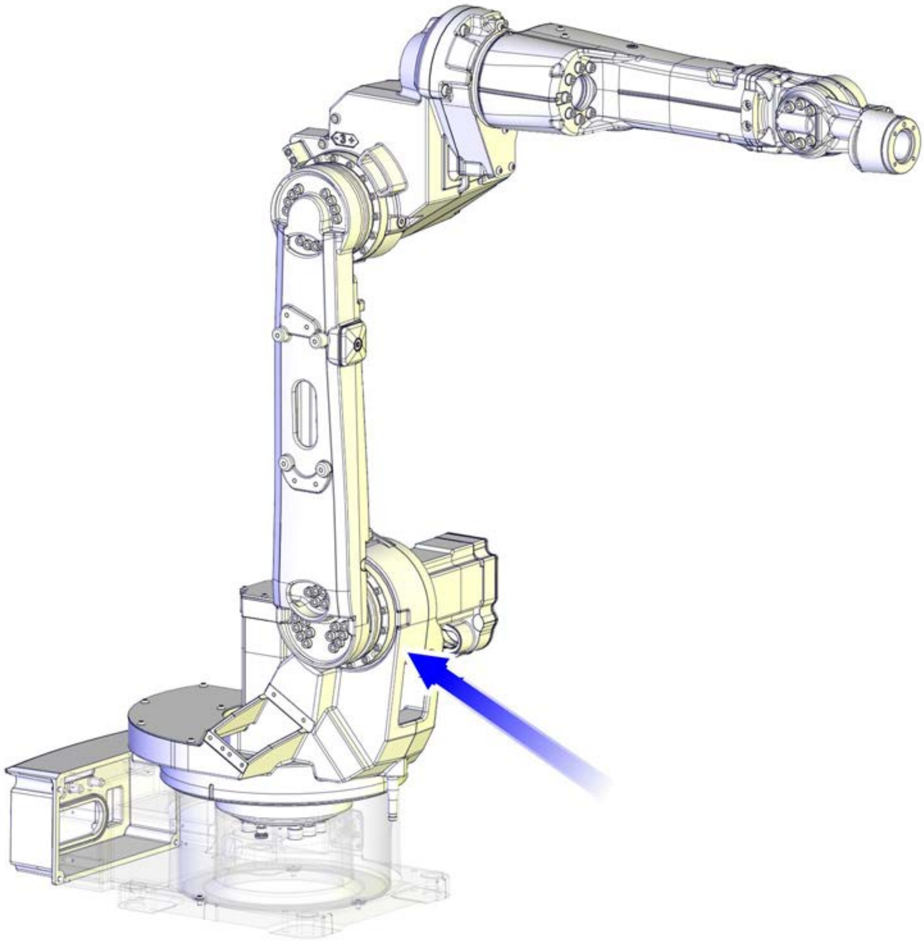
	Action	Note
5	Slide the gearbox on the guide pins into position in the frame.	
6	Secure the gearbox with six of the attachment screws.	Tightening torque: 34 Nm M8x40
7	Remove the guide pins and the two M14 screws.	
8	Fit the two remaining attachment screws securing the gearbox.	Tightening torque: 34 Nm M8x40
9	Refit the base.	See *Replacing the base on page 211*.
10	Perform a leak-down test.	See *Performing a leak-down test on page 136*.
11	Refill gearbox with oil.	See *Changing the oil, axis 1 gearbox on page 111*.
12	Recalibrate the robot.	Calibration is described in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.
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 75*.	

5.7.2 Replacing the axis 2 gearbox

Location of axis 2 gearbox



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Required equipment

Equipment	Art. no.	Note
Gearbox, axis 2	See *Spare parts on page 307*.	
Lifting accessories		
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.
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.

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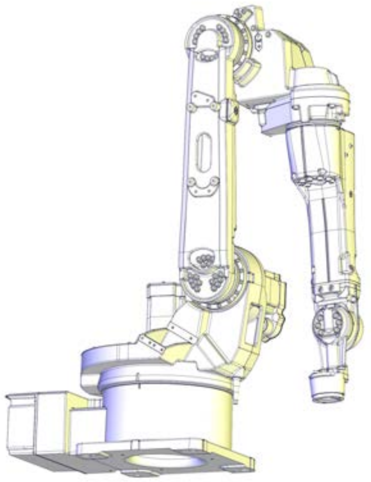
Removing the axis 2 gearbox

Use this procedure to remove the axis 2 gearbox.

	Action	Note
1	Jog the robot to the position shown in the figure.	 xx1100000439
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Drain the axis 2 gearbox of oil.	See *Changing the oil, axis-2 gearbox on page 116*.
4	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	
5	Remove the axis 2 motor.	See *Removing the axes 1 and 2 motors on page 235*.
6	Remove the cable harness from base and frame.	See *Replacing the cable harness - lower end on page 145*.
7	Remove the complete arm system.	See *Replacing the complete arm system on page 181*.

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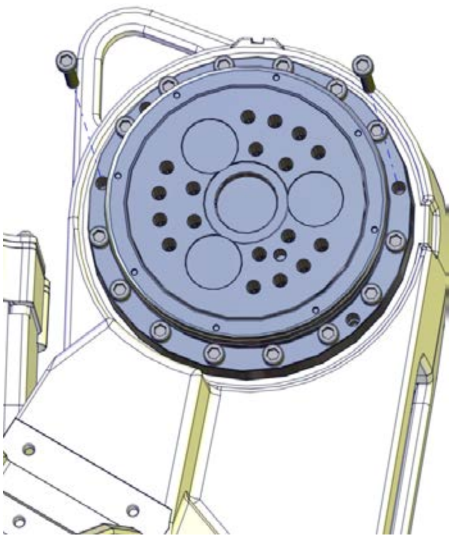
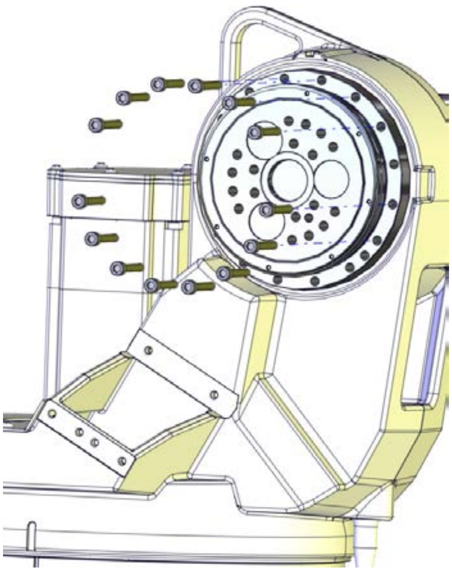
	Action	Note
8	Remove two attachment screws and fit two guide pins in opposite holes.	 xx1100000455
9	Unscrew the remaining attachment screws securing the gearbox.	 xx1100000456
10	If needed use the threaded holes on the gearbox and press out the gearbox.	

