



Product manual

IRB 6620LX

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**Product manual
IRB 6620LX
IRC5**

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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.

Organization of chapters

The manual is organized in the following chapters:

Chapter	Contents
Safety	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 on the robot. Based on available spare parts.
Calibration	Calibration procedures and 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.

Continues on next page

Overview of this manual

Continued

Chapter	Contents
Spare parts and exploded views	Complete spare part list and complete list of robot components, shown in the exploded views.
Circuit diagrams	Reference to the circuit diagram for the robot.

References

Following manuals are referred to from inside of the product manual. All referred manuals are found on the documentation DVD.

Reference	Document ID
<i>Product specification - IRB 6620</i>	3HAC025861-001
<i>Product manual, spare parts - IRB 6620LX</i>	3HAC049110-001
<i>Product specification - Linear Axis</i>	3HAC036094-001
<i>Circuit diagram - IRB 6620 / IRB 6620LX</i>	3HAC025090-001
<i>Operating manual - General safety information</i> ⁱ	3HAC031045-001
<i>Product manual - IRC5</i> IRC5 with main computer DSQC 639.	3HAC021313-001
<i>Product manual - IRC5</i> IRC5 with main computer DSQC1000.	3HAC047136-001
<i>Operating manual - IRC5 with FlexPendant</i>	3HAC050941-001
<i>Operating manual - Calibration Pendulum</i>	3HAC16578-1
<i>Operating manual - Service Information System</i>	3HAC050944-001
<i>Application manual - Additional axes and stand alone controller</i>	3HAC051016-001
<i>Technical reference manual - Lubrication in gearboxes</i>	3HAC042927-001
<i>Technical reference manual - System parameters</i>	3HAC050948-001
<i>Application manual - CalibWare Field 5.0</i>	3HAC030421-001
<i>System manual - Automatic lubrication system (Güdel)</i>	-
<i>Installation guide - Gliding applications (IGUS)</i> Always download latest version from http://www.igus.com .	IGUS_installation-guide_en
<i>Transport and startup - E-chainsystems (IGUS)</i> Always download latest version from http://www.igus.com .	Transport and startup of assembled e-chainsystems
<i>Operating manual - TM-O Sizes 40-90 (Güdel)</i> Contains information for linear axes built before 2014.	D000679-1
<i>Operating manual - TM-O 1-4 (Güdel)</i> Contains information for linear axes built after 2014.	D003806-1

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

Revisions

Revision	Description
-	First edition

Continues on next page

Revision	Description
A	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> • Corrected tightening torques in sections Lifting and securing the frame on page 69, and Joining two frame tracks on page 76. • Circuit diagrams are not included in this document but delivered as separate files. See Circuit diagram on page 355. • List of standards updated, see Applicable standards on page 343. <p>The chapter Safety updated with:</p> <ul style="list-style-type: none"> • Updated safety signal graphics for the levels Danger and Warning, see Safety signals in the manual on page 39. • New safety labels on the manipulators, see Safety symbols on product labels on page 41. • Revised terminology: <i>robot</i> replaced with <i>manipulator</i>.
B	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> • Updates in chapter Calibration. • Minor updates.
C	<p>Minor updates.</p>
D	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> • A new block, about general illustrations, added in section How to read the product manual on page 15. • Some general tightening torques have been changed/added, see updated values in Screw joints on page 346. • The interval for changing oil in axis-2 gearbox is added to the maintenance schedule, see Maintenance schedule on page 129. • Added WARNING - Safety risks during handling of batteries on page 54. • Added Automatic lubrication system on page 124. • All data about type of lubrication in gearboxes is moved from the manual to a separate lubrication manual, see Type and amount of oil in gearboxes on page 152. • Edited information about securing the frame support (welded), see Lifting and securing the frame on page 69.
E	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> • Added section on page ?. • Added information about handling of signal from grease level sensor, see Automatic lubrication system on page 124. • Corrected location of label for lifting, see Inspecting the information labels on page 146. • Spare part number for wrist (standard) was wrong. Has been corrected. • Corrected the method of inspecting oil level in the axis-6 gearbox, see Inspecting the oil level in axis-6 gearbox on page 143. • A new SMB unit and battery is introduced, with longer battery lifetime.
F	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> • Corrected interval for oil change in axis-4 gearbox, Maintenance schedule on page 129. • Corrected spare part number for axis-1 motor. • Added information about risks when scrapping a decommissioned robot, see Scraping of robot on page 342. • <i>Spare parts and exploded views</i> are not included in this document but delivered as a separate document. See Product manual, spare parts - IRB 6620LX.

Continues on next page

Overview of this manual

Continued

Revision	Description
G	This revision includes the following updates: <ul style="list-style-type: none">• Changed dimension of cable holder carrier screw, see Replacement of cable harness, upper end on page 201.• Added new sections to the manual: Robot transportation precautions on page 58 Working range and type of motion on page 63 Robot cabling and connection points on page 126• Minor corrections.
H	This revision includes the following updates: <ul style="list-style-type: none">• The value for the system parameter <i>Gamma Rotation</i> is corrected, see Setting the system parameters for a suspended or tilted robot on page 110.• Information is added about reducing the risk for vibrations, see Optimizing the performance on page 121.• Improvements Foundry Plus added throughout the manual. New wrist cover and improved sealing on arm house cover, and more.
J	This revision includes the following updates: <ul style="list-style-type: none">• Additional information about the linear axis is added throughout the manual.
K	Published in release R17.1. The following updates are done in this revision: <ul style="list-style-type: none">• New standard calibration method is introduced (Axis Calibration). See Calibration on page 305.• Corrections due to updates in terminology for spare parts.• Maintenance interval for changing the axis-1 gearbox oil is changed.

Product documentation, IRC5

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.

All documents listed can be ordered from ABB on a DVD. The documents listed are valid for IRC5 robot systems.

Product manuals

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

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

Technical reference manuals

The technical reference manuals describe reference information for robotics products.

- *Technical reference manual - Lubrication in gearboxes*: Description of types and volumes of lubrication for the manipulator gearboxes.
- *Technical reference manual - RAPID overview*: An overview of the RAPID programming language.
- *Technical reference manual - RAPID Instructions, Functions and Data types*: Description and syntax for all RAPID instructions, functions, and data types.
- *Technical reference manual - RAPID kernel*: A formal description of the RAPID programming language.
- *Technical reference manual - System parameters*: Description of system parameters and configuration workflows.

Continues on next page

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, DVD with PC software).
- How to install included or required hardware.
- How to use the application.
- 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 trouble shooters.

The group of manuals includes (among others):

- *Operating manual - Emergency safety information*
- *Operating manual - General safety information*
- *Operating manual - Getting started, IRC5 and RobotStudio*
- *Operating manual - IRC5 Integrator's guide*
- *Operating manual - IRC5 with FlexPendant*
- *Operating manual - RobotStudio*
- *Operating manual - Trouble shooting IRC5*

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 <i>rear attachment screws, gearbox</i> .	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 <i>sealing, axis 2</i> 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 17](#).

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 Introduction to safety information

Overview

The safety information in this manual is divided into the following categories:

- General safety aspects, important to attend to before performing any service work on the robot. These are applicable for all service work and are found in [General safety information on page 18](#).
- Safety signals and symbols shown in the manual and on the robot, warning for different types of dangers, are found in [Safety signals and symbols on page 39](#).
- Specific safety information, pointed out in the procedures. How to avoid and eliminate the danger is either described directly in the procedure, or in specific instructions in the section [Safety related instructions on page 47](#).

1 Safety

1.2.1 Introduction to general safety information

1.2 General safety information

1.2.1 Introduction to general safety information

Definitions

This section details general safety information for personnel performing installation, repair and maintenance work.

Sections

The general safety information is divided into the following sections.

Section	Examples of content
<i>Safety in the manipulator system on page 19</i>	This section describes the following: <ul style="list-style-type: none">• safety, service• limitation of liability• related information
<i>Protective stop and emergency stop on page 21</i>	This section describes protective stop and emergency stop.
<i>Safety risks on page 22</i>	This section lists dangers relevant when working with the product. The dangers are split into different categories. <ul style="list-style-type: none">• safety risks during installation or service• risks associated with live electrical parts
<i>Safety actions on page 31</i>	This section describes actions which may be taken to remedy or avoid dangers. <ul style="list-style-type: none">• fire extinguishing• safe use of the teach pendant or jogging device

1.2.2 Safety in the manipulator system

Validity and responsibility

The information does not cover how to design, install and operate a complete system, nor does it cover all peripheral equipment that can influence the safety of the entire system. To protect personnel, the complete system must be designed and installed in accordance with the safety requirements set forth in the standards and regulations of the country where the robot is installed.

The users of ABB industrial robots are responsible for ensuring that the applicable safety laws and regulations in the country concerned are observed and that the safety devices necessary to protect people working with the robot system are designed and installed correctly. Personnel working with robot must be familiar with the operation and handling of the industrial robot as described in the applicable documents, for example:

- *Operating manual - IRC5 with FlexPendant*
- *Operating manual - General safety information*¹
- *Product manual*

¹ This manual contains all safety instructions from the product manuals for the robots and the controllers.

The robot system shall be designed and constructed in such a way as to allow safe access to all areas where intervention is necessary during operation, adjustment, and maintenance.

Where it is necessary to perform tasks within the safeguarded space there shall be safe and adequate access to the task locations.

Users shall not be exposed to hazards, including slipping, tripping, and falling hazards.

Connection of external safety devices

Apart from the built-in safety functions, the robot is also supplied with an interface for the connection of external safety devices. An external safety function can interact with other machines and peripheral equipment via this interface. This means that control signals can act on safety signals received from the peripheral equipment as well as from the robot.

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.

Related information

Type of information	Detailed in document	Section
Installation of safety devices	<i>Product manual for the robot</i>	Installation and commissioning
Changing operating modes	<i>Operating manual - IRC5 with FlexPendant</i> <i>Operator's Manual - IRC5P</i>	Operating modes

Continues on next page

1 Safety

1.2.2 Safety in the manipulator system

Continued

Type of information	Detailed in document	Section
Restricting the working space	<i>Product manual for the robot</i>	Installation and commissioning

1.2.3 Protective stop and emergency stop

Overview

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

1 Safety

1.2.4.1 Safety risks during installation and service work on robots

1.2.4 Safety risks

1.2.4.1 Safety risks during installation and service work on robots

Overview

This section includes information on general safety risks to be considered when performing installation and service work on the robot.

These safety instructions have to be read and followed by any person who deals with the installation and maintenance of the robot. Only persons who know the robot and are trained in the operation and handling of the robot are allowed to maintain the robot. Persons who are under the influence of alcohol, drugs or any other intoxicating substances are not allowed to maintain, repair, or use the robot.

General risks during installation and service

- The instructions in the product manual in the chapters *Installation and commissioning*, and *Repair* must always be followed.
- Emergency stop buttons must be positioned in easily accessible places so that the robot can be stopped quickly.
- Those in charge of operations must make sure that safety instructions are available for the installation in question.
- Those who install or service/maintain the robot must have the appropriate training for the equipment in question and in any safety matters associated with it.

Spare parts and special equipment

ABB does not supply spare parts and special equipment which have not been tested and approved by ABB. The installation and/or use of such products could negatively affect the structural properties of the robot and as a result of that affect the active or passive safety operation. ABB is not liable for damages caused by the use of non-original spare parts and special equipment. ABB is not liable for damages or injuries caused by unauthorized modifications to the robot system.

Personal protective equipment

Always use suitable personal protective equipment, based on the risk assessment for the robot installation.

Nation/region specific regulations

To prevent injuries and damages during the installation of the robot, the regulations applicable in the country concerned and the instructions of ABB Robotics must be complied with.

Non-voltage related risks

- Make sure that no one else can turn on the power to the controller and robot while you are working with the system. A good method is to always lock the main switch on the controller cabinet with a safety lock.

Continues on next page

1.2.4.1 Safety risks during installation and service work on robots

Continued

- Safety zones, which must be crossed before admittance, must be set up in front of the robot's working space. Light beams or sensitive mats are suitable devices.
- Turntables or the like should be used to keep the operator out of the robot's working space.
- If the robot is installed at a height, hanging, or other than standing directly on the floor, there may be additional risks than those for a robot standing directly on the floor.
- The axes are affected by the force of gravity when the brakes are released. In addition to the risk of being hit by moving robot parts, there is a risk of being crushed by the parallel arm (if there is one).
- Energy stored in the robot for the purpose of counterbalancing certain axes may be released if the robot, or parts thereof, are dismantled.
- When dismantling/assembling mechanical units, watch out for falling objects.
- Be aware of stored heat energy in the controller.
- Never use the robot as a ladder, which means, do not climb on the robot motors or other parts during service work. There is a serious risk of slipping because of the high temperature of the motors and oil spills that can occur on the robot.
- Never use the robot as a ladder, which means, do not climb on the manipulator motors or other parts during service work. There is a risk of the robot being damaged.

To be observed by the supplier of the complete system

When integrating the robot with external devices and machines:

- The supplier of the complete system must ensure that all circuits used in the safety function are interlocked in accordance with the applicable standards for that function.
- The supplier of the complete system must ensure that all circuits used in the emergency stop function are interlocked in a safe manner, in accordance with the applicable standards for the emergency stop function.

Complete robot

Safety risk	Description
Hot components!	 CAUTION Motors and gearboxes are HOT after running the robot! Touching motors and gearboxes may result in burns! With a higher environment temperature, more surfaces on the manipulator will get HOT and may also result in burns.

Continues on next page

1 Safety

1.2.4.1 Safety risks during installation and service work on robots

Continued

Safety risk	Description
Removed parts may result in collapse of the robot!	 WARNING Take any necessary measures to ensure that the robot does not collapse as parts are removed. For example, secure the lower arm according to the repair instruction if removing the axis-2 motor.
Removed cables to the measurement system	 WARNING If the internal cables for the measurement system have been disconnected during repair or maintenance, then the revolution counters must be updated.

Cabling

Safety risk	Description
Cable packages are sensitive to mechanical damage!	 CAUTION The cable packages are sensitive to mechanical damage. Handle the cable packages and the connectors with care in order to avoid damage.

Gearboxes and motors

Safety risk	Description
Gears may be damaged if excessive force is used!	 CAUTION Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!

1.2.4.2 CAUTION - Hot parts may cause burns!

1.2.4.2 CAUTION - Hot parts may cause burns!**Description**

During normal operation, many robot parts become hot, especially the drive motors and gearboxes. Sometimes areas around these parts also become hot. Touching these may cause burns of various severity.

Because of a higher environment temperature, more surfaces on the robot get hot and may result in burns.

Elimination

The following instructions describe how to avoid the dangers specified above:

	Action	Information
1	Always use your hand, at some distance, to feel if heat is radiating from the potentially hot component before actually touching it.	
2	Wait until the potentially hot component has cooled if it is to be removed or handled in any other way.	

1 Safety

1.2.4.3 Safety risks related to tools/work pieces

1.2.4.3 Safety risks related to tools/work pieces

Safe handling

It must be possible to safely turn off tools, such as milling cutters, etc. Make sure that guards remain closed until the cutters stop rotating.

It should be possible to release parts by manual operation (valves).

Safe design

Grippers/end effectors must be designed so that they retain work pieces in the event of a power failure or a disturbance to the controller.

Unauthorized modifications of the originally delivered robot are prohibited. Without the consent of ABB it is forbidden to attach additional parts through welding, riveting, or drilling of new holes into the castings. The strength could be affected.



CAUTION

Ensure that a gripper is prevented from dropping a work piece, if such is used.

1.2.4.4 Safety risks related to pneumatic/hydraulic systems

General

Special safety regulations apply to pneumatic and hydraulic systems.



Note

All components that remain pressurized after separating the machine from the power supply must be provided with clearly visible drain facilities and a warning sign that indicates the need for pressure relief before adjustments or performing any maintenance on the robot system.

Residual energy

- Residual energy can be present in these systems. After shutdown, particular care must be taken.
- The pressure must be released in the complete pneumatic or hydraulic systems before starting to repair them.
- Work on hydraulic equipment may only be performed by persons with special knowledge and experience of hydraulics.
- All pipes, hoses, and connections have to be inspected regularly for leaks and damage. Damage must be repaired immediately.
- Splashed oil may cause injury or fire.

Safe design

- Gravity may cause any parts or objects held by these systems 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.

1 Safety

1.2.4.5 Safety risks during operational disturbances

General

- The industrial robot is a flexible tool that can be used in many different industrial applications.
- All work must be carried out professionally and in accordance with the applicable safety regulations.
- Care must be taken at all times.

Qualified personnel

Corrective maintenance must only be carried out by qualified personnel who are familiar with the entire installation as well as the special risks associated with its different parts.

Extraordinary risks

If the working process is interrupted, extra care must be taken due to risks other than those associated with regular operation. Such an interruption may have to be rectified manually.

1.2.4.6 Risks associated with live electric parts

Voltage related risks, general

Work on the electrical equipment of the robot must be performed by a qualified electrician in accordance with electrical regulations.