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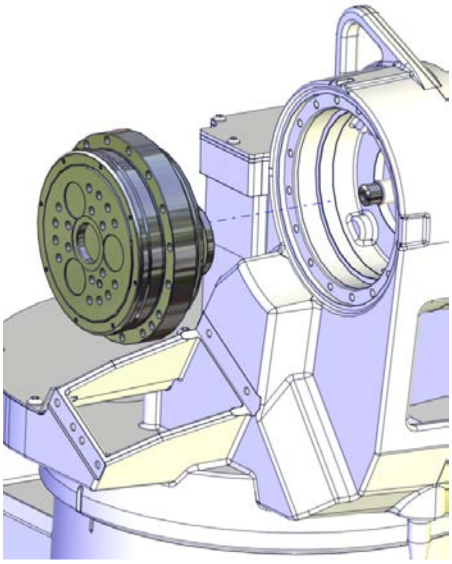
	Action	Note
11	Slide the gearbox out on the guide pins and remove it.	 xx1100000457

Refitting the axis 2 gearbox

Use this procedure to refit the axis 2 gearbox.

	Action	Note
1	Wipe all contact surfaces clean on gearbox and robot.	
2	Check the cable protection.	 xx1100000459

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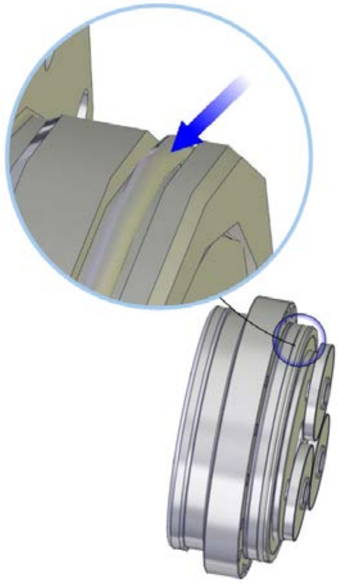
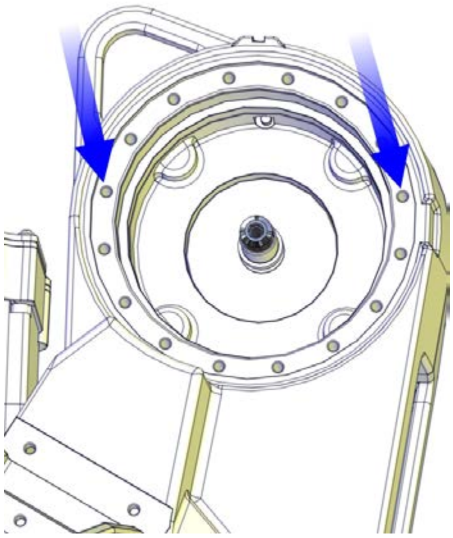
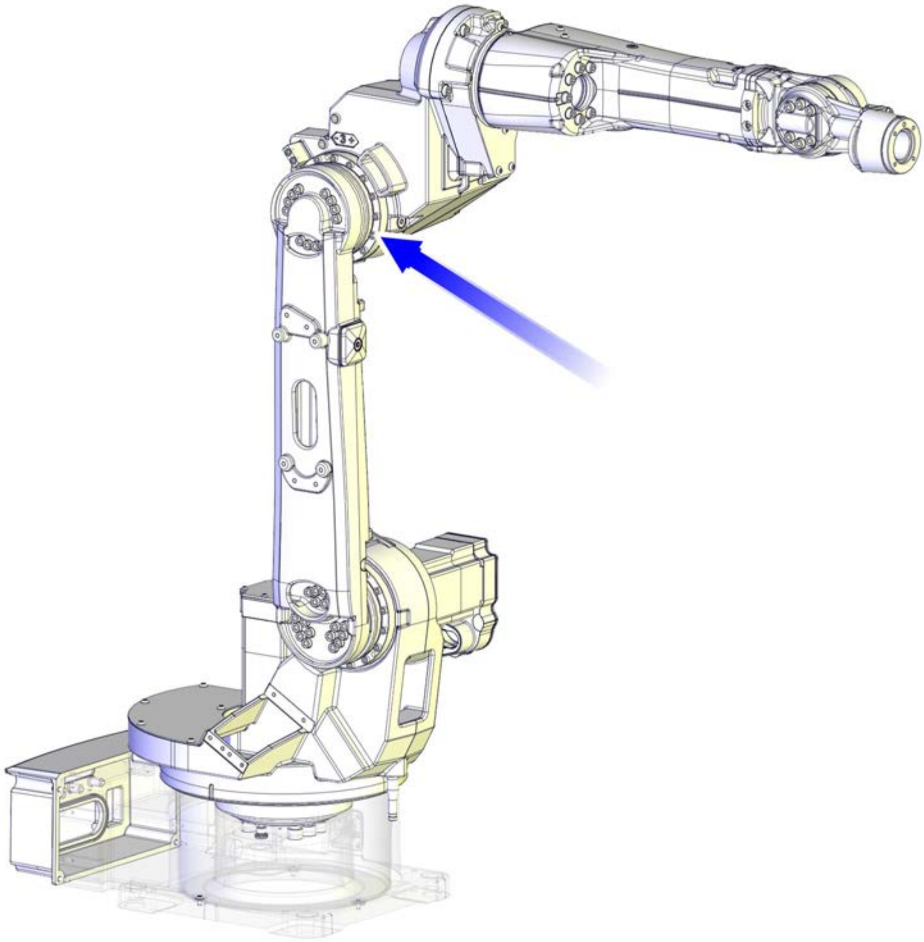
	Action	Note
3	Check the o-ring. Replace if damaged!	 xx1100000458
4	Put some grease on the o-ring.	
5	Fit two guide pins in opposite holes.	 xx1100000460 Always use guide pins in pairs!
6	Put the gearbox on the guide pins and slide it in position.	
7	Secure the gearbox with its attachment screws.	Tightening torque: 17 Nm. M6x40 (16 pcs)
8	Remove the guide pins and fit the two remaining attachments screws.	Tightening torque: 17 Nm.

Continues on next page

	Action	Note
9	Refit the complete arm system.	See *Replacing the complete arm system on page 181*.
10	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	
11	Refit the axis 2 motor. Mate pinion and gear carefully.	See *Replacing motors on axis 1 and 2 on page 232*.
12	Refit the cable harness in the base and frame.	See *Replacing the cable harness - lower end on page 145*.
13	Perform a leak-down test.	See *Performing a leak-down test on page 136*.
14	Refill oil in the gearbox.	See *Changing the oil, axis-2 gearbox on page 116*.
15	Recalibrate the robot.	Calibration is described in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.
16	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 75*.	

5.7.3 Replacing the axis 3 gearbox

Location of axis 3 gearbox



xx1100000385

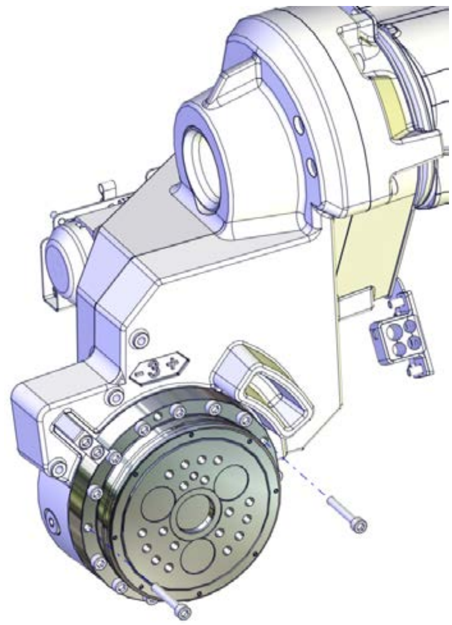
Required equipment

Equipment	Art. no.	Note
Gearbox, axis 3	See *Spare parts on page 307*.	
Lifting accessories		
Standard toolkit	-	Content is defined in section *Standard tools on page 303*.
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.

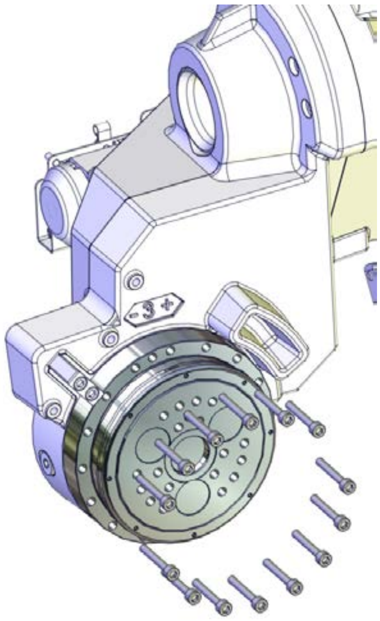
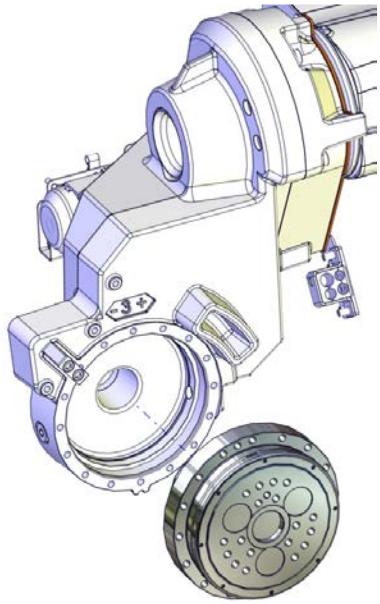
Continues on next page

Removing the axis 3 gearbox

Use this procedure to remove the axis 3 gearbox.

	Action	Note
1	Drain the axis 3 gearbox from oil.	See *Changing the oil, axis-3 gearbox on page 120*.
2	Jog the robot to the synchronization position.	
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
4	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	
5	Remove the axis 3 motor.	See *Replacing motors on axes 3 and 4 on page 242*.
6	Remove the cable harness in the upper arm.	See *Replacing the cable harness - upper end on page 165*.
7	Remove the complete upper arm.	See *Replacing the complete upper arm, IRB 1510ID on page 186*.
8	Place the complete upper arm on a workbench, some pallets or similar.	
9	Remove two of the attachment screws and fit two guide pins in opposite holes.	 xx1100000463 Always use guide pins in pairs.

Continues on next page

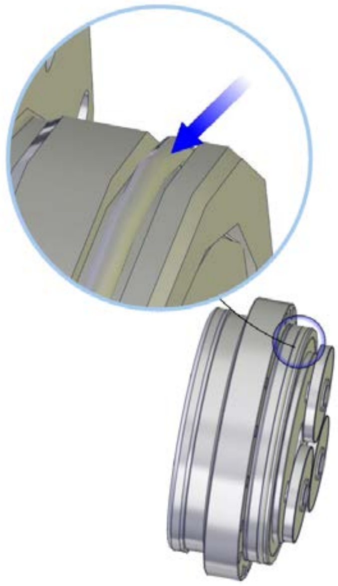
	Action	Note
10	Unscrew the remaining attachment screws securing the gearbox.	 xx1100000464
11	If needed use the threaded holes on the gearbox and press out the gearbox.	
12	Slide the gearbox out on the guide pins and remove it.	 xx1100000465

Refitting the axis 3 gearbox

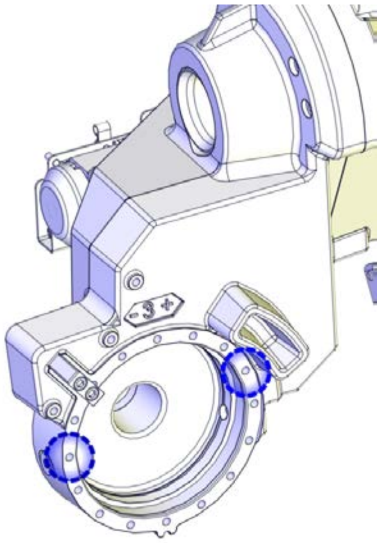
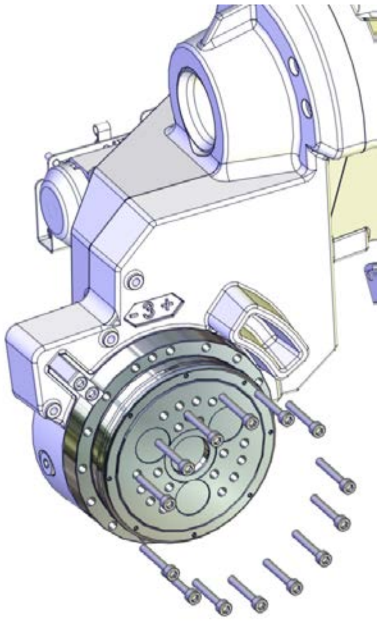
Use this procedure to refit the axis 3 gearbox.

	Action	Note
1	Wipe clean all mating surfaces on lower arm and frame with isopropanol.	