- Although troubleshooting may, on occasion, need to be carried out while the power supply is turned on, the robot must be turned off (by setting the main switch to OFF) when repairing faults, disconnecting electric leads and disconnecting or connecting units.
- The main supply to the robot must be connected in such a way that it can be turned off from outside the working space of the robot.
- Make sure that no one else can turn on the power to the controller and robot while you are working with the system. A good method is to always lock the main switch on the controller cabinet with a safety lock.

The necessary protection for the electrical equipment and robot system during construction, commissioning, and maintenance is guaranteed if the valid regulations are followed.

All work must be performed:

- by qualified personnel
- on machine/robot system in deadlock
- in an isolated state, disconnected from power supply, and protected against reconnection.

Voltage related risks, IRC5 controller

A danger of high voltage is associated with, for example, the following parts:

- Be aware of stored electrical energy (DC link, Ultracapacitor bank unit) in the controller.
- Units such as I/O modules, can be supplied with power from an external source.
- The main supply/main switch
- The transformers
- The power unit
- The control power supply (230 VAC)
- The rectifier unit (262/400-480 VAC and 400/700 VDC. Note: capacitors!)
- The drive unit (400/700 VDC)
- The drive system power supply (230 VAC)
- The service outlets (115/230 VAC)
- The customer power supply (230 VAC)
- The power supply unit for additional tools, or special power supply units for the machining process.
- The external voltage connected to the controller remains live even when the robot is disconnected from the mains.
- Additional connections.

Continues on next page

1 Safety

1.2.4.6 Risks associated with live electric parts

Continued

Voltage related risks, robot

A danger of high voltage is associated with the robot in:

- The power supply for the motors (up to 800 VDC).
 - The user connections for tools or other parts of the installation (max. 230 VAC).
-

Voltage related risks, tools, material handling devices, etc.

Tools, material handling devices, etc., may be live even if the robot system is in the OFF position. Power supply cables which are in motion during the working process may be damaged.

1.2.5 Safety actions

1.2.5.1 Safety fence dimensions

General

Install a safety cell around the robot to ensure safe robot installation and operation.

Dimensioning

The fence or enclosure must be dimensioned to withstand the force created if the load being handled by the robot is dropped or released at maximum speed.

Determine the maximum speed from the maximum velocities of the robot axes and from the position at which the robot is working in the work cell (see the section *Robot motion* in the *Product specification*).

Also consider the maximum possible impact caused by a breaking or malfunctioning rotating tool or other device fitted to the robot.

1 Safety

1.2.5.2 Fire extinguishing



Note

Use a CARBON DIOXIDE (CO₂) extinguisher in the event of a fire in the robot or controller!

1.2.5.3 Emergency release of the robot arm

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 detailed in the section:

- [Manually releasing the brakes on page 105.](#)

The robot arm 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 arms does not increase the pressure on the trapped person, further increasing any injury!



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.

1 Safety

1.2.5.4 Brake testing

1.2.5.4 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 robot axis to a position where the combined weight of the robot arm 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 robot does not change position as the motors are switched off, then the brake function is adequate.

1.2.5.5 Risk of disabling function "Reduced speed 250 mm/s"



Note

Do not change *Transm gear ratio* or other kinematic system parameters from the FlexPendant or a PC. This will affect the safety function "Reduced speed 250 mm/s".

1 Safety

1.2.5.6 Safe use of the jogging device

1.2.5.6 Safe use of the jogging device

Three-position enabling device

The three-position enabling device is a manually operated, constant pressure push-button which, when continuously activated in one position only, allows potentially hazardous functions but does not initiate them. In any other position, hazardous functions are stopped safely.

The three-position enabling device is of a specific type where you must press the push-button only half-way to activate it. In the fully in and fully out positions, operating the robot is impossible.



Note

The three-position enabling device is a push-button located on the jogging device which, when pressed halfway in, switches the system to MOTORS ON. When the enabling device is released or pushed all the way in, the manipulator switches to the MOTORS OFF state.

To ensure safe use of the jogging device, the following must be implemented:

- The enabling device must never be rendered inoperational in any way.
- During programming and testing, the enabling device must be released as soon as there is no need for the robot to move.
- Anyone entering the working space of the robot must always bring the jogging device with him/her. This is to prevent anyone else from taking control of the robot without his/her knowledge.

Hold-to-run function

The hold-to-run function allows movement when a button connected to the function is actuated manually and immediately stops any movement when released. The hold-to-run function can only be used in manual mode.

How to operate the hold-to-run function for IRC5 is described in *Operating manual - IRC5 with FlexPendant*.

1.2.5.7 Work inside the working range of the robot



WARNING

If work must be carried out within the work area of the robot, then the following points must be observed:

- The operating mode selector on the controller must be in the manual mode position to render the three-position enabling device operational and to block operation from a computer link or remote control panel.
- The maximum speed of the robot is limited to 250 mm/s when the operating mode selector is in the position *Manual mode with reduced speed*. This should be the normal position when entering the working space.
The position *Manual mode with full speed (100%)* may only be used by trained personnel who are aware of the risks that this entails. *Manual mode with full speed (100%)* is not available in USA or Canada.
- Pay attention to the rotating axes of the robot. Keep away from axes to not get entangled with hair or clothing. Also, be aware of any danger that may be caused by rotating tools or other devices mounted on the robot or inside the cell.
- Test the motor brake on each axis, according to the section [Brake testing on page 34](#).
- To prevent anyone else from taking control of the robot, always put a safety lock on the cell door and bring the three-position enabling device with you when entering the working space.



WARNING

NEVER, under any circumstances, stay beneath any of the robot's axes! There is always a risk that the robot will move unexpectedly when robot axes are moved using the three-position enabling device or during other work inside the working range of the robot.

1 Safety

1.2.5.8 Signal lamp (optional)

1.2.5.8 Signal lamp (optional)

Description

A signal lamp with a yellow fixed light can be mounted on the robot, as a safety device.

Function

The lamp is active in MOTORS ON mode.

Further information

Further information about the MOTORS ON/MOTORS OFF mode may be found in the product manual for the controller.

1.3 Safety signals and symbols

1.3.1 Safety signals in the manual

Introduction to safety signals

This section specifies all dangers that can arise when doing the work described in the user manuals. Each danger consists of:

- A caption specifying the danger level (DANGER, WARNING, or CAUTION) and the type of danger.
- A brief description of what will happen if the operator/service personnel do not eliminate the danger.
- Instruction about how to eliminate danger to simplify doing the work.

Danger levels

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

Symbol	Designation	Significance
 xx0200000022	DANGER	Warns that an accident <i>will</i> occur if the instructions are not followed, resulting in a serious or fatal injury and/or severe 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, and so on.
 xx0100000002	WARNING	Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, etc.
 xx0200000024	ELECTRICAL SHOCK	Warns for electrical hazards which could result in severe personal injury or death.
 xx0100000003	CAUTION	Warns that an accident <i>may</i> 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.
 xx0200000023	ELECTROSTATIC DISCHARGE (ESD)	Warns for electrostatic hazards which could result in severe damage to the product.

Continues on next page

1 Safety

1.3.1 Safety signals in the manual

Continued

Symbol	Designation	Significance
 xx010000004	NOTE	Describes important facts and conditions.
 xx0100000098	TIP	Describes where to find additional information or how to do an operation in an easier way.

1.3.2 Safety symbols on product labels

Introduction to labels

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

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 safety and health symbols on the labels on the product must be observed. Additional safety information given by the system builder or integrator must also be observed.

Types of labels

Both the robot and the controller are marked with several safety and information labels, containing important information about the product. The information is useful for all personnel handling the robot system, for example during installation, service, or operation.

The safety labels are language independent, they only use graphics. See [Symbols on safety labels on page 41](#).

The information labels can contain information in text (English, German, and French).

Symbols on safety labels

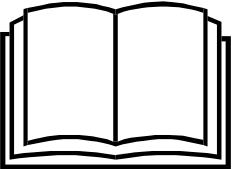
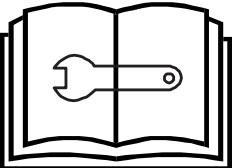
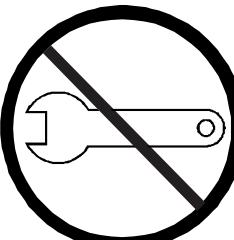
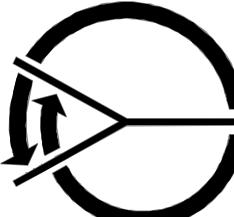
Symbol	Description
	Warning! Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion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

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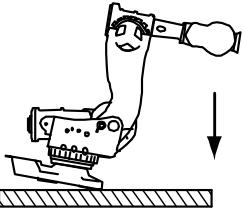
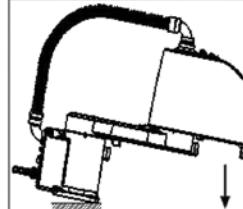
1 Safety

1.3.2 Safety symbols on product labels

Continued

Symbol	Description
 xx0900000813	See user documentation Read user documentation for details. Which manual to read is defined by the symbol: <ul style="list-style-type: none">• No text: <i>Product manual</i>.• EPS: <i>Application manual - Electronic Position Switches</i>.
 xx0900000816	Before disassemble, 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

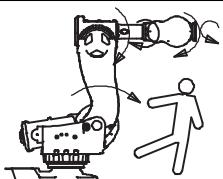
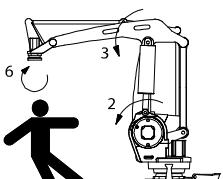
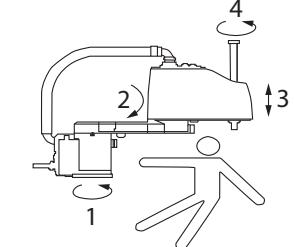
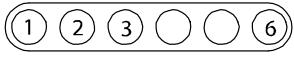
Symbol	Description
 xx0900000810	Tip risk when loosening bolts The robot can tip over if the bolts are not securely fastened.
  3HAC 057068-001	
  xx0900000817	Crush Risk of crush injuries.
 xx0900000818	Heat Risk of heat that can cause burns.

Continues on next page

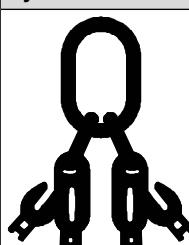
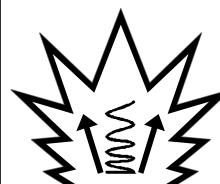
1 Safety

1.3.2 Safety symbols on product labels

Continued

Symbol	Description
 xx0900000819	Moving robot The robot can move unexpectedly.
 xx1000001141	
 xx1500002616	
 xx0900000820	Brake release buttons
 xx1000001140	
 xx0900000821	Lifting bolt

Continues on next page

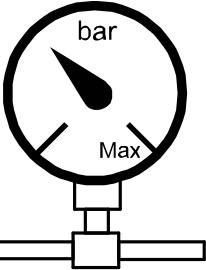
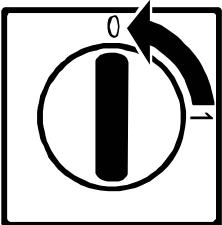
Symbol	Description
 xx1000001242	Chain sling with shortener
 xx0900000822	Lifting of robot
 xx0900000823	Oil Can be used in combination with prohibition if oil is not allowed.
 xx0900000824	Mechanical stop
 xx1000001144	No mechanical stop
 xx0900000825	Stored energy Warns that this part contains stored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

Continues on next page

1 Safety

1.3.2 Safety symbols on product labels

Continued

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

1.4.1 DANGER - Moving robots are potentially lethal!

1.4 Safety related instructions

1.4.1 DANGER - Moving robots are potentially lethal!

Description

Any moving robot is a potentially lethal machine.

When running, the robot may perform unexpected and sometimes irrational movements. Moreover, all movements are performed with great force and may seriously injure any personnel and/or damage any piece of equipment located within the working range of the robot.

Elimination

	Action	Note
1	Before attempting to run the robot, make sure all emergency stop equipment is correctly installed and connected.	Emergency stop equipment such as gates, tread mats, light curtains, etc.
2	Usually the hold-to-run function is active only in manual full speed mode. To increase safety it is also possible to activate hold-to-run for manual reduced speed with a system parameter. The hold-to-run function is used in manual mode, not in automatic mode.	How to use the hold-to-run function is described in section <i>How to use the hold-to-run function</i> in the <i>Operating manual - IRC5 with FlexPendant</i> .
3	Make sure no personnel are present within the working range of the robot before pressing the start button.	

1 Safety

1.4.2 DANGER - First test run may cause injury or damage!

Description

Since performing a service activity often requires disassembly of the robot, there are several safety risks to take into consideration before the first test run.

Elimination

Follow the procedure below when performing the first test run after a service activity, such as repair, installation, or maintenance.



DANGER

Running the robot without fulfilling the following aspects, may cause severe damage to the robot.

	Action
1	Remove all service tools and foreign objects from the robot and its working area.
2	Verify that the robot is secured to its position, see installation section in the product manual for the robot.
3	Verify that any safety equipment installed to secure the robot arm position or restrict the robot arm motion during service activity is removed.
4	Verify that the fixture and work piece are well secured, if applicable.
5	Install all safety equipment properly.
6	Make sure all personnel are standing at a safe distance from the robot, that is out of its reach behind safety fences, and so on.
7	Pay special attention to the function of the part that previously was serviced.

Collision risks



CAUTION

When programming the movements of the robot, always identify potential collision risks before the first test run.

1.4.3 WARNING - The brake release buttons may be jammed after service work

1.4.3 WARNING - 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!

1 Safety

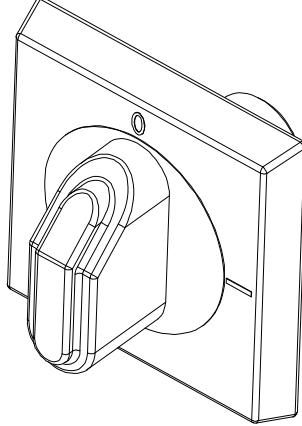
1.4.4 DANGER - Make sure that the main power has been switched off!

1.4.4 DANGER - Make sure that the main power has been switched off!

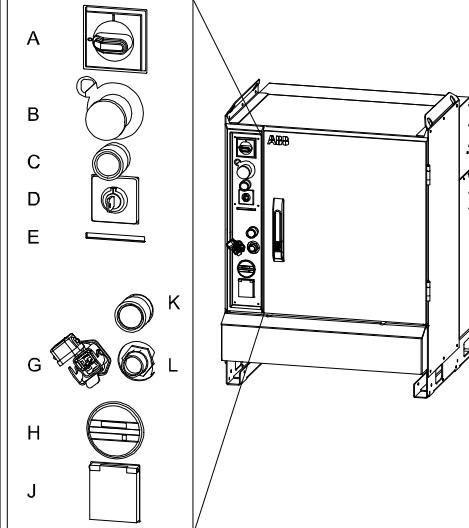
Description

Working with high voltage is potentially lethal. Persons subjected to high voltage may suffer cardiac arrest, burn injuries, or other severe injuries. To avoid these dangers, do not proceed working before eliminating the danger as detailed below.

Elimination, IRC5 Panel Mounted Controller

	Action	Note/illustration
1	Switch off the main switch for the controller.	 xx0600003255

Elimination, IRC5 Single Cabinet Controller

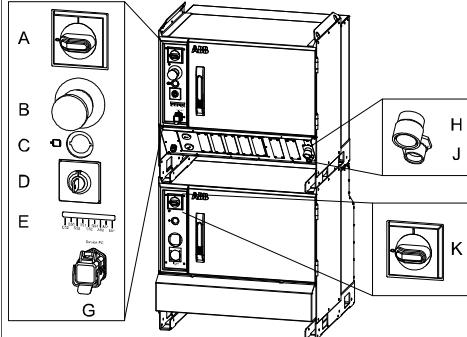
	Action	Note/illustration
1	Switch off the main switch on the controller cabinet.	 xx0600002782 A: Main switch

Continues on next page

1.4.4 DANGER - Make sure that the main power has been switched off!

Continued

Elimination, IRC5 Dual Cabinet Controller

	Action	Note/illustration
1	Switch off the main switch on the Drive Module.	 <p>xx0600002783</p> <p>K: Main switch, Drive Module</p>
2	Switch off the main switch on the Control Module.	A: Main switch, Control Module

1 Safety

1.4.5 WARNING - 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.

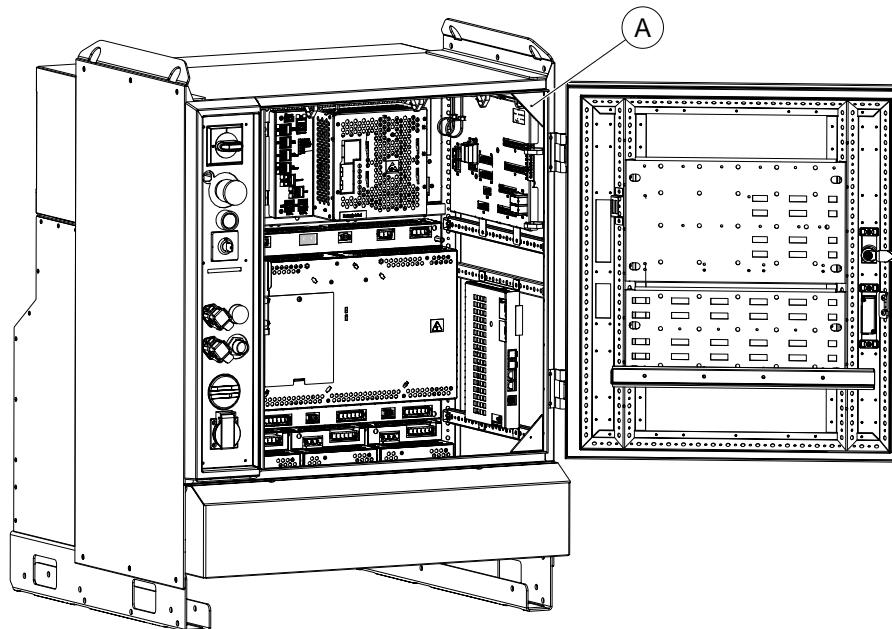
Elimination

Action	Note
1 Use a wrist strap.	Wrist straps must be tested frequently to ensure that they are not damaged and are operating correctly.
2 Use an ESD protective floor mat.	The mat must be grounded through a current-limiting resistor.
3 Use a dissipative table mat.	The mat should provide a controlled discharge of static voltages and must be grounded.

Location of wrist strap button

The location of the wrist strap button is shown in the following illustration.

IRC5



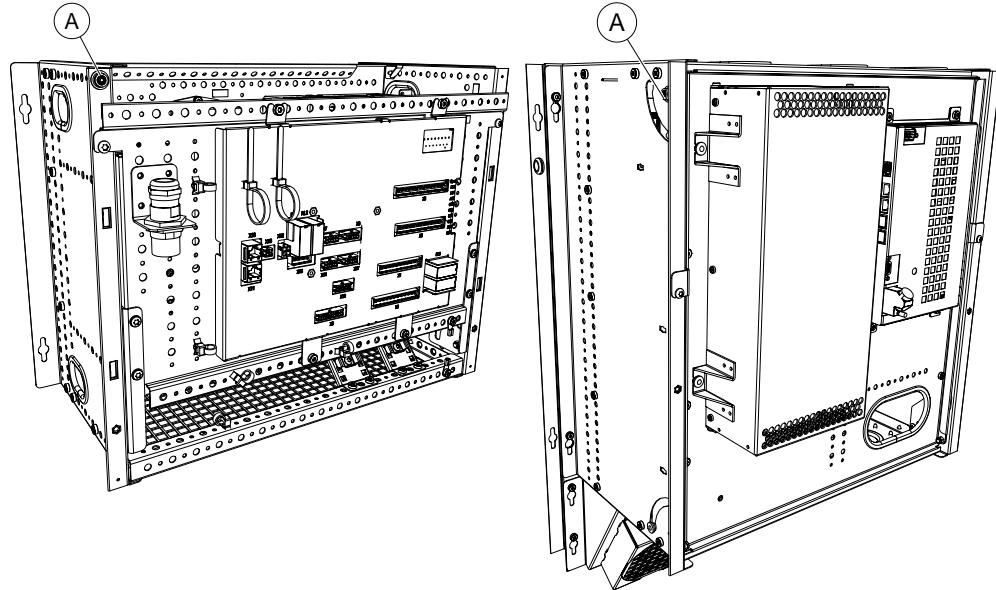
A Wrist strap button

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1.4.5 WARNING - The unit is sensitive to ESD!

Continued

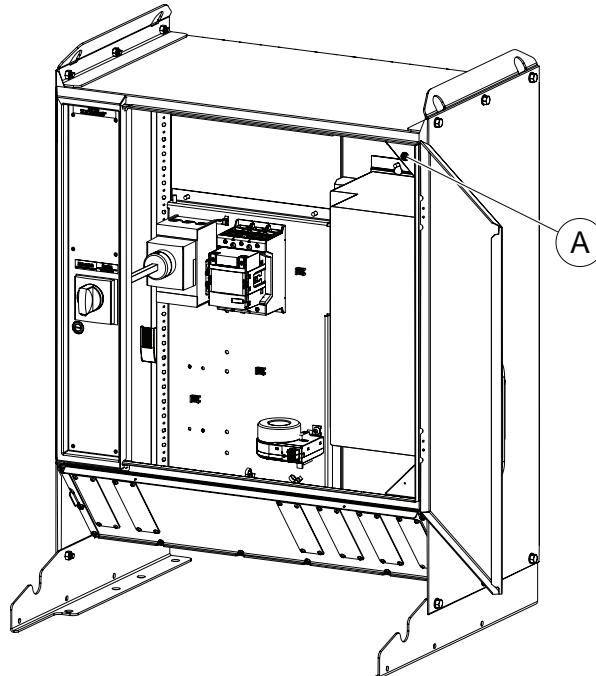
Panel Mounted Controller



xx1300001960

A	Wrist strap button
---	--------------------

Spot welding cabinet



xx1600000253

1 Safety

1.4.6 WARNING - Safety risks during handling of batteries

Description

Under normal conditions of use, the electrode materials and liquid electrolyte in the batteries are not exposed to the outside, provided the battery integrity is maintained and seals remain intact.

There is a risk of exposure only in case of abuse (mechanical, thermal, electrical) which leads to the activation of safety valves and/or the rupture of the battery container. Electrolyte leakage, electrode materials reaction with moisture/water or battery vent/explosion/fire may follow, depending upon the circumstances.



Note

Appropriate disposal regulations must be observed.

Elimination

	Action	Note
1	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 Pre-installation procedure on page 59 .
2	Use safety glasses when handling the batteries.	
3	In the event of leakage, wear gloves and chemical apron.	
4	In the event of fire, use self-contained breathing apparatus.	

1.4.7 WARNING - Safety risks during work with gearbox lubricants (oil or grease)

1.4.7 WARNING - Safety risks during work with gearbox lubricants (oil or grease)**Description**

When handling gearbox lubricants, there is a risk of both personal injury and product damage occurring. The following safety information must be regarded before performing any work with lubricants in the gearboxes.

**Note**

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

**Note**

When aggressive media is handled, an appropriate skin protection must be provided. Gloves and goggles are recommended.

**Note**

Appropriate disposal regulations must be observed.

**Note**

Take special care when handling hot lubricants.

Warnings and elimination

Warning	Description	Elimination/Action
 xx0100000002 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.
 xx0100000002 Allergic reaction	When working with gearbox lubricant there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.
 xx0100000002 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.

Continues on next page

1 Safety

1.4.7 WARNING - Safety risks during work with gearbox lubricants (oil or grease)

Continued

Warning	Description	Elimination/Action
 xx010000002 Do not overfill	Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may: <ul style="list-style-type: none">• 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.
 xx010000002 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 by the manufacturer!
 xx010000008 Heat up the oil	Warm oil drains quicker than cold oil.	When changing gearbox oil, first run the robot for a time to heat up the oil.
 xx010000004 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.
 xx010000003 Contaminated oil in gear boxes	When draining the oil make sure that as much oil as possible is drained from the gearbox. The reason for this is to drain as much oil sludge and metal chips as possible from the gearbox. The magnetic oil plugs will take care of any remaining metal chips.	

2 Installation and commissioning

2.1 Introduction

General

This chapter contains assembly instructions and information for installing the IRB 6620LX at the working site.

More detailed technical data can be found in the *Product specification* for the IRB 6620LX, such as:

- Load diagram
- Permitted extra loads (equipment), if any
- Location of extra loads (equipment), if any.

Safety information

Before any installation work is commenced, it is extremely important that all safety information is observed!

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



Note

If the IRB 6620LX is connected to power, always make sure that the robot is connected to *protective earth* before starting any installation work!

For more information see:

- *Product manual - IRC5*

2 Installation and commissioning

2.2 Robot transportation precautions

2.2 Robot transportation precautions

General

This section describes ABB approved transportation precautions for ABB robots.



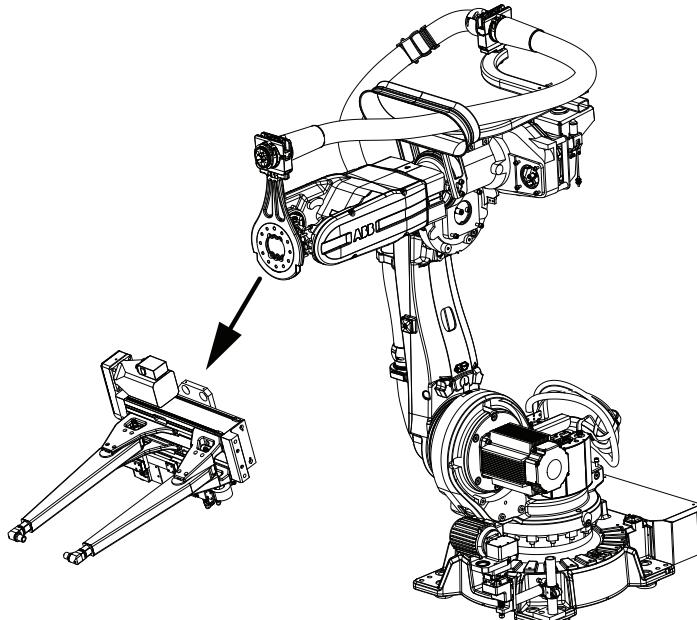
CAUTION

All transportation in or outside the plant, must be carried out according to the method described in this section.

Transportation in any other way can seriously damage the robot. If the robot is incorrectly transported and the instructions are not followed, the robot is not covered by the warranty and ABB will not accept any compensation claim.

Method 1 - recommended method

Transportation according to method 1 is strongly recommended by ABB.



xx0800000030

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

- Always remove the tool before transportation of the robot.
- Always place the robot in the ABB recommended transport position, described in section [Risk of tipping/stability on page 65](#).
- Always read and follow the instructions in section [Pre-installation procedure on page 59](#)

2.3 Unpacking

2.3.1 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	<p>Check for any visible transport damage.</p> <p> Note</p> <p>Stop unpacking and contact ABB if transport damages are found.</p>
4	Clean the unit with a lint-free cloth, if necessary.
5	Make sure that the lifting accessory used is suitable to handle the weight of the robot as specified in: <i>Weight, robot on page 59</i>
6	If the robot is not installed directly, it must be stored as described in: <i>Storage conditions, robot on page 61</i>
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: <i>Operating conditions, robot on page 61</i>
8	Before taking the robot to its installation site, make sure that the site conforms to: <ul style="list-style-type: none"> • <i>Loads on foundation, robot on page 60</i> • <i>Protection classes, robot on page 62</i> • <i>Requirements, foundation on page 61</i>
9	Before moving the robot, please observe the stability of the robot: <i>Risk of tipping/stability on page 65</i>
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: <i>On-site installation on page 66</i>
11	Install required equipment, if any. <ul style="list-style-type: none"> • <i>Installation of signal lamp (option) on page 123</i>

Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 6620LX	610 kg

Continues on next page

2 Installation and commissioning

2.3.1 Pre-installation procedure

Continued

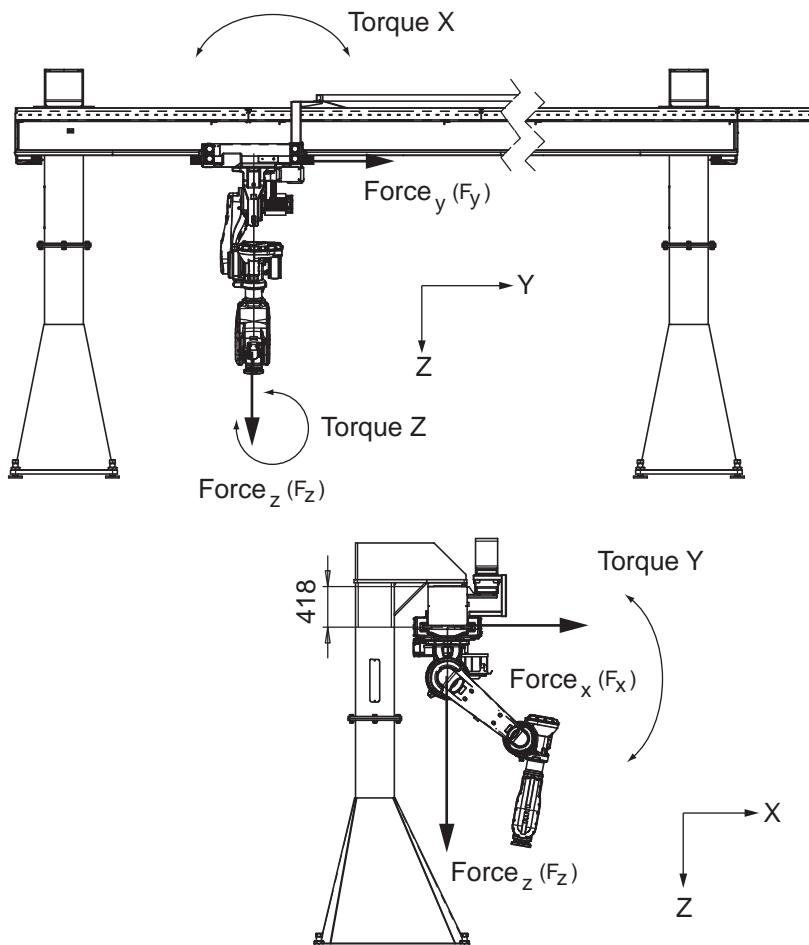


Note

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

Loads on foundation, robot

The forces specified are forces from the robot acting on the beam. For leg dimensioning, the beam mass needs to be added. The beam mass is specified in *Product specification - Linear Axis*.



xx1000000055

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!

Side mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force x	11.5 ± 3.5 kN	11.5 ± 11.3 kN

Continues on next page

2 Installation and commissioning

2.3.1 Pre-installation procedure

Continued

Force	Endurance load (in operation)	Max. load (emergency stop)
Force y	5.2 kN	7.7 kN
Force z	5.6 kN	13.5 kN
Torque x	8.3 kNm	17.8 kNm
Torque y	14.8 kNm	29.5 kNm
Torque z	6.5 kNm	9 kNm

Suspended

Force	Endurance load (in operation)	Max. load (emergency stop)
Force x	4.9 kN	13.4 kN
Force y	5.2 kN	7.7 kN
Force z	11.5 ±3.5 kN	11.5 ±11.3 kN
Torque x	8.5 kNm	18.5 kNm
Torque y	11.2 kNm	21.5 kNm
Torque z	6.1 kNm	9.1 kNm

Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.3 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base.
Maximum tilt	0°	
Minimum resonance frequency		

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)	+70° C
Maximum ambient humidity	95% at constant temperature (gaseous only)

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	+5° C i
Maximum ambient temperature	+50° C

Continues on next page

2 Installation and commissioning

2.3.1 Pre-installation procedure

Continued

Parameter	Value
Maximum ambient humidity	Max. 95% at constant temperature

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

Protection classes, robot

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

Protection type	Protection class
Manipulator, protection type Standard	IP 54
Manipulator, protection type Foundry Plus	IP 67

2.3.2 Working range and type of motion

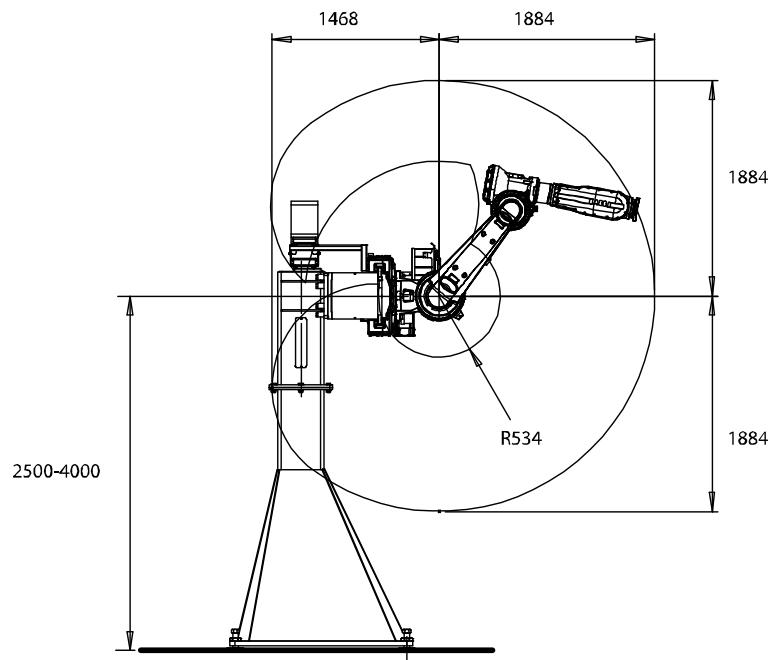
Type of Motion - IRB 6620LX-150/1.9

Axis	Type of motion	Range of movement
		IRB 6620LX-150/1.9
1	Travel length, Linear Axis	1.8 to 33 m
2	Arm motion	+ 125° to - 125°
3	Arm motion	+ 70° to - 180°
4	Wrist motion	+ 300° to - 300°
5	Bend motion	+ 130° to - 130°
6	Turn motion	+ 300° to - 300° default Max. ± 96 Revolutions ⁱ

ⁱ The default working range for axis 6 can be extended by changing parameter values in the software. Option 610-1 "Independent axis" can be used for resetting the revolution counter after the axis has been rotated (no need for "rewinding" the axis).