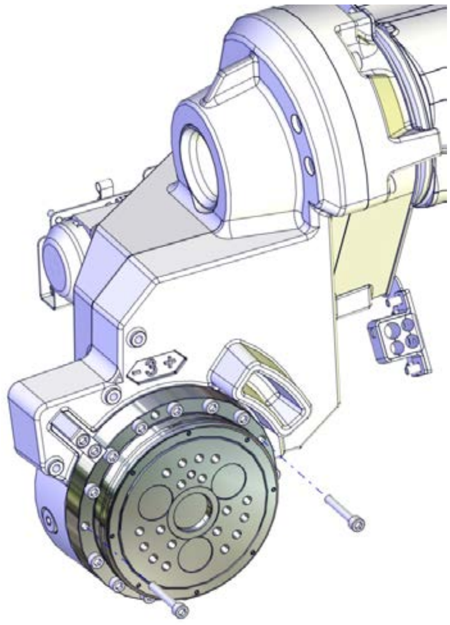
Continues on next page

	Action	Note
2	Check the protection ring.	 xx1100000459
3	Check the o-ring. Replace if damaged!	 xx1100000458
4	Put some grease on the o-ring.	

Continues on next page

	Action	Note
5	Fit two guide pins in opposite holes for attachment screws.	 xx1100000466
6	Place the gearbox on the guide pins and slide it in position.	
7	Secure the gearbox with its attachment screws.	 xx1100000464 Tightening torque: 14 Nm. M6x40 (16 pcs)

Continues on next page

	Action	Note
8	Remove the guide pins and fit the two remaining attachment screws.	 xx1100000463 Tightening torque: 14 Nm. M6x40
9	Refit the complete upper arm.	See *Replacing the complete upper arm, IRB 1510ID on page 186*.
10	**CAUTION** Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	
11	Refit the axis 3 motor. Mate pinion and gear carefully!	See *Replacing motors on axes 3 and 4 on page 242*.
12	Refit the cable harness.	See *Replacing the cable harness - upper end on page 165*.
13	Perform a leak-down test.	See *Performing a leak-down test on page 136*.
14	Refill the gearbox with oil.	See *Changing the oil, axis-3 gearbox on page 120*.
15	Recalibrate the robot.	Calibration is described in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section *Calibration information on page 277*.
16	**DANGER** Make sure all safety requirements are met when performing the first test run. See *Test run after installation, maintenance, or repair on page 75*.	

5.7.4 Service work on axes 4, 5 and 6 gearboxes

Replacing of gearboxes

The gearboxes of axes 4, 5 and 6 are intended to run without requiring any repairs or maintenance work. This implies that they must under *no circumstances* be opened or serviced.

If the gearboxes require replacement:

- axis 4: the complete upper arm is to be replaced. This procedure is detailed in section *Replacing the complete upper arm, IRB 1510ID on page 186*.
- axes 5 and 6: the complete wrist unit is to be replaced. This procedure is detailed in section *Replacing the wrist unit, IRB 1600ID on page 198*.

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6 Calibration information

6.1 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 283*. This will occur when:

- The battery is discharged
- A resolver error occurs
- The signal between a resolver and measurement board is interrupted
- A robot axis is moved with the control system disconnected

The revolution counters must also be updated after the robot and controller are connected at the first installation.

The robot is rebuilt

If the robot is rebuilt, for example, after a crash or when the reachability of a robot is changed, it needs to be re-calibrated for new resolver values.

If the robot has *absolute accuracy* calibration, it needs to be calibrated for new absolute accuracy.

Robot is not floor mounted

The original calibration data delivered with the robot is generated when the robot is floor mounted. If the robot is not floor mounted, then the robot accuracy could be affected. The robot needs to be calibrated after it is mounted.

6.2 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.	Calibration Pendulum
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). 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
Optimization	Optimization of TCP reorientation performance. The purpose is to improve reorientation accuracy for continuous processes like welding and gluing. Wrist optimization will update standard calibration data for axes 4 and 5.	Wrist Optimization

Brief description of calibration methods

Calibration Pendulum method

Calibration Pendulum is a standard calibration method for calibration of some ABB robots.

Two different routines are available for the Calibration Pendulum method:

- Calibration Pendulum II
- Reference calibration

Continues on next page

The calibration equipment for Calibration Pendulum is delivered as a complete toolkit, including the *Operating manual - Calibration Pendulum*, which describes the method and the different routines further.

Wrist Optimization method

Wrist Optimization is a method for improving reorientation accuracy for continuous processes like welding and gluing and is a complement to the standard calibration method.

The actual instructions of how to perform the wrist optimization procedure is given on the FlexPendant.

CalibWare - Absolute Accuracy calibration

The CalibWare tool guides through the calibration process and calculates new compensation parameters. This is further detailed in the *Application manual - CalibWare Field*.

If a service operation is done to a robot with the option Absolute Accuracy, a new absolute accuracy calibration is required in order to establish full performance. For most cases after replacements that do not include taking apart the robot structure, standard calibration is sufficient.

References

Article numbers for the calibration tools are listed in the section *Special tools on page 304*.

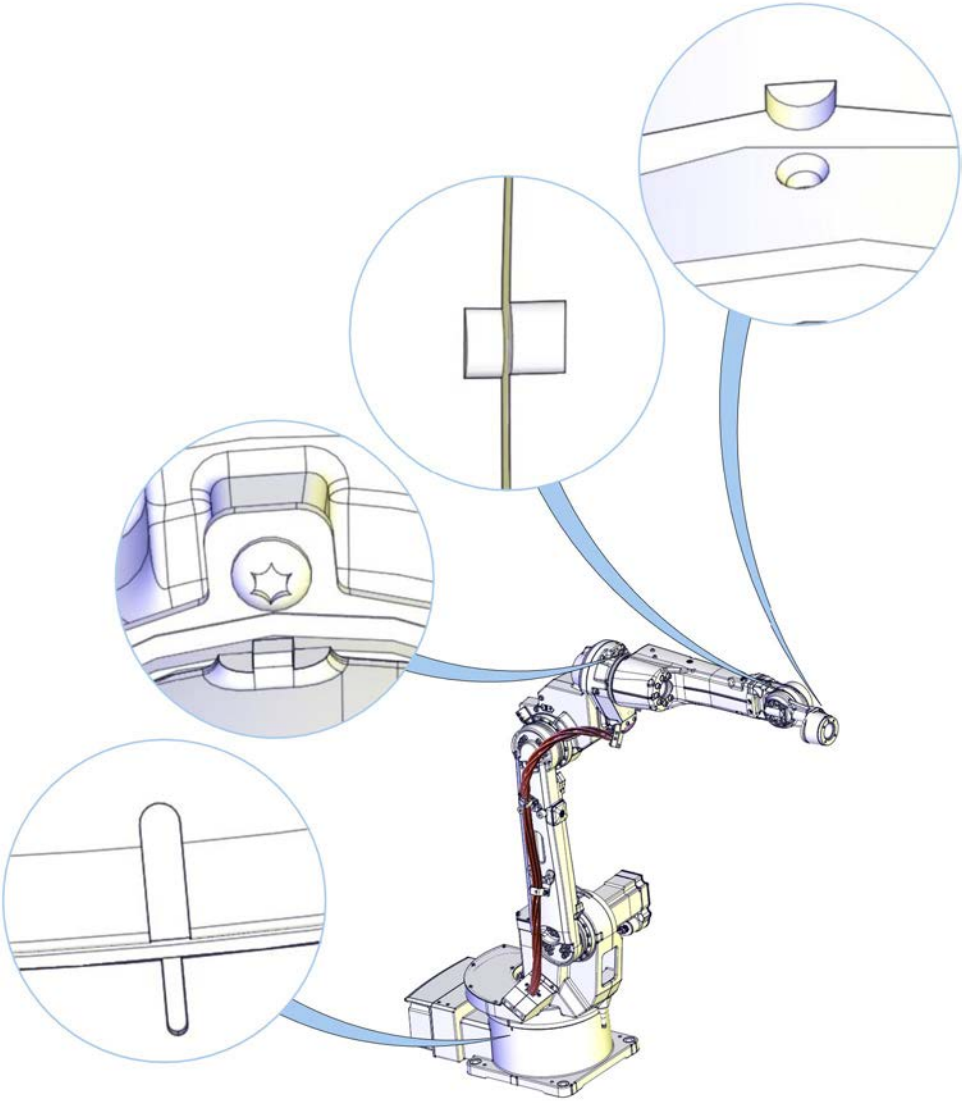
The calibration equipment for Calibration Pendulum is delivered as a complete toolkit, including the *Operating manual - Calibration Pendulum*, which describes the method and the different routines further.