IRB6620LX-150/1.9

Robot Type	Handling capacity (kg)	Reach (m)
IRB 6620LX-150/1.9	150	2.2



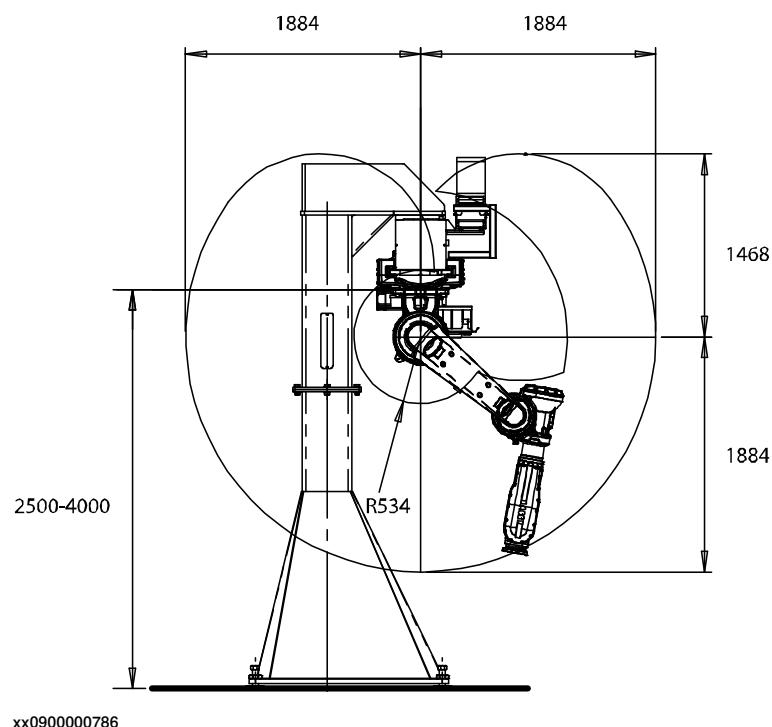
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2 Installation and commissioning

2.3.2 Working range and type of motion

Continued



2.3.3 Risk of tipping/stability

Risk of tipping

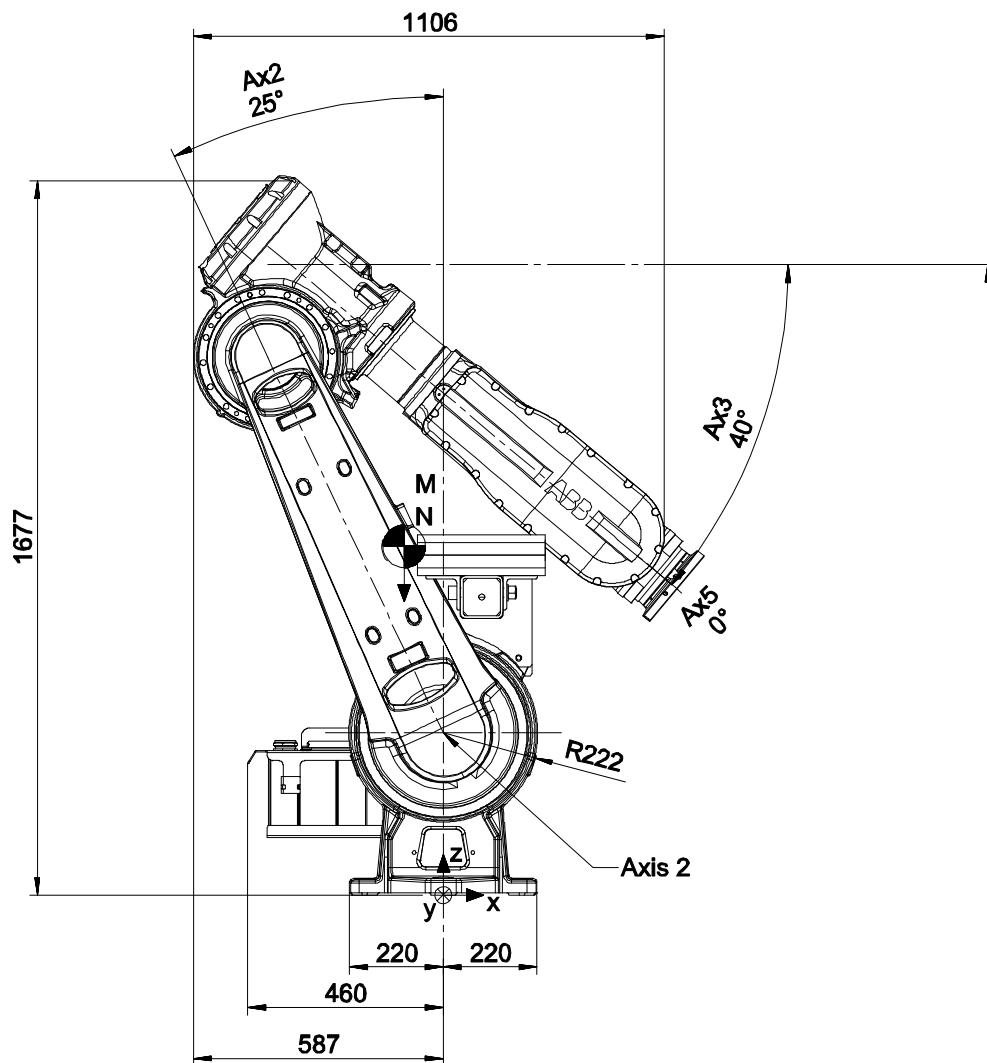
If the robot is not fastened to the foundation while moving the arm, the robot is not stable in the whole working area. Moving the arm will displace the center of gravity, which may cause the robot to tip over.

The shipping position is the most stable position.

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

Shipping and transportation position

This figure shows the robot in its shipping position and transportation position.



xx0900000167



WARNING

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

2 Installation and commissioning

2.4.1 Frame configurations

2.4 On-site installation

2.4.1 Frame configurations

Transportation and unpacking

The machine parts are treated with rust protection oil (spray) and packed in oiled paper. Carefully remove the packing.

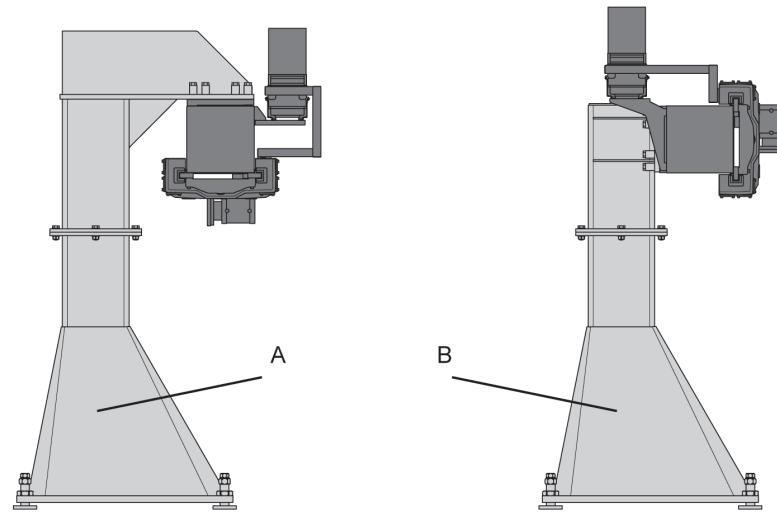


Note

The rust protection oil serves as protection for the machine parts. Do not remove the oil.

Configurations

Two configurations are used for the IRB6620LX.



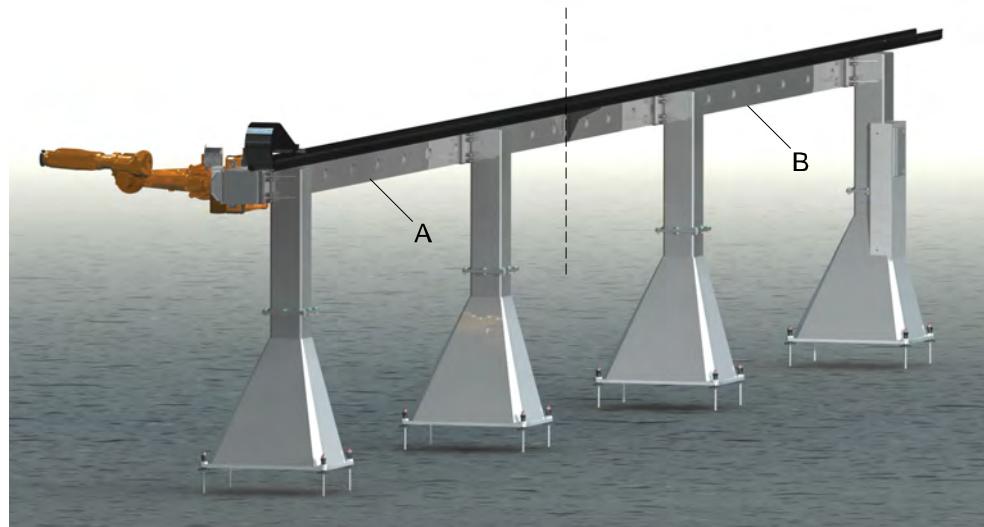
xx0900000226

A	Frame configuration for inverted mounting
B	Frame configuration for side assembly

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Sections

The track is divided into sections, each section having a maximum length of twelve (12) meters. Each section has to be supported by one or two stands.

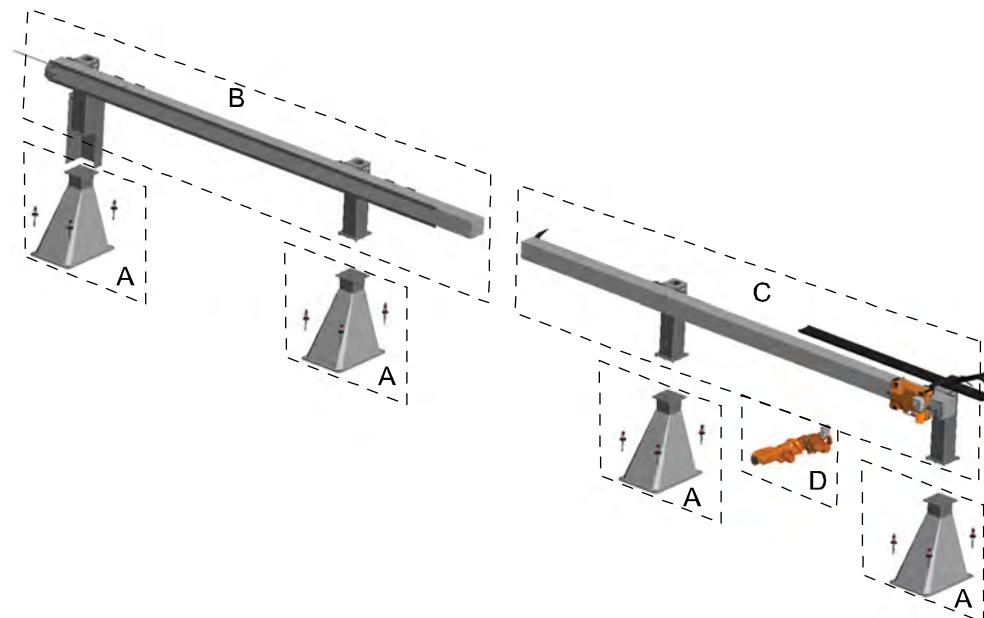


xx0900000231

A	Section (12 m)
B	Section (12 m)

Sections at delivery

At delivery the IRB 6620LX is divided in sections. The sections and their weight are described in the figure below. In this figure the sections are 12 m.



xx0900000275

A	Lower leg sections (lifting weight approx. 1300 kg)
---	---

Continues on next page

2 Installation and commissioning

2.4.1 Frame configurations

Continued

B	Upper leg sections with carriage track (lifting weight approx. 5,000 kg) (valid for 12 m)
C	Upper leg sections with carriage track and carriage (lifting weight approx. 5,400 kg) (12 m)
D	IRB 6620LX manipulator (lifting weight approx. 600 kg)

Sections to assembly

For assembly information see:

- Section A to B and A to C described in [*Assembling the frame supports on page 72.*](#)
- Section B to C described in [*Joining frames on page 76.*](#)

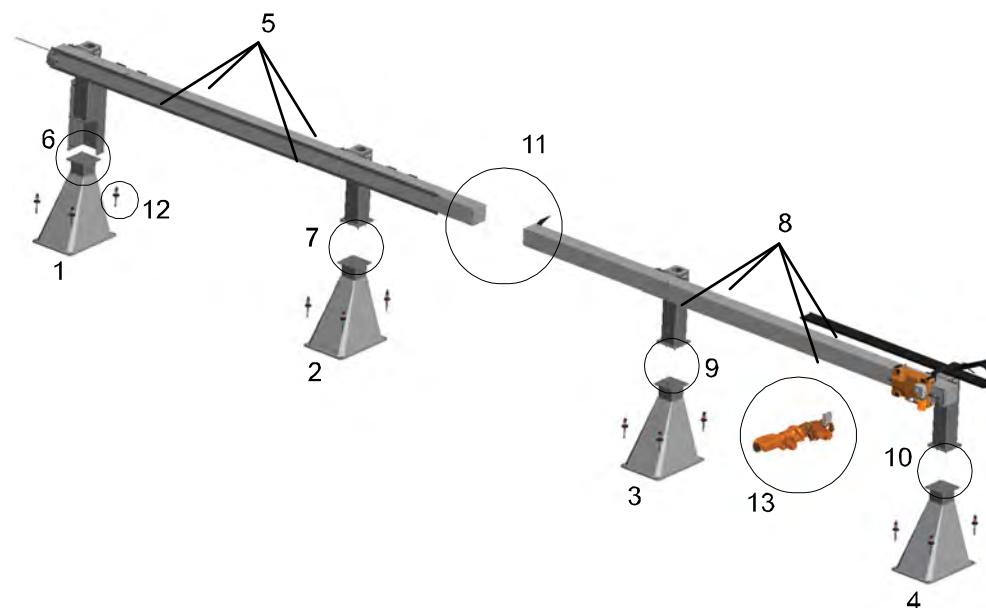
2.4.2 Lifting and securing the frame

Section overview

This section is divided into:

- [Lifting the frame support on page 70](#)
- [Lifting the frame on page 71](#)
- [Securing the frame support on page 74](#)
- [Securing the frame support \(welded\) on page 75](#)

At delivery the IRB 6620LX is divided into two sections. The sections and their weights are described in [Frame configurations on page 66](#). The assembly of the IRB6620LX is therefore divided into sections. The figure below explains the mounting sequence.



xx0900000334

1	Lift the frame supports 1- 4 and place them in an approximate position.
2	Lift frame 5 and place it on top of frame supports 1 and 2.
3	Assemble all bolts and nuts 6-7 and tighten them.
4	Lift frame 8 and place it on top of frame supports 3 and 4.
5	Assemble all bolts and nuts 9-10 and tighten them.
6	Join the two tracks 11 and tighten the assembly see section Joining two frame tracks on page 76 . (more than 12m).
7	Secure the frame supports to the floor 12.
8	Assemble the robot arm system 13 (axis 2-6).

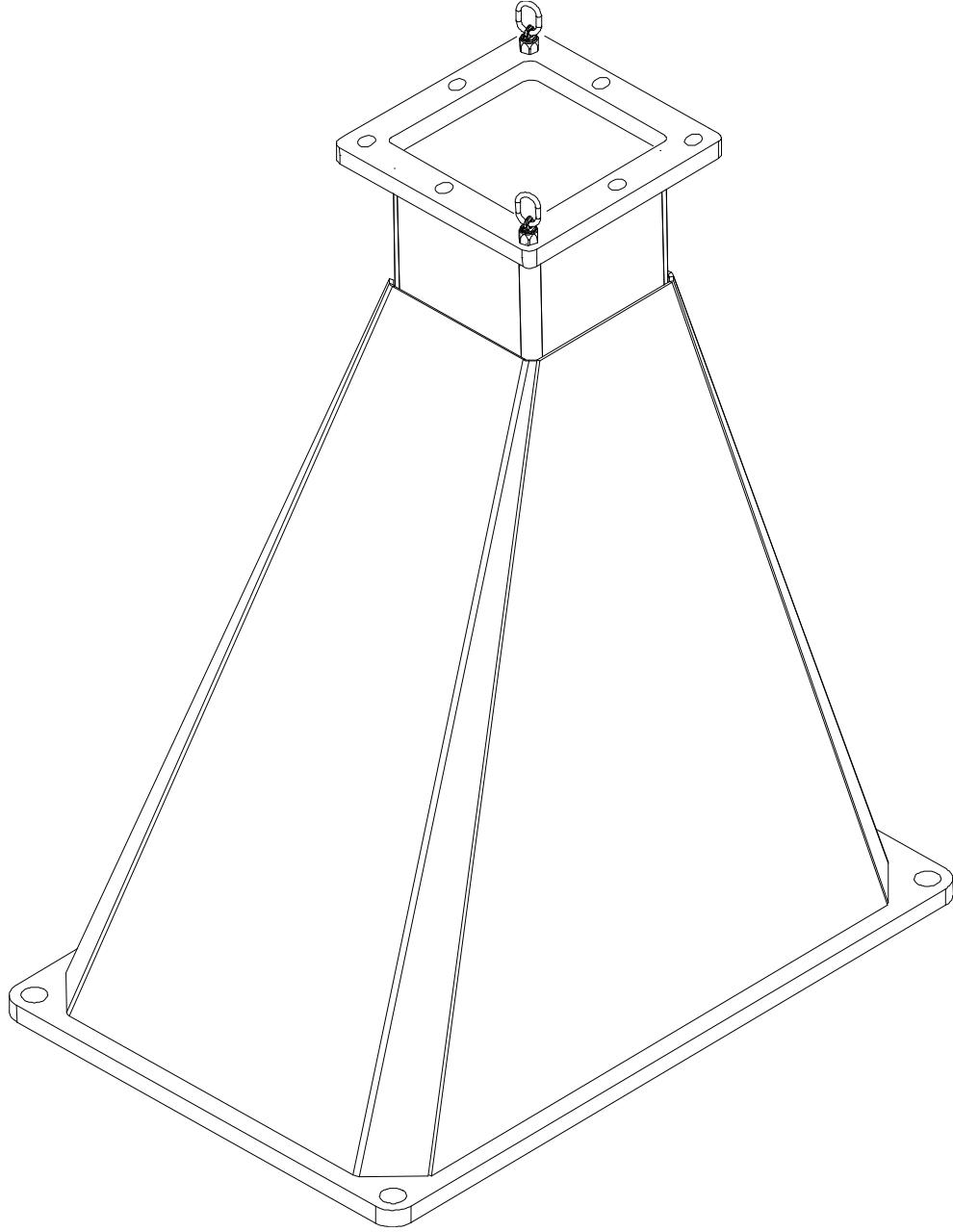
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2 Installation and commissioning

2.4.2 Lifting and securing the frame

Continued

Lifting the frame support



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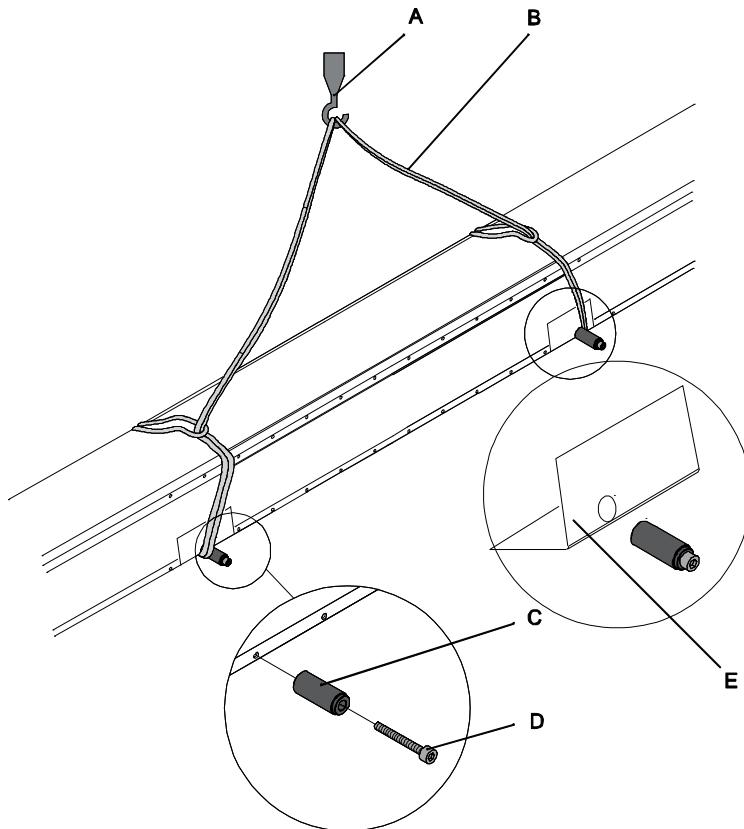
CAUTION

The support frame weighs 1300 kg, all lifting equipment used must be sized accordingly.

Continues on next page

Action	Information
 WARNING Personnel must not, under any circumstances, be present under the suspended load!	

Lifting the frame



xx0900000224

A	Lifting hook
B	Lifting slings
C	Lifting assistance
D	Screw
E	Lifting protection



DANGER

Always use lifting protective plates against sharp corners.



CAUTION

The support frame weigh, up to 5400 kg, all lifting equipment used must be sized accordingly.

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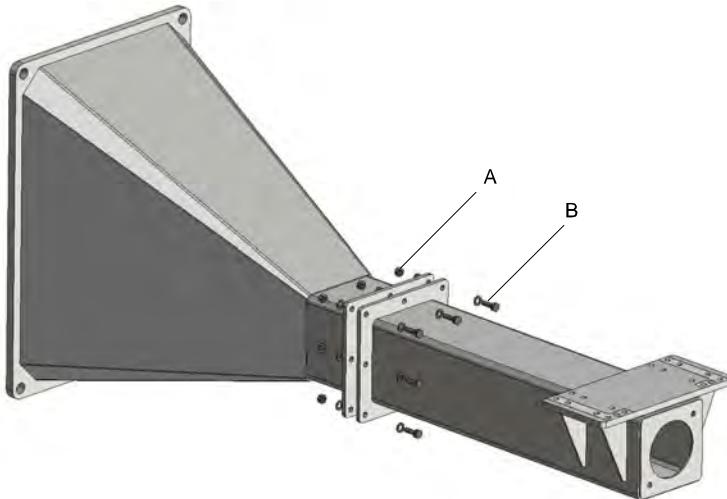
2 Installation and commissioning

2.4.2 Lifting and securing the frame

Continued

	Action	Note
1	Put on the lifting belts in accordance with sketch	
2	Use lifting protective plates against sharp corners	

Assembling the frame supports



xx0900000233

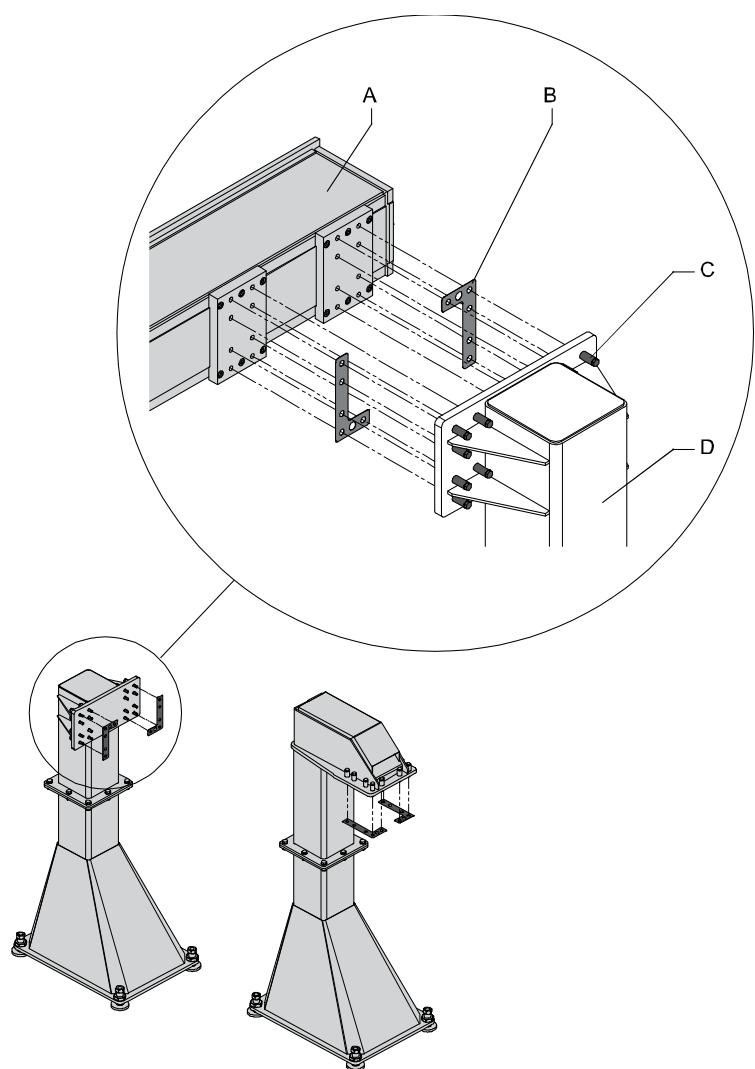
A	Nut M24
B	Screw M24 x 70 with washer
Tightening torque: 725 Nm	

Continues on next page

2 Installation and commissioning

2.4.2 Lifting and securing the frame

Continued



xx0900000229

A	Frame
B	Distance plate
C	Spacer
D	Frame support

	Action	Note
1	Assemble the frame support using the eight M24 screw.	Tightening torque 725 Nm
2	Assemble the frame support to the frame using the sixteen M24 x 120 screws (use the distance plates).	Tightening torque 725 Nm

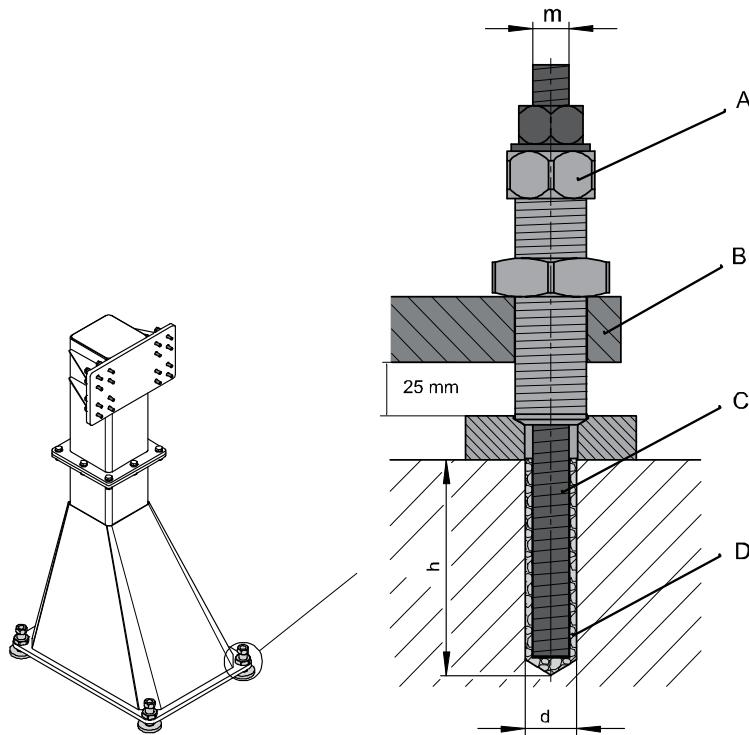
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2 Installation and commissioning

2.4.2 Lifting and securing the frame

Continued

Securing the frame support



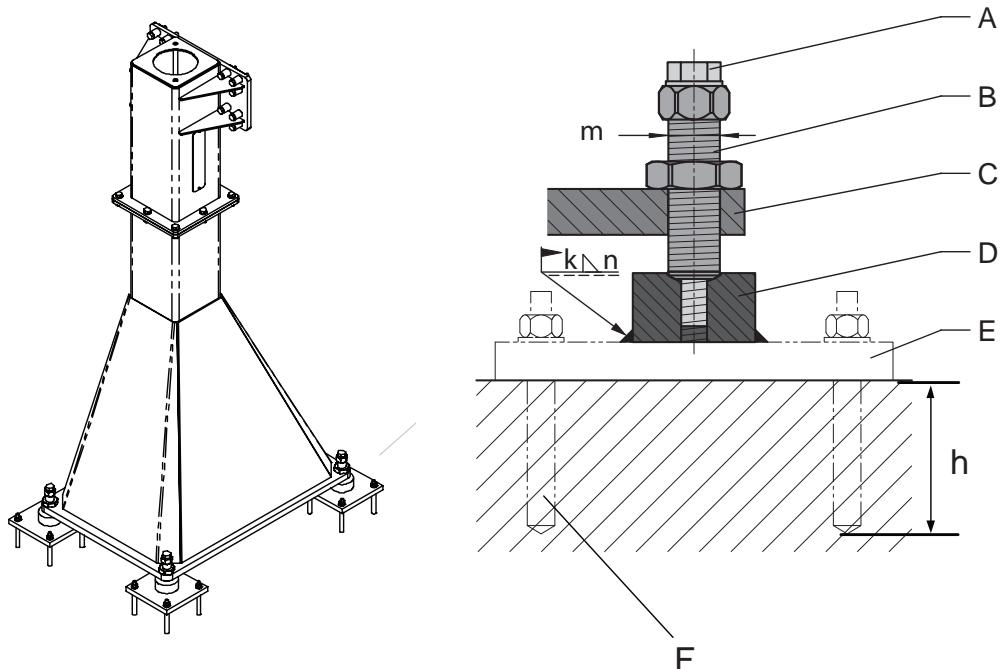
A	Ground levelling screw
B	Support/framework
C	Anchor bolt
D	Chemical anchor cartridge

m (anchor bolt size)	M30
d (drill size) mm	Ø35
h (drill depth) mm	270
Tightening torque (Nm)	300

	Action	Information
1	Use the ground levelling screw to adjust the height of each frame support. Use a water leveler to get the frame horizontal.	
2	Drill holes for the anchor bolts, use drills according to the table above.	
3	Assemble the anchor bolts according to the manufacturer instructions.	

Continues on next page

Securing the frame support (welded)



xx0900000272

A	Screw
B	Ground levelling screw
C	Support/framework
D	Weld nut
E	Plate
F	Anchor bolt M20

(m) Ground levelling screw	M56x3
(k) Fillet weld thickness (mm)	a 5
(n) Seam length (mm)	330

Anchor bolt size	M20
d (drill size) mm	Ø24
h (drill depth) mm	170
Tightening torque (Nm)	160

	Action
1	Drill holes for the anchor bolts and fasten the plate to the floor.
2	Assemble and fasten the anchor bolts according to the manufacturer instructions.
3	Use the ground levelling screw to adjust the height of each frame support. Use a water leveler to get the frame horizontal.
4	When the support stands are positioned, weld the weld nuts according to the table above.

2 Installation and commissioning

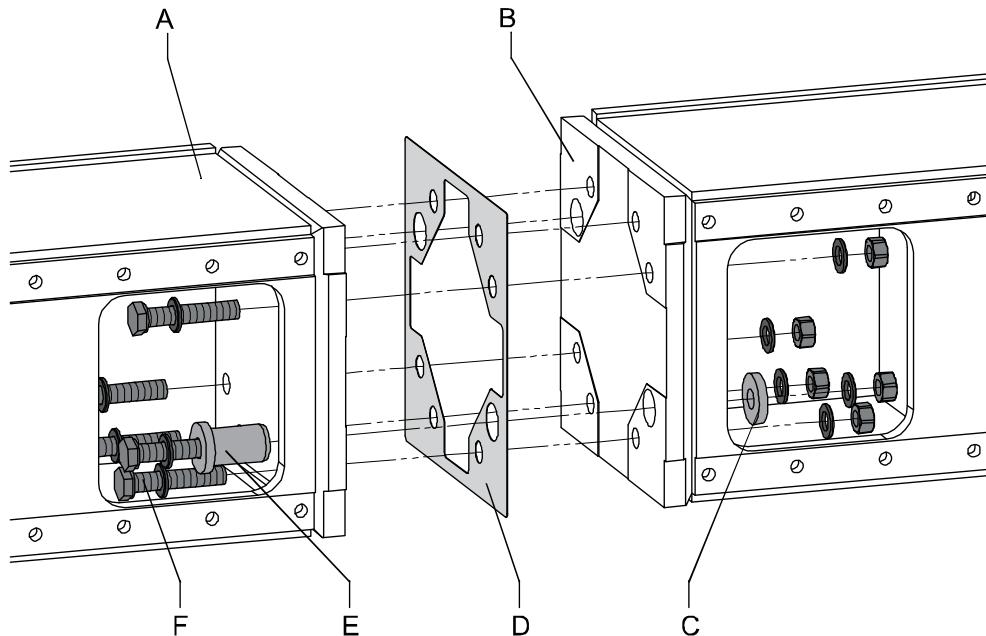
2.4.3 Joining two frame tracks

2.4.3 Joining two frame tracks

Required equipment

Equipment	Art.no	Note
Standard tools		<i>Standard tools on page 350</i>

Joining frames



A	Track bar 1
B	Track bar 2
C	Washer
D	Distance plate
E	Centering bolt
F	Screws M20 x 105
	Tightening torque: 600 Nm

	Action	Note
1	Move two sections together.	 xx0900000349

Continues on next page

Action	Note
2 Adjust the height using the leveling screws. <ul style="list-style-type: none"> • A: Screw • B: Adjustment screw • C: Locking nut • D: Weld 	 xx0900000355
3 Fix the frames using the two centering bolts and the twelve attachment screws.	Tightening torque 600 Nm.