6.3 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 1510



xx1100000363

Figure 6.1: Calibration marks (from bottom left to top right): Axis 1, axis 4, axis 5 and axis 6.

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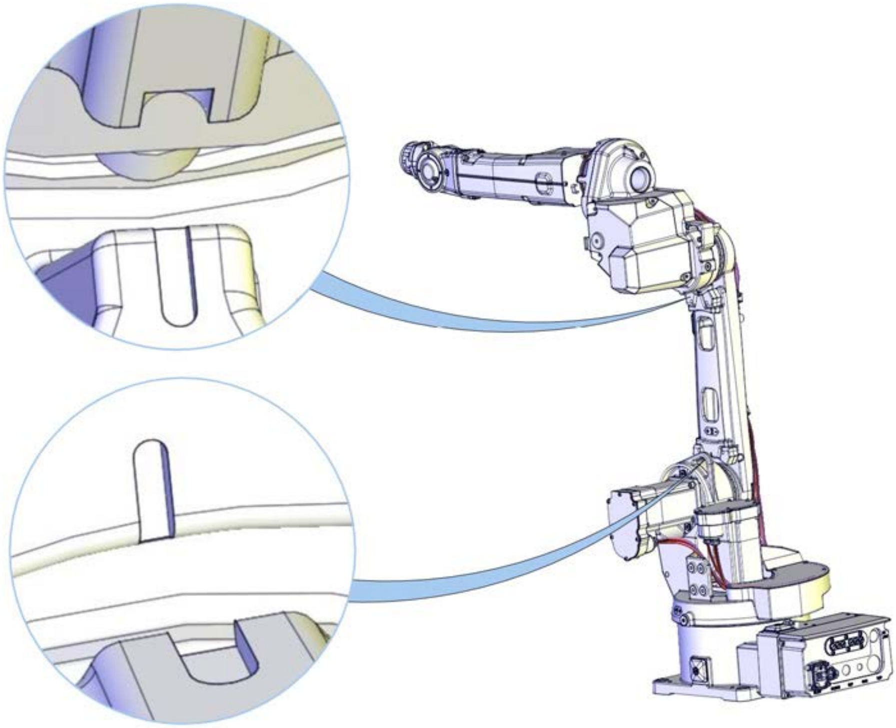


xx1100000364

Figure 6.2: Calibration marks (from top to bottom): Axis 3 and axis 2.

6.4 Calibration movement directions for all axes

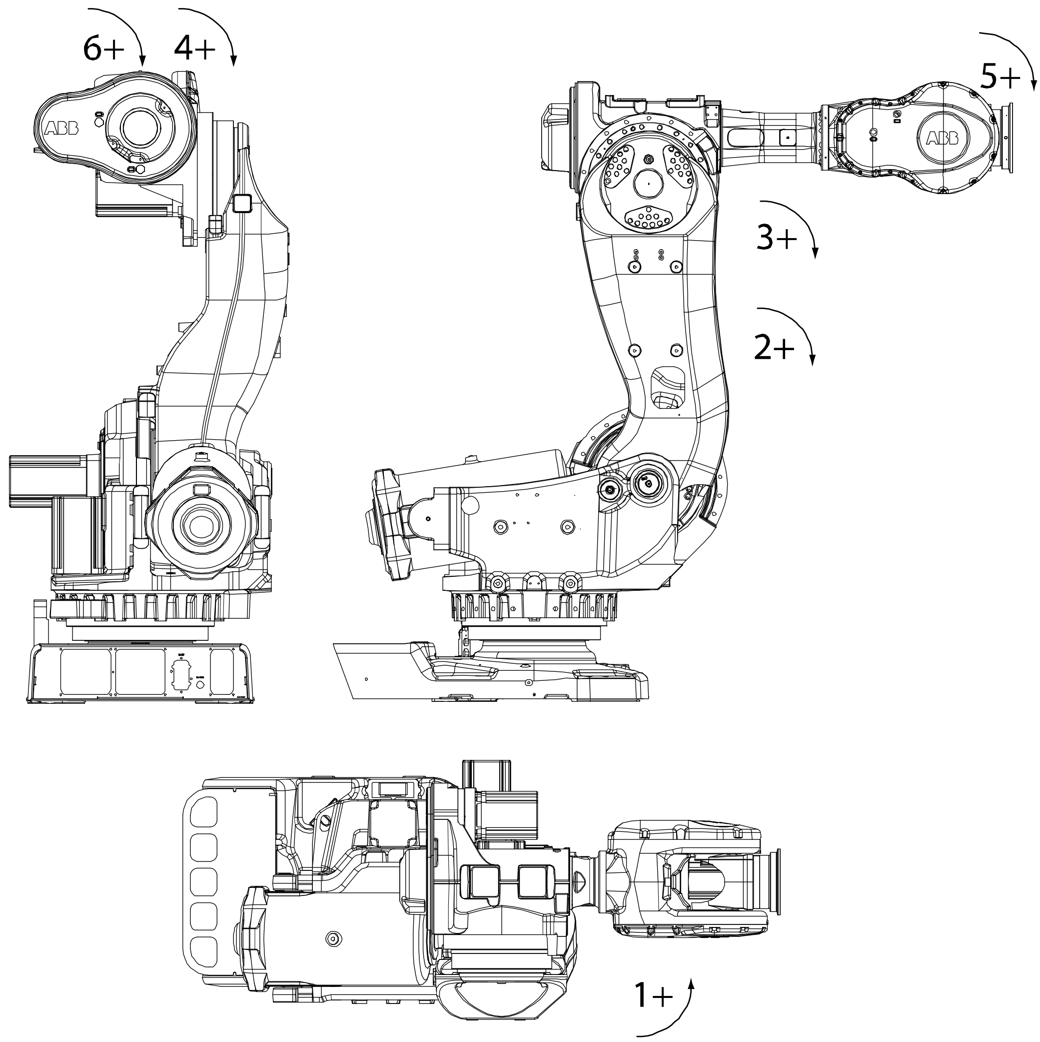
Overview

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

6.5 Updating revolution counters

6.5.1 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.