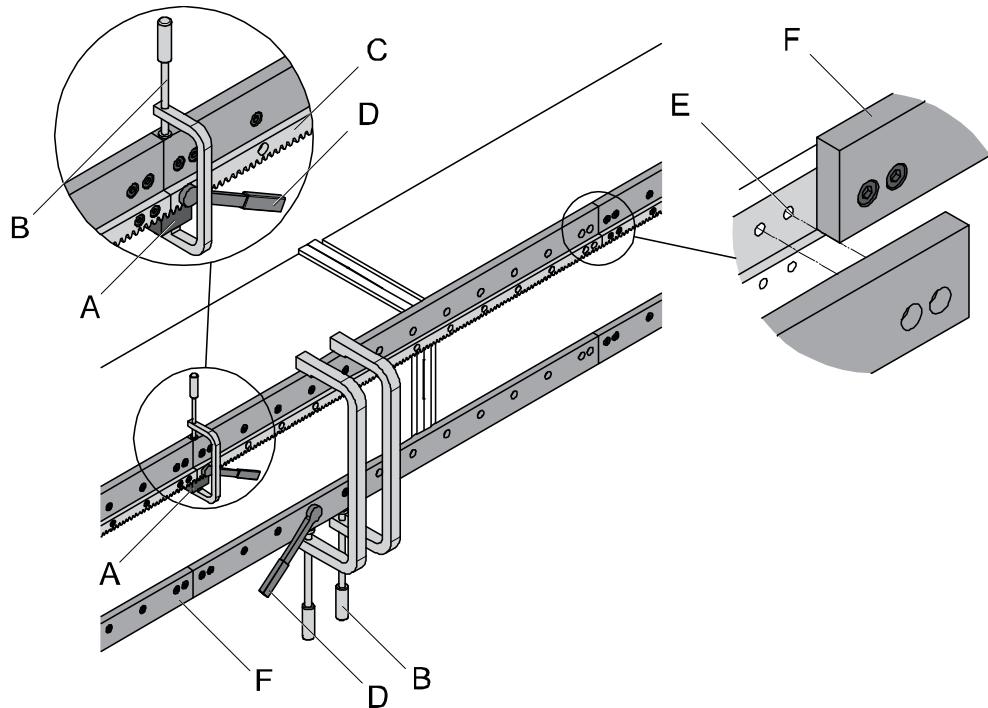
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2 Installation and commissioning

2.4.3 Joining two frame tracks

Continued

Mounting rails and guides

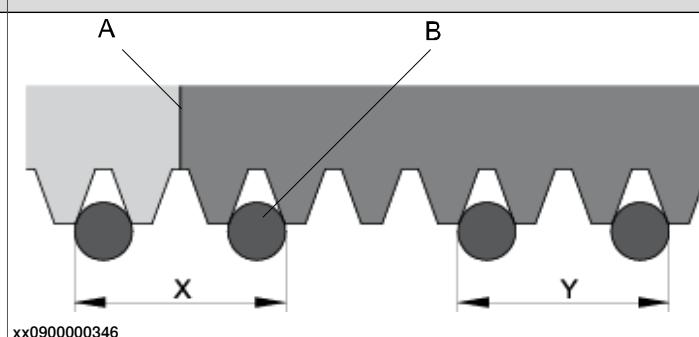


xx0900000345

A	Gauge
B	Clamp
C	Racks
D	Torque wrench
E	Reference areas
F	Guide

	Action	Note
1	Use a gauge (B) to adjust the gear racks (A).	 xx0900000362
2	Tighten the gear racks.	Tightening torque 83 Nm

Continues on next page

Action	Note
3 Measure the distance X and Y: Desired value: $X = Y \pm 0.02\text{mm}$	 <p>A B X Y xx0900000346</p> <ul style="list-style-type: none">• A: Guidance transition• B: Measurement tool

2 Installation and commissioning

2.4.4 Lifting robot with fork lift accessory

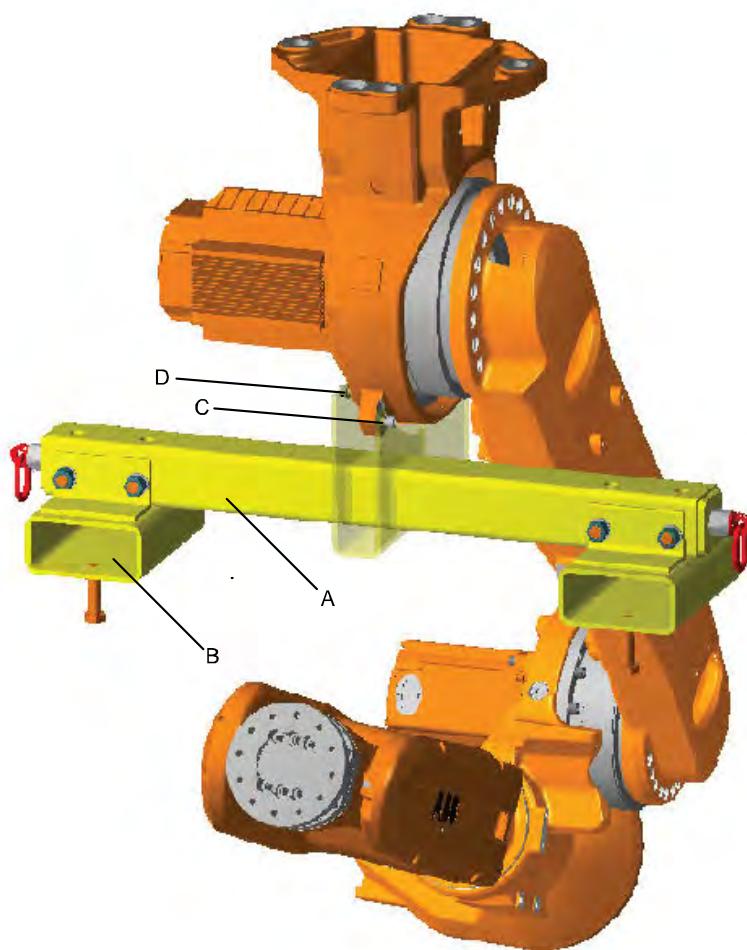
General

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

This section describes how to attach the fork lift equipment to the robot.

Fork lift device set

The fork lift device accessory is fitted to the robot as shown in the figure.



xx0900000168

A	Lifting and turning tool 3HAC034648-001
B	Fork lift pocket
C	2x screw M12x30
D	2x screw M12x20

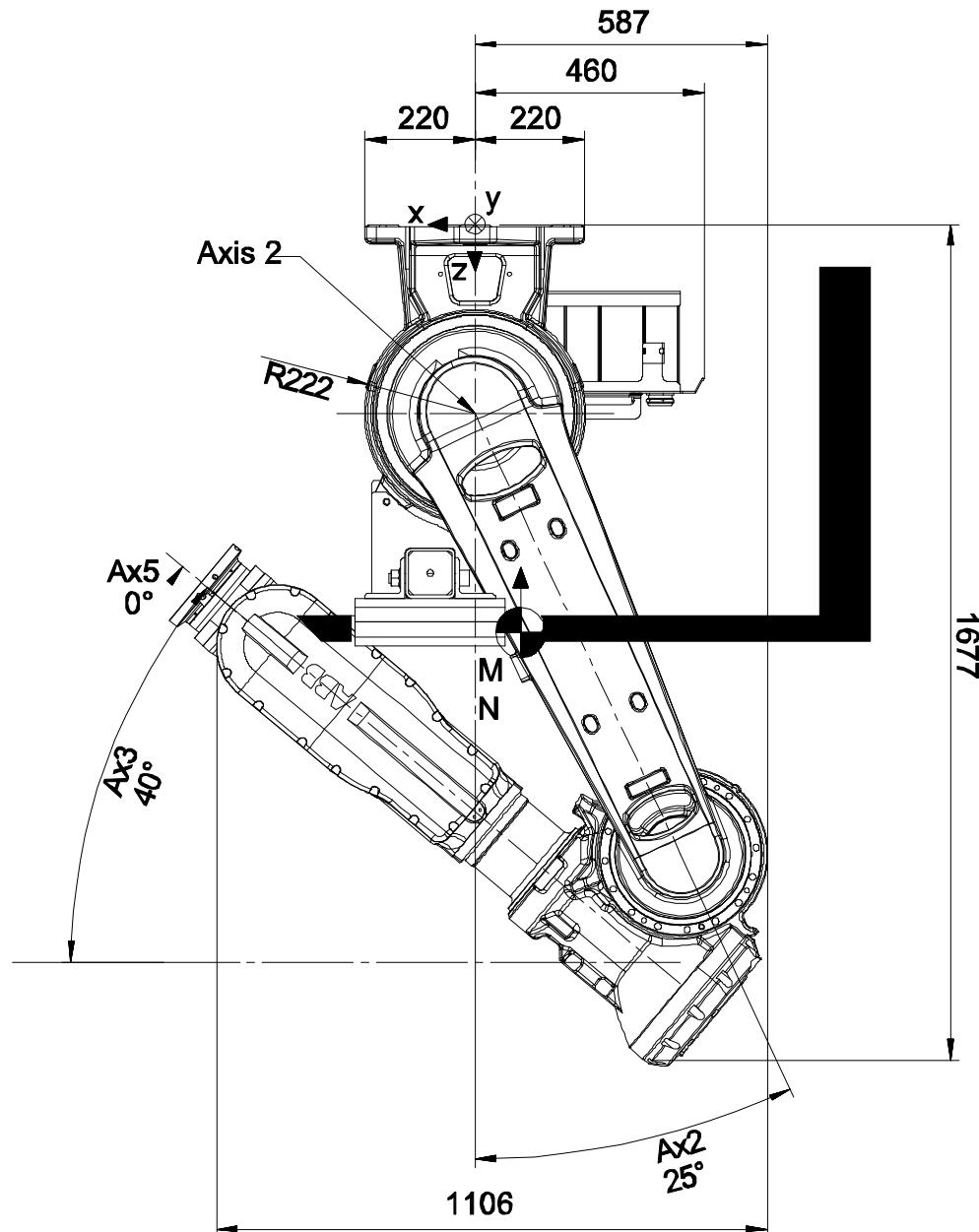
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Required equipment

Equipment	Art. no.	Note
Fork lift device accessory		
Turning tool	3HAC034648-001	
Standard toolkit	-	Content is defined in section Standard tools on page 350 .

Shipping position

The illustration shows the position of the robot when lifting it with a fork lift.



xx0900000169

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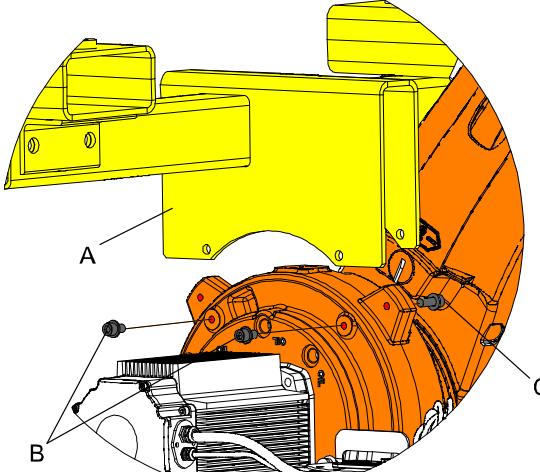
2 Installation and commissioning

2.4.4 Lifting robot with fork lift accessory

Continued

Lifting the robot with fork lift

This procedure details how to secure the fork lift set in order to lift the robot and move it using fork lift ONLY!

Action	Note
1 Move robot to its shipping position!  Note No load is permitted on the robot!	Shown in figure Shipping position on page 81 . Release the brakes if required as detailed in the section Manually releasing the brakes on page 105 .
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3 Fit the turning tool 3HAC034648-001.	 xx0900000170 <ul style="list-style-type: none">• A: Turning tool 3HAC034648-001• B: 2x screw M12x20• C: 2x screw M12x30
4 Insert fork lift forks into the pockets.	
5  CAUTION Lifting the robot with fork lift shall only be done with all four fork lift pockets fitted! If lifting with fewer than four fork lift pockets fitted, there is a risk of accidents happen!	

Continues on next page

	Action	Note
6	 CAUTION The IRB 6620LX robot weighs 610 kg. All lifting accessories used must be sized accordingly!	
7	Carefully lift the robot and move it to its installation site.  Note Move the robot with low speed!	
8	 WARNING Personnel must not, under any circumstances, be present under the suspended load!	
9	For more information see the section <i>Lifting and turning tool on page 84</i>	

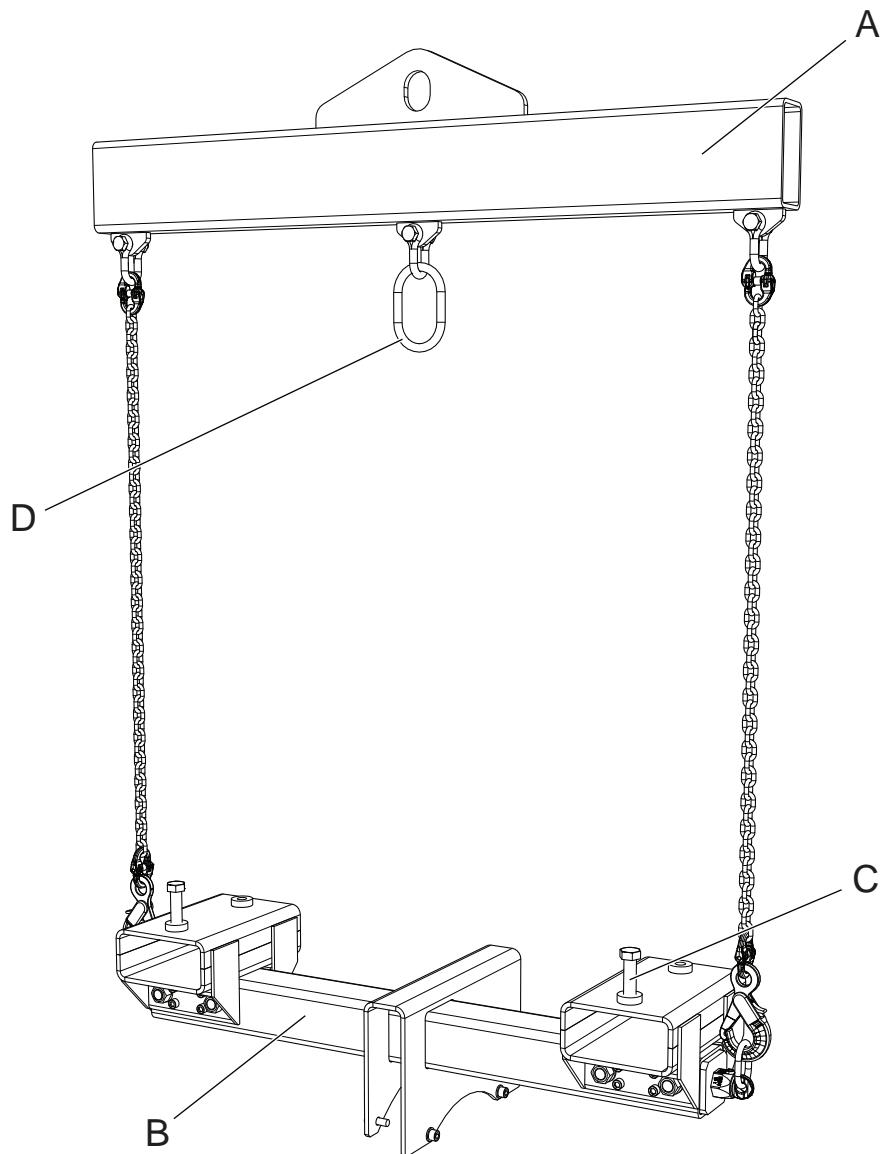
2 Installation and commissioning

2.4.5 Lifting and turning tool

2.4.5 Lifting and turning tool

The lifting and turning tool

The lifting and turning tool 3HAC034648-001 is used for lifting and turning of the IRB 6620LX.

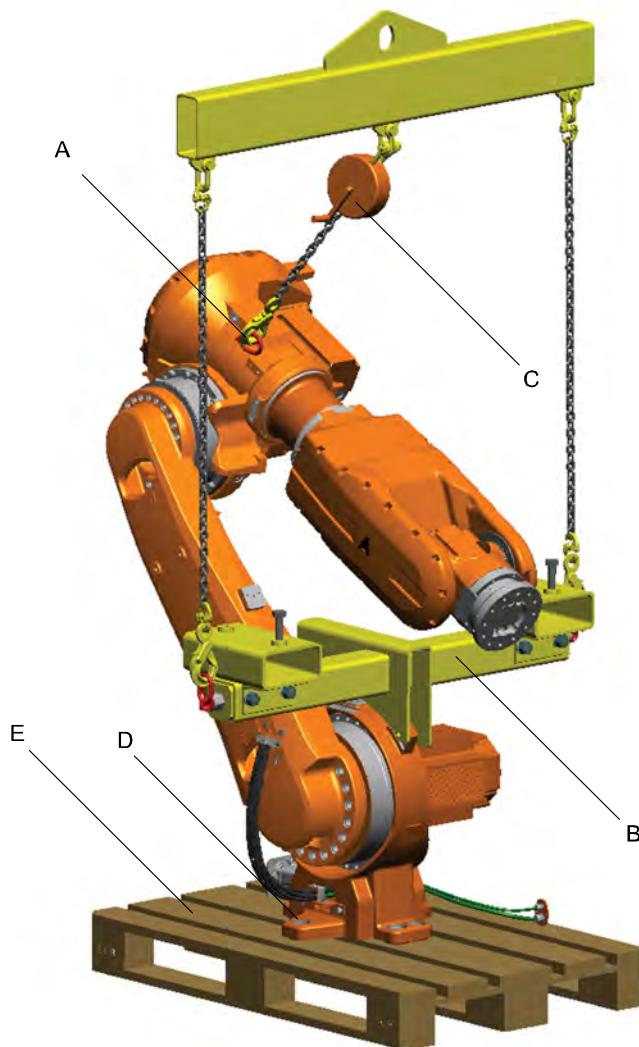


xx0900000243

A	Upper lifting beam
B	Lower lifting beam
C	Locking screws
D	Lifting eye

Continues on next page

Installation procedure



xx0900000253

A	Lifting eye
B	Lifting and turning tool 3HAC034648-001
C	Chain block for minimum lifting weight 500 kg, chain length minimum 3 m
D	Attachment holes in the robot foot
E	IRB 6620LX shipment pallet



CAUTION

The IRB 6620LX shipment pallet is prepared for this specific use and is not a standard pallet., do not use a standard pallet as a transportation or storage stand for the robot.

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2 Installation and commissioning

2.4.5 Lifting and turning tool

Continued

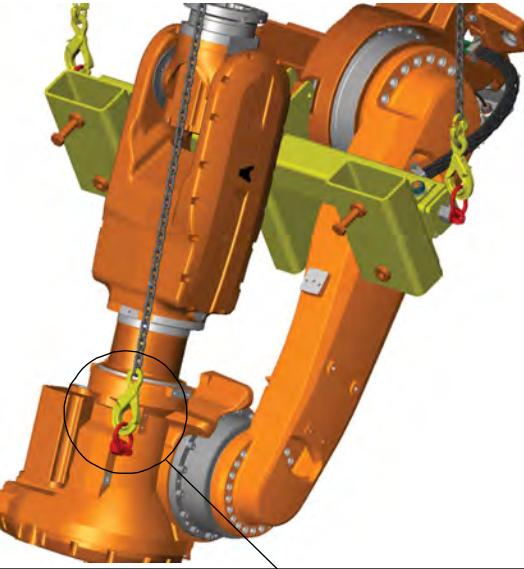
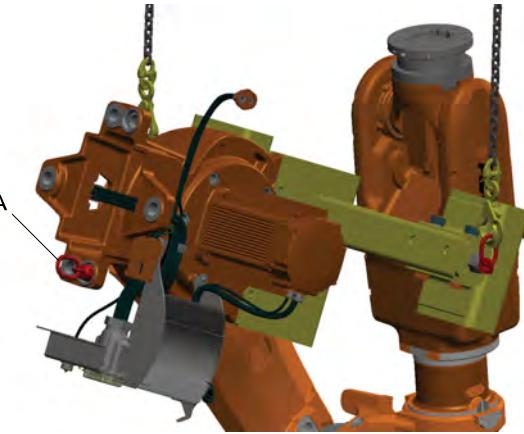


Note

Keep the shipment pallet for later storage of the IRB 6620LX.

Action	Note
1 Use a fork lift to transport the IRB 6620LX to the mounting site.	<p>!</p> <p>CAUTION</p> <p>The lifting weight is 640 kg</p>
2 Fit the lifting and turning tool 3HAC034648-001 according to the figure.	<p>xx0900000170</p> <ul style="list-style-type: none">• A: Lifting and turning tool 3HAC034648-001• B: 2x screw M12x20• C: 2x screw M12x30
3 Attach a overhead crane to the upper lifting beam.	
4 Attach a chain block and a lifting eye in the robot upper arm.	<p>!</p> <p>Note</p> <p>Use a suitable chain block for minimum lifting weight 500 kg and with chain length minimum 3 m.</p>
5 Tighten the chain block.	
6 Lift the robot.	

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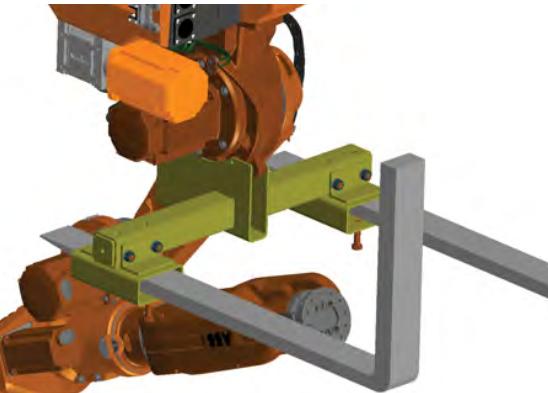
Action	Note
7 Release the tension on the chain block until the robot is balanced.	  xx0900000250
8 Fit a lifting eye in the robot foot.	 xx0900000254

Continues on next page

2 Installation and commissioning

2.4.5 Lifting and turning tool

Continued

Action	Note
9 Lift the robot to a suspended position.	 xx0900000248
10 Use the forklift to lift the robot.  CAUTION Always use the locking screws on the lifting tool shown in figure in the section Lifting and turning tool on page 84 .	 xx0900000244

Continues on next page

2 Installation and commissioning

2.4.5 Lifting and turning tool

Continued

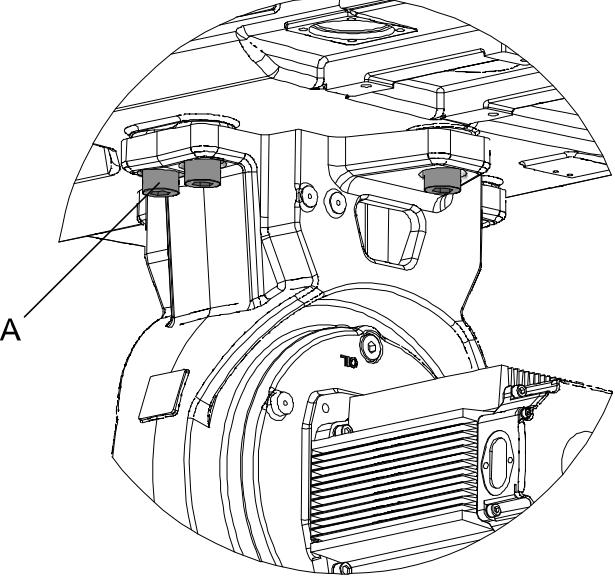
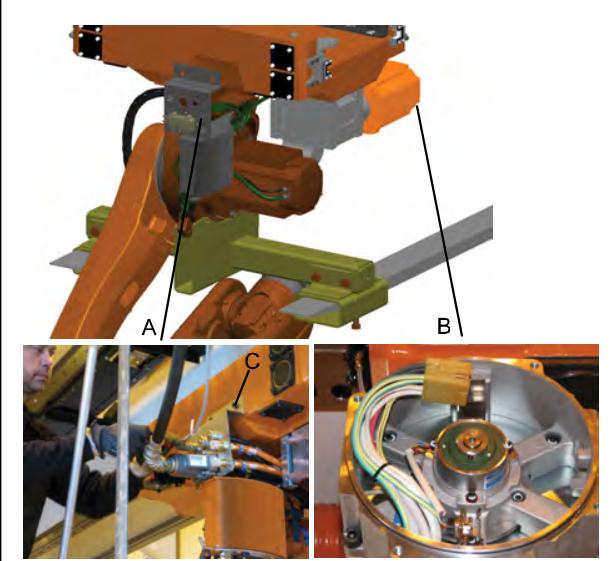
Action	Note
11 Assemble the cable harness to the robot foot using the base flange. Fit: <ul style="list-style-type: none">• A: 2x M6 Screws• B: Base flange	 xx0900000373
12 Strap the cables to the base flange.	 xx0900000374
13 Remove: <ul style="list-style-type: none">• A: Grease reservoir• B: Motor cover Fit: <ul style="list-style-type: none">• C: Guide sleeves	 xx0900000267

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2 Installation and commissioning

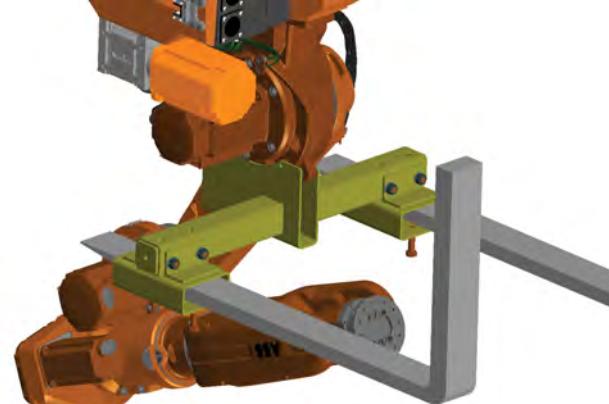
2.4.5 Lifting and turning tool

Continued

Action	Note
14 Use the fork lift to lift the robot and the guide sleeves to get the robot in position.	 CAUTION There should be a 10 mm gap between the robot foot and the carriage, do not lift the whole way, there is a great risk of damaging the bearings in the carriage.
15 Fit the six (6) attachment screws (A).	 xx0900000188
16 Close the 10 mm gap using the six (6) attachment screws and tighten them.	Tightening torque 725 Nm
17 Do the electrical connections (R1.MP/R1.SMB) as in figure A. Then follow the connections as (R1.MP1 and R1.FB1) in figure B. Fit the cover on the back of the axis-1 motor. Fit the cable gland. Fit the connection plate C for the connectors R1.MP/R1.SMB onto the carriage.	 xx0900000245
18 Calibrate the robot.	Described in the section Checking the synchronization position on page 340 .

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Dismantle procedure suspended

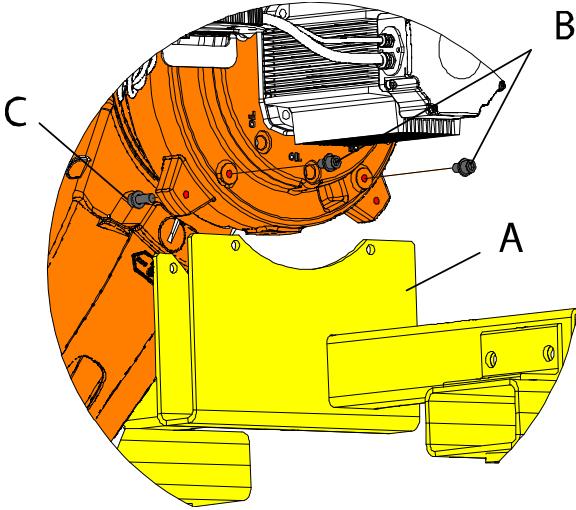
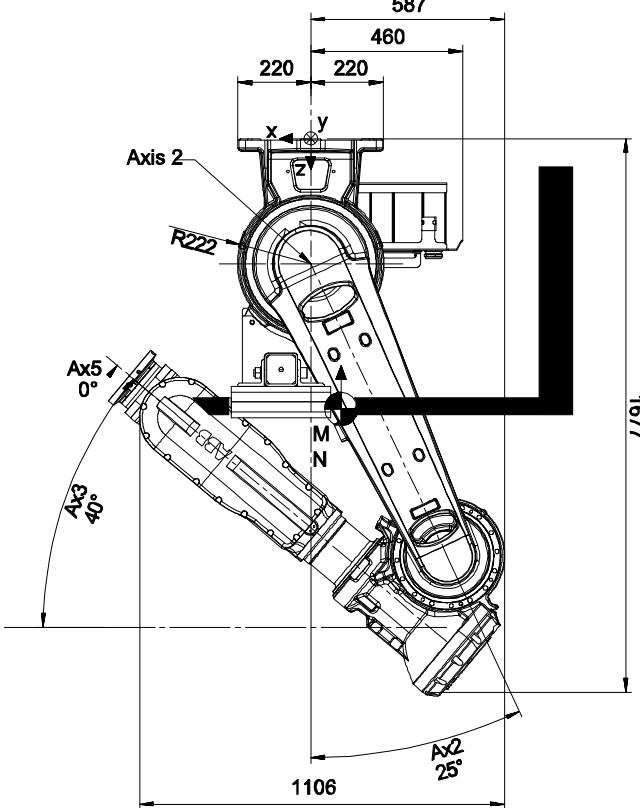
	Action	Information
1	Jog the robot axis to a position suitable for dismantling and mounting the turning tool.	
2	<p>Open the clamps (A) holding the lower arm cable harness.</p> <p>CAUTION</p> <p>It is possible to damage the cable harness depending on from which side the forklift is used.</p>	 xx0900000246
3	Use a forklift for easier mounting of the lifting and turning tool.	 xx0900000244

Continues on next page

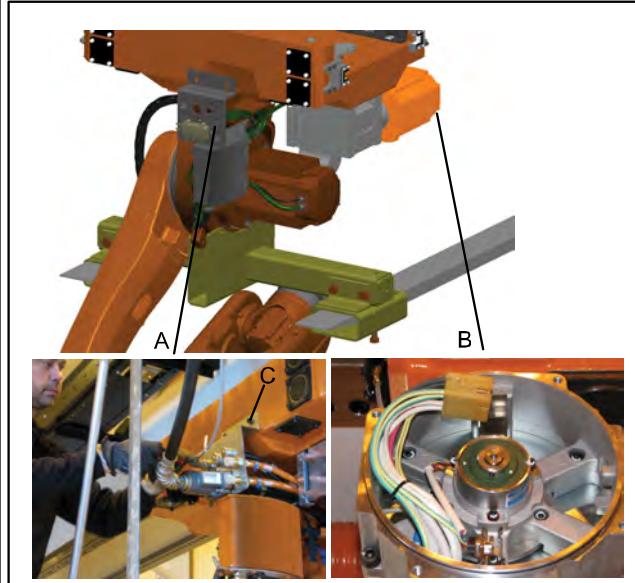
2 Installation and commissioning

2.4.5 Lifting and turning tool

Continued

Action	Information
4 Mount the lifting and turning tool as in the figure.	 <p>xx0900000179</p> <ul style="list-style-type: none"> • A: Lifting beam lower • B: Screws 2x M12x20 • C: Screws 2x M12x30
5 Jog the robot into lifting position.	 <p>xx0900000169</p>

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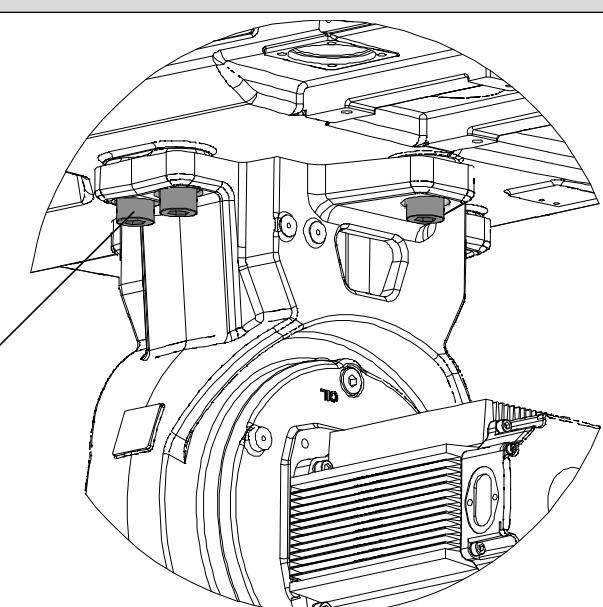
Action	Information
<p>6</p> <p> DANGER</p> <p>Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.</p> <p>Also read the safety sections:</p> <ul style="list-style-type: none"> • <i>Safety risks related to pneumatic/hydraulic systems on page 27</i> • <i>Risks associated with live electric parts on page 29</i> • <i>Safety risks during installation and service work on robots on page 22</i> 	
<p>7</p> <p>Disconnect the electrical connections (R1.MP/R1.SMB) A in figure.</p> <p>Dismount the cover on the back of the motor axis 1 and disconnect (R1.MP1 and R1.FB1) B in figure.</p> <p>Dismount the cable gland.</p> <p>Dismount the connection plate C for the connectors R1.MP/R1.SMB from the carriage.</p>	 <p>xx0900000245</p>

Continues on next page

2 Installation and commissioning

2.4.5 Lifting and turning tool

Continued

Action	Information
8 Loosen the six (6) attachment screws (A) until you see a gap between the robot and the carriage.	 xx0900000188 <p>! CAUTION</p> <p>This step is essential to prevent the forklift from damaging the carriage bearings.</p>
9 Lift the robot with the forklift to release the pressure on the attachment screws.	
10 ! CAUTION The lifting weight is 640 kg.	
11 Remove the six (6) attachment screws.	
12 ! WARNING Personnel must not, under any circumstances, be present under the suspended load!	