Coupled axes

When updating the revolution counters for a coupled axis, also the axis it is coupled to needs to be at its synchronization position for the update to be correct; i.e. axis 4 needs to be in synchronization position when updating axis 5 and 6.

With reversed coupled joints, the relationship is the opposite, i.e. axis 4 needs to be in synchronization position to update axis 3.

Coupled axes	IRB 1410	IRB 1510	IRB 1520	IRB 1600	IRB 1600ID	IRB 1660ID	IRB 910 SC	IRB 2400	IRB 2600	IRB 2600ID	IRB 4400	IRB 4450S	IRB 4600
Axis 4, 5, 6				x				x	x		x	x	x
Axis 5, 6	x	x	x		x	x				x			
Axis 4, 3							x						

Step 1 - Manually running the manipulator to the synchronization position

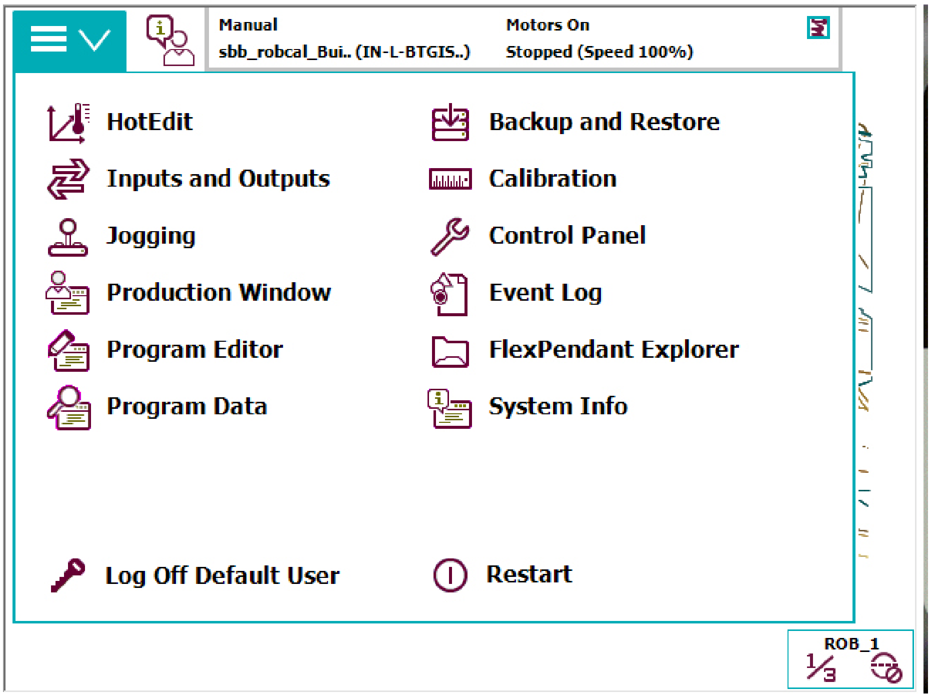
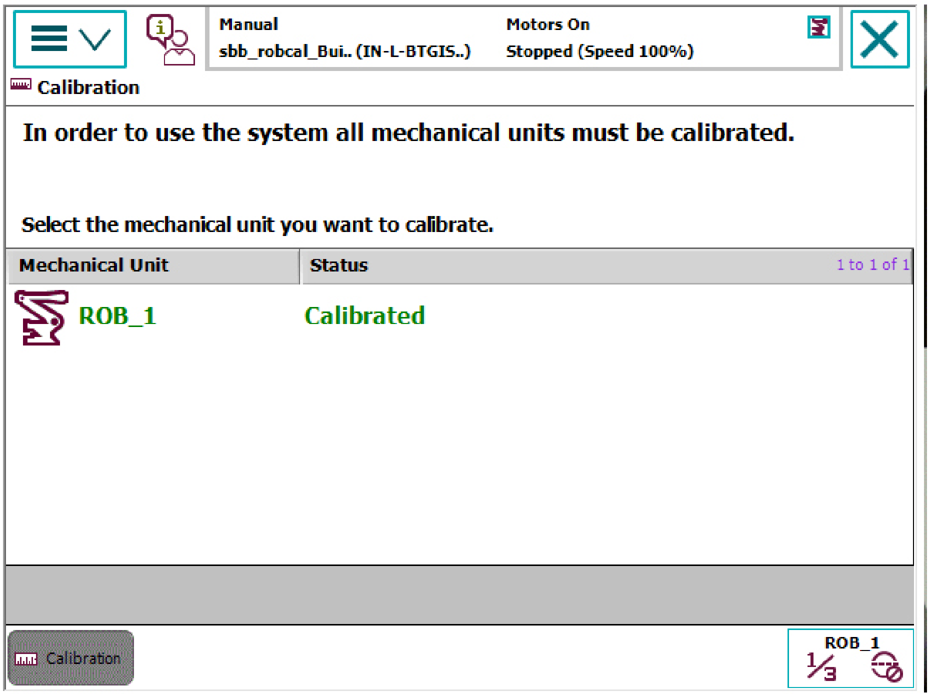
Use this procedure to manually run the manipulator to the synchronization position.

	Action	Note
1	Select axis-by-axis motion mode.	
2	Jog the manipulator to align the synchronization marks.	See *Synchronization marks and synchronization position for axes on page 280*.
3	When all axes are positioned, update the revolution counter.	*Step 2 - Updating the revolution counter with the FlexPendant on page 284*.

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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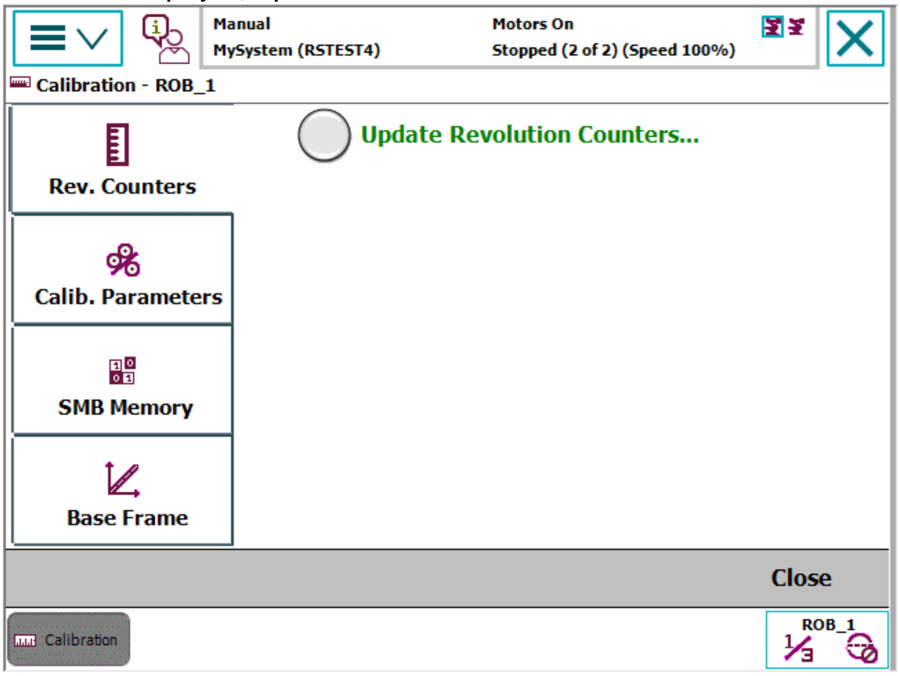
	Action
3	A screen is displayed, tap **Rev. Counters**.  en0400000771
4	Tap **Update Revolution Counters...**. A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions: • Tap **Yes** to update the revolution counters. • Tap **No** to cancel updating the revolution counters. Tapping **Yes** displays the axis selection window.
5	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**.
6	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.
7	**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 288*.

6.6 Calibrating with Wrist Optimization method

When to run Wrist Optimization

Wrist Optimization routine is run to improve TCP reorientation performance.

Calibrating the robot with standard calibration method overwrites the optimized positions of axes 4, 5. Re-run the **Wrist Optimization** routine after standard calibration to re-achieve the optimized positions of the wrist axes.

Overview of the calibration procedure on the FlexPendant

The actual instructions of how to perform the calibration procedure and what to do at each step is given on the FlexPendant. You will be guided through the calibration procedure, step by step.

Use the following list to learn about the calibration procedure before running the RobotWare program on the FlexPendant. It gives you a brief overview of the calibration procedure sequence.

After the calibration method has been called for on the FlexPendant, the following sequence will be run.

1 Choose calibration routine Wrist Optimization.

2 Modify targets for 4-point tool frame definition, in Wrist Optimization routine.

Tip

Select positions with large reorientations around the TCP. For best results, make sure that axis 4 and 5 have large movements.

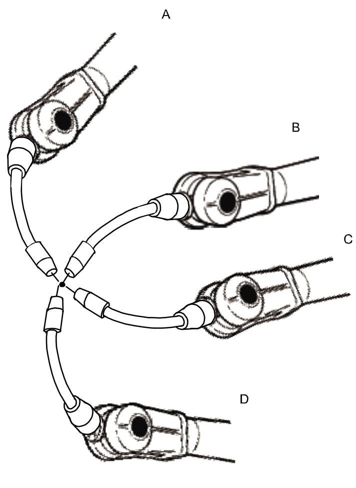
a Jog the robot to an appropriate position, A, for the first approach point.

Use small increments to accurately position the tool tip as close to the reference point as possible.

b Tap **Modify Position** to define the point.

c Repeat for each approach point to be defined, positions B, C, and D.

Jog away from the fixed world point to achieve the best result. Just changing the tool orientation will not give as good a result.



en0400000906

3 Improved calibration data to the wrist axes is identified and presented.

4 Optimized positions for the wrist axes are presented.

Continues on next page

5 The robot moves to the optimized positions for the wrist axes and automatically overwrites previous calibration data.

WARNING

Robot moves automatically when pressing **Calibrate**.

6 Wrist optimization is finished.

7 Redefine / verify TCP for all tools.

6.7 Checking the synchronization position

Introduction

Check the synchronization position of the robot before beginning any programming of the robot system. This may be done:

- Using a `MoveAbsJ` instruction with argument zero on all axes.
- Using the **Jogging** window on the FlexPendant.

Continues on next page

6.7.1 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 280* and *Updating revolution counters on page 283*.

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 280* and *Updating revolution counters on page 283*.

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7 Decommissioning

7.1 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 292*.

Transportation

Prepare the robot or parts before transport, this to avoid hazards.

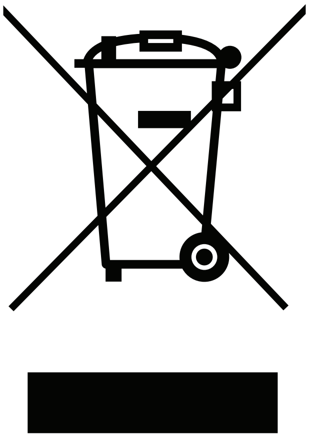
7.2 Environmental information

Introduction

ABB robots contain components in different materials. During decommissioning, all materials should be dismantled, recycled, or reused responsibly, according to the relevant laws and industrial standards. Robots or parts that can be reused or upcycled helps to reduce the usage of natural resources.

Symbol

The following symbol indicates that the product must not be disposed of as common garbage. Handle each product according to local regulations for the respective content (see table below).



xx1800000058

Materials used in the product

The table specifies some of the materials in the product and their respective use throughout the product.

Dispose components properly according to local regulations to prevent health or environmental hazards.

Material	Example application
Aluminium	Covers, synchronization brackets
Batteries, Lithium	Serial measurement board
Cast iron/nodular iron	Base, lower arm, upper arm
Copper	Cables, motors
Neodymium	Brakes, motors
Oil, grease	Gearboxes
Plastic/rubber	Cables, connectors, drive belts, and so on.
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.

7.3 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.

8 Reference information

8.1 Introduction

General

This chapter includes general information, complementing the more specific information in the different procedures in the manual.

8.2 Applicable standards

Note

The listed standards are valid at the time of the release of this document. Phased out or replaced standards are removed from the list when needed.

General

The product is designed in accordance 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 deviations from ISO 10218-1:2011, these are listed in the declaration of incorporation which is part of the product delivery.

Normative standards as referred to from ISO 10218-1

Standard	Description
ISO 9283:1998	Manipulating industrial robots - Performance criteria and related test methods
ISO 10218-2	Robots and robotic devices - Safety requirements for industrial robots - Part 2: Robot systems and integration
ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
ISO 13849-1:2006	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design
ISO 13850	Safety of machinery - Emergency stop - Principles for design
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements

Deviations from ISO 10218-1:2011 for IRC5 with MultiMove

A deviation exists towards ISO 10218-1:2011, paragraph *5.9 Control of simultaneous motion*, for the option MultiMove. See the application manual for MultiMove.

Other standards used in design

Standard	Description
ISO 9787:2013	Robots and robotic devices -- Coordinate systems and motion nomenclatures
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 13732-1:2006	Ergonomics of the thermal environment - Part 1
IEC 60974-1:2012[i]	Arc welding equipment - Part 1: Welding power sources
IEC 60974-10:2014[i]	Arc welding equipment - Part 10: EMC requirements
ISO 14644-1:2015[ii]	Classification of air cleanliness

Continues on next page

Standard	Description
IEC 60529:1989 + A2:2013	Degrees of protection provided by enclosures (IP code)

i Only valid for arc welding robots. Replaces IEC 61000-6-4 for arc welding robots.
ii Only robots with protection Clean Room.

8.3 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	

8.4 Screw joints

General

This section describes how to tighten the various types of screw joints on ABB robots.

The instructions and torque values are valid for screw joints comprised of metallic materials and do *not* apply to soft or brittle materials.

UNBRAKO screws

UNBRAKO is a special type of screw recommended by ABB for certain screw joints. It features special surface treatment (Gleitmo as described below) and is extremely resistant to fatigue.

Whenever used, this is specified in the instructions, and in such cases, *no other type of replacement screw* is allowed. Using other types of screws will void any warranty and may potentially cause serious damage or injury.

Gleitmo treated screws

Gleitmo is a special surface treatment to reduce the friction when tightening the screw joint. It is recommended by ABB for M6-M20 screw joints. Screws treated with Gleitmo may be reused 3-4 times before the coating disappears. After this the screw must be discarded and replaced with a new one.

When handling screws treated with Gleitmo, protective gloves of **nitrile rubber** type should be used.

Generally, screws are lubricated with *Gleitmo 603* mixed with *Geomet 500* or *Geomet 702* in proportion 1:3. *Geomet* thickness varies according to screw dimensions, refer to the following.

Dimension	Lubricant	Geomet thickness
M6-M20 (any length except M20x60)	*Gleitmo 603* + *Geomet 500*	3-5 µm
M6-M20 (any length except M20x60)	*Gleitmo 603* + *Geomet 720*	3-5 µm
M20x60	*Gleitmo 603* + *Geomet 500*	8-12 µm
M20x60	*Gleitmo 603* + *Geomet 720*	6-10 µm

Screws lubricated in other ways

Screws lubricated with Molykote 1000 or Molykote P1900 should *only* be used when specified in the repair, maintenance or installation procedure descriptions.

In such cases, proceed as follows:

1. Apply lubricant to the screw thread.
2. Apply lubricant between the plain washer and screw head.
3. Screw dimensions of M8 or larger must be tightened with a torque wrench. Screw dimensions of M6 or smaller may be tightened without a torque wrench *if* this is done by trained and qualified personnel.

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Lubricant	Article number
Molykote 1000 (molybdenum disulphide grease)	3HAC042472-001
Molykote P1900 (molybdenum disulphide grease)	3HAC070875-001

Tightening torque

Before tightening any screw, note the following:

- Determine whether a **standard** tightening torque or **special** torque is to be applied. The **standard torques** are specified in the following tables. Any **special torques** are specified in the repair, maintenance or installation procedure descriptions. **Any special torque specified overrides the standard torque!**
- Use the *correct tightening torque* for each type of screw joint.
- Only use *correctly calibrated* torque keys.
- Always *tighten the joint by hand,* and never use pneumatic tools.
- Use the *correct tightening technique*, that is *do not* jerk. Tighten the screw in a slow, flowing motion.
- Maximum allowed total deviation from the specified value is **10%**!

Tightening torque for oil-lubricated screws with slotted or cross-recess head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws* with *slotted or cross-recess head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Tightening torque for oil-lubricated screws with allen head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws* with *allen head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Dimension	Tightening torque (Nm) Class 8.8, oil-lubricated	Tightening torque (Nm) Class 10.9, oil-lubricated	Tightening torque (Nm) Class 12.9, oil-lubricated
M5	6	-	-
M6	10	-	-
M8	24	34	40
M10	47	67	80
M12	82	115	140
M16	200	290	340
M20	400	560	670

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Dimension	Tightening torque (Nm) Class 8.8, oil-lubricated	Tightening torque (Nm) Class 10.9, oil-lubricated	Tightening torque (Nm) Class 12.9, oil-lubricated
M24	680	960	1150

Tightening torque for lubricated screws (Molykote, Gleitmo or equivalent) with allen head screws

The following table specifies the recommended standard tightening torque for *screws lubricated with Molycote 1000, Gleitmo 603 or equivalent* with *allen head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Dimension	Tightening torque (Nm) Class 10.9, lubricated [i]	Tightening torque (Nm) Class 12.9, lubricated [i]
M5		8
M6		14
M8	28	35
M10	55	70
M12	96	120
M16	235	300
M20	460	550
M24	790	950

i Lubricated with Molycote 1000, Gleitmo 603 or equivalent

8.5 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.	

8.6 Standard tools

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
1	Ring-open-end spanner 8-19 mm
1	Socket head cap 2.5-17 mm
1	Torx socket no: 20-60
1	Torque wrench 4-200 Nm
1	Small screwdriver
1	Plastic mallet
1	Ratchet head for torque wrench 1/2"
1	Socket head cap no: 5, socket 1/2" bit L 20 mm
1	Socket head cap no: 6, socket 1/2" bit L 20 mm
1	Socket head cap no: 8, socket 1/2" bit L 20 mm
1	Socket head cap no: 10, socket 1/2" bit L 20 mm
1	Socket head cap no: 12, socket 1/2" bit L 20 mm
1	Socket head cap no: 14, socket 1/2" bit L 20 mm
1	100 mm extension, 1/2" square drive
1	Small cutting plier
1	T-handle with ball head

8.7 Special tools

Special tools

Tool	Art. no.	Note
Guide pin	3HAC15520-1	M8 x 100 Used for replacement of axis 1 gearbox. Always use the guide pins in pairs.
Guide pin	3HAC041574-001	M6 x 100 Used for axis 1 and 2. Always use the guide pins in pairs.
Guide pin	3HAC039940-001	Used for replacing the base. Always use the guide pins in pairs.

Lifting accessory

Equipment	Art. no.
Lifting and turning tool for suspended robot	3HAC041569-001 Includes instruction 3HAC041419-002.

Calibration equipment, Calibration Pendulum

The following table specifies the calibration equipment needed when calibrating the robot with the Calibration Pendulum method.

Tools	Art. no.	Note
Calibration Pendulum tool set	3HAC15716-1	Complete kit that also includes operating manual.
Calibration tool set	3HAC041422-001	Additional equipment to the Calibration Pendulum tool set, required for calibration of axis 1. Includes calibration tool block, parallel pins and a protection screw.

8.8 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.

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9 Spare parts

9.1 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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