Dismantle procedure 90°

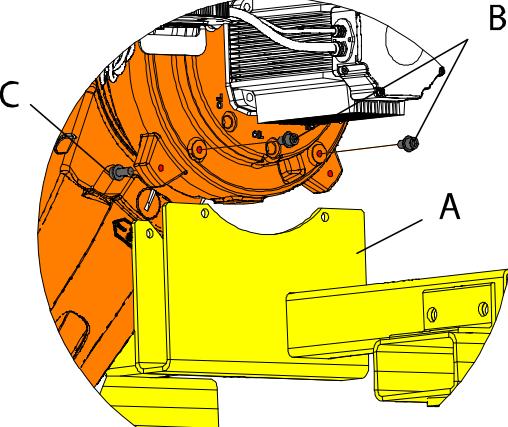
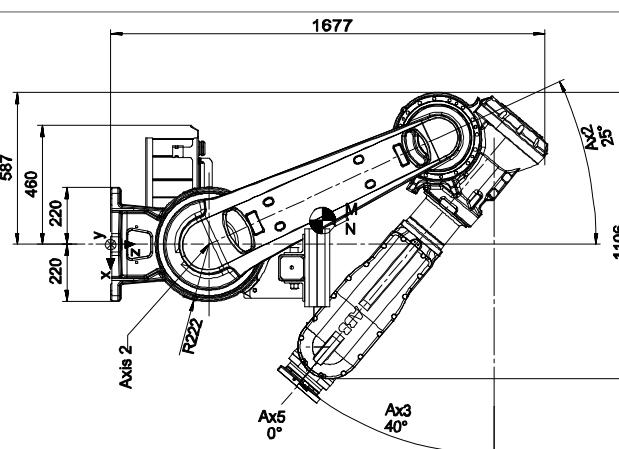
Action	Information
1 Jog the robot axis to a position suitable for dismantling and mounting the turning tool.	

Continues on next page

2 Installation and commissioning

2.4.5 Lifting and turning tool

Continued

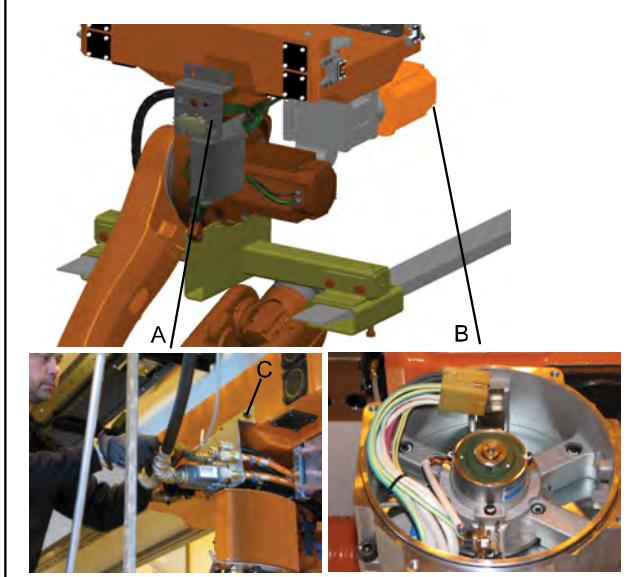
Action	Information
2 Mount the lifting and turning tool as in the figure.	 <p>xx0900000179</p> <ul style="list-style-type: none"> • A: Lifting beam lower • B: Screws 2x M12x20 • C: Screws 2x M12x30
3 Jog the robot into lifting position.	 <p>xx0900000382</p>

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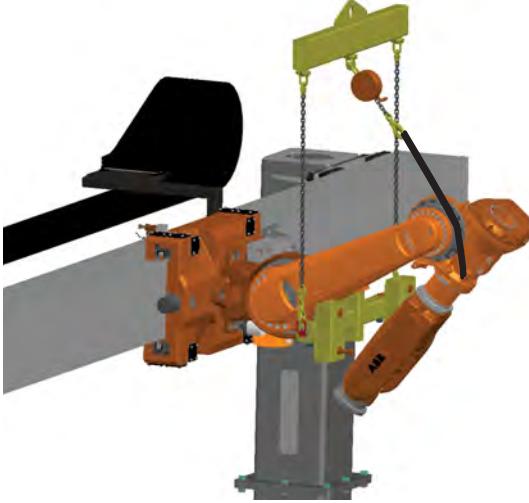
2 Installation and commissioning

2.4.5 Lifting and turning tool

Continued

Action	Information
4 <p>DANGER</p> <p>Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.</p> <p>Also read the safety sections:</p> <ul style="list-style-type: none"> • <i>Safety risks related to pneumatic/hydraulic systems on page 27</i> • <i>Risks associated with live electric parts on page 29</i> • <i>Safety risks during installation and service work on robots on page 22</i> 	
5 <p>Disconnect the electrical connections (R1.MP/R1.SMB) A in figure.</p> <p>Dismount the cover on the back of the motor axis 1 and disconnect (R1.MP1 and R1.FB1) B in figure.</p> <p>Dismount the cable gland.</p> <p>Dismount the connection plate C for the connectors R1.MP/R1.SMB from the carriage.</p>	 <p>xx0900000245</p>
6 <p>Loosen the six (6) attachment screws (A) until you see a gap between the robot and the carriage.</p>	<p>CAUTION</p> <p>This step is essential to prevent the overhead crane from damaging the carriage bearings.</p>

Continues on next page

Action	Information
7 Lift the robot using the overhead crane until you close the gap.	 xx0900000383
8  CAUTION The lifting weight is 640 kg+tool.	
9 Remove the six (6) attachment screws.	
10  WARNING Personnel must not, under any circumstances, be present under the suspended load!	

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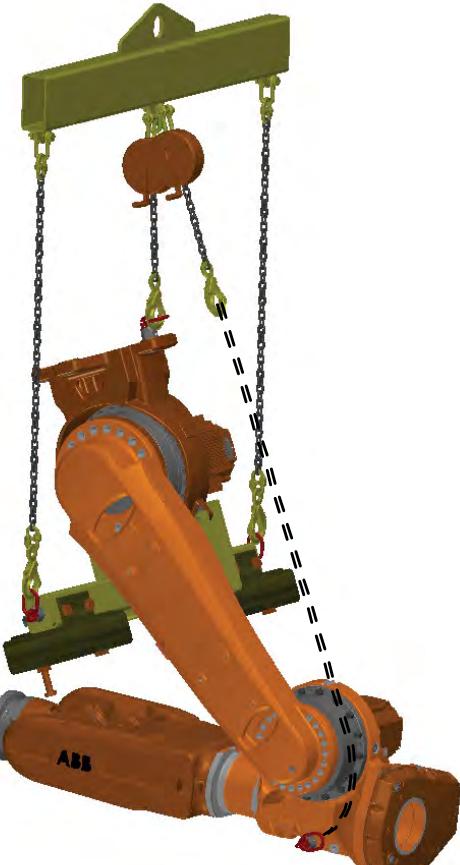
2 Installation and commissioning

2.4.5 Lifting and turning tool

Continued

Action	Information
11 Use the chain blocks to lower the robot until it is possible to use the forklift, or using a second chain block.	 xx0900000430

Continues on next page

Action	Information
12 Use the second chain block to lower the robot completely.	 xx0900000432

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2 Installation and commissioning

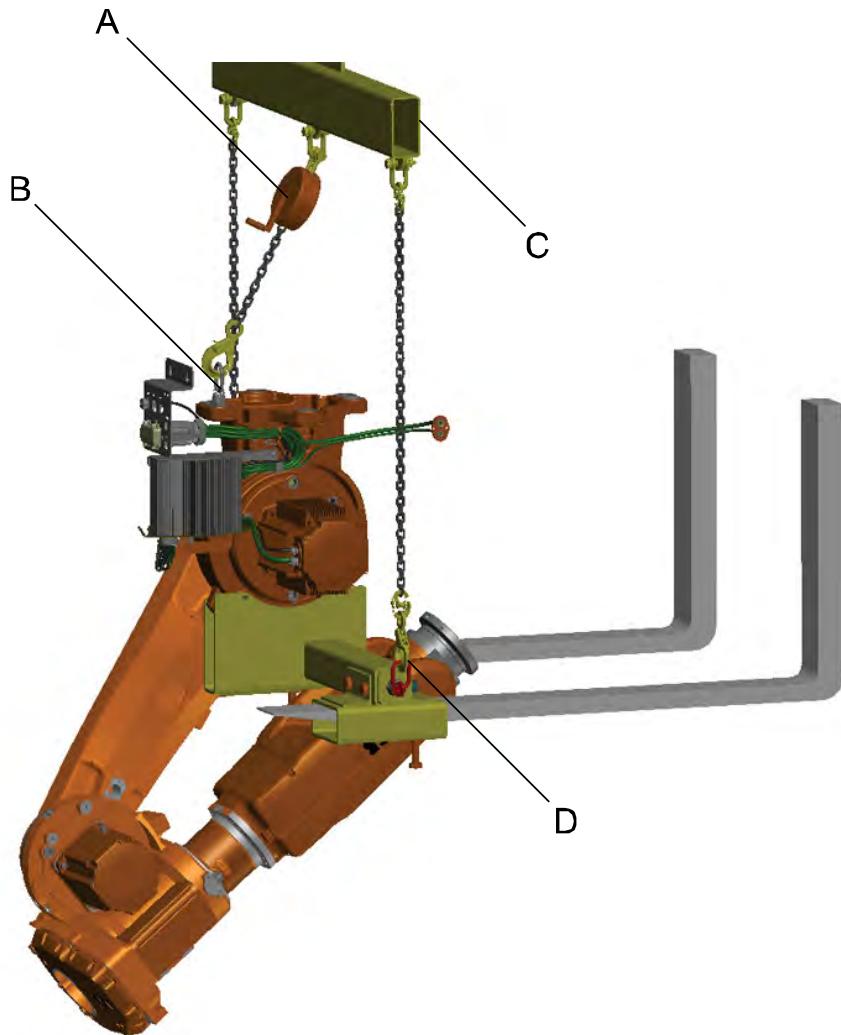
2.4.5 Lifting and turning tool

Continued

Turning procedure

Fitting the lifting and turning tool

The figure shows the lifting and turning tool fitted to the robot.



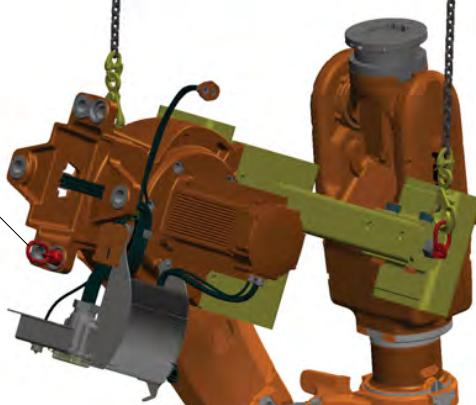
xx0900000247

A	Chain block for minimum lifting weight 500 kg, chain length minimum 3 m
B	Lifting eye
C	Lifting beam upper
D	Lifting chains

Turning the robot

	Action	Information
1	Attach the upper beam to the lower beam using the lifting chains.	

Continues on next page

Action	Information
2 Attach the chain block to the upper beam lifting eye.	 Note Use a suitable chain block for minimum lifting weight 500 kg and with chain length minimum 3 m.
3 Fit a lifting eye in the robot foot attachment hole and attach the chain block.	 xx0900000254
4 Loosen the fork locking screws.	
5 Use the chain block to lift and balance the robot.	
6 Remove the straps from the cables on the base flange.	 xx0900000374

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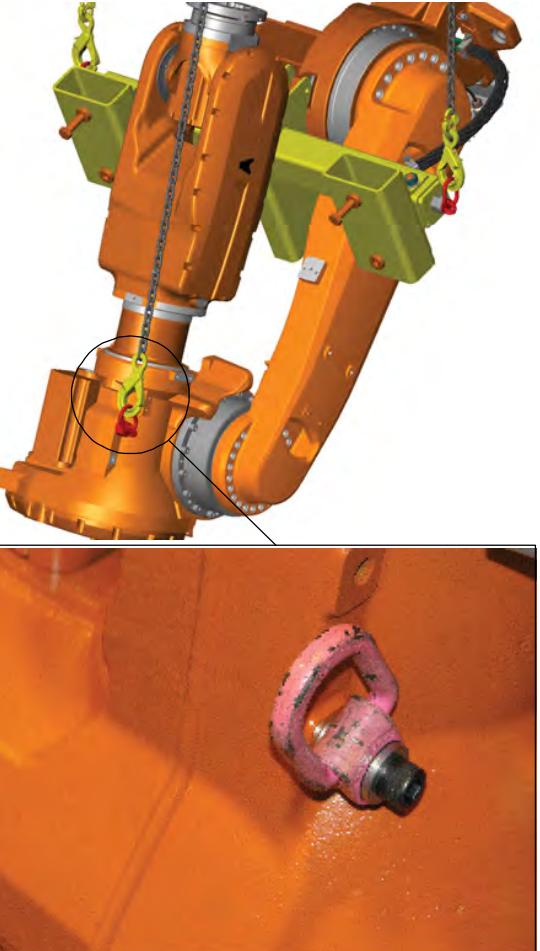
2 Installation and commissioning

2.4.5 Lifting and turning tool

Continued

Action	Information
7 Remove the base flange from the robot foot. Fit: <ul style="list-style-type: none">• A: 2x M6 Screws• B: Base flange	 xx0900000373
8 Remove the forks.	
9 Release the pressure on the chain block.	 xx0900000248
10 When the pressure is gone remove the chain block from the robot foot.	
11 Remove the lifting eye.	

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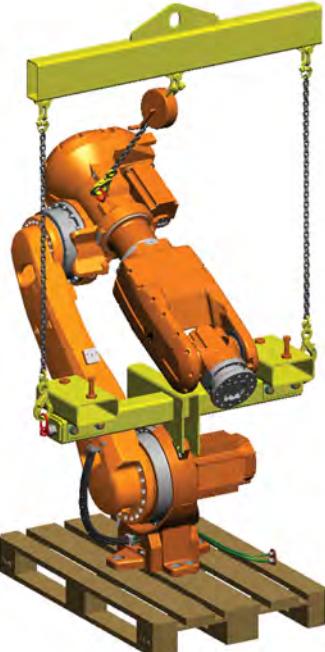
Action	Information
12 Fit a lifting eye in the robot upper arm.	  xx0900000250

Continues on next page

2 Installation and commissioning

2.4.5 Lifting and turning tool

Continued

Action	Information
13 Lift the robot using the chain block until the robot foot is horizontal.	 xx0900000251
14 Fit the robot onto the shipment pallet.	 xx0900000252

2.4.6 Manually releasing the brakes

General

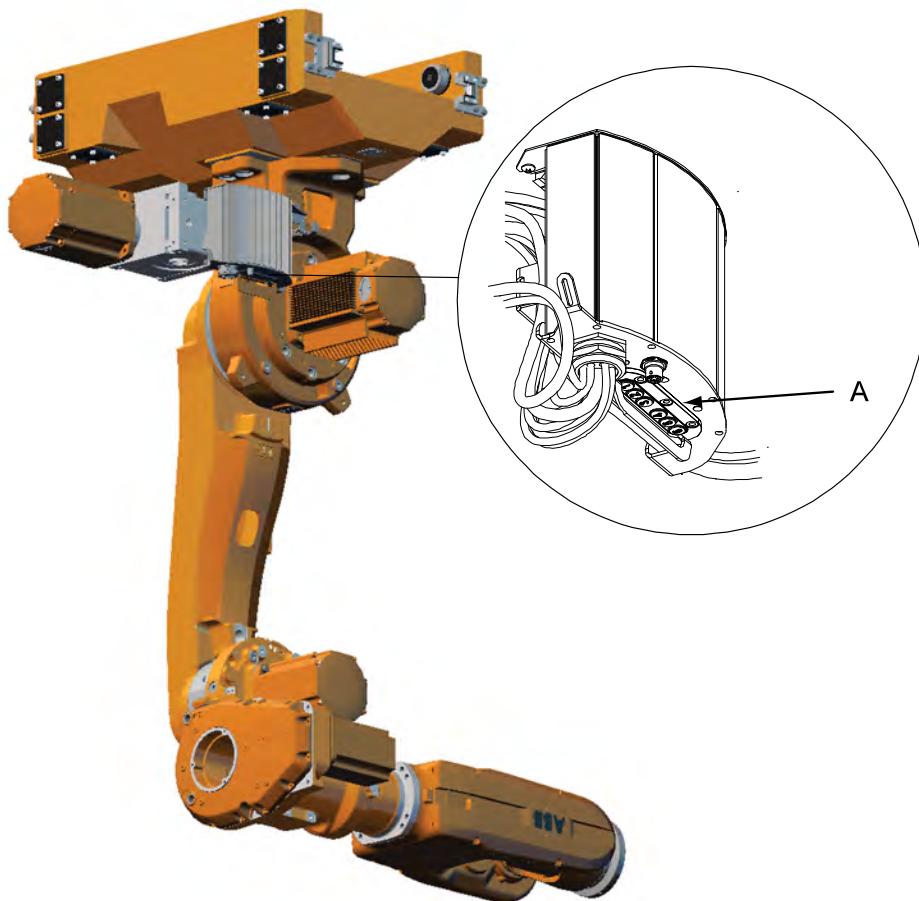
This section details how to release the holding brakes of each axis motor.

Location of brake release unit

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

Brake release at base

The figure below shows the unit located at the base.



A	Internal brake release unit with push buttons
---	---

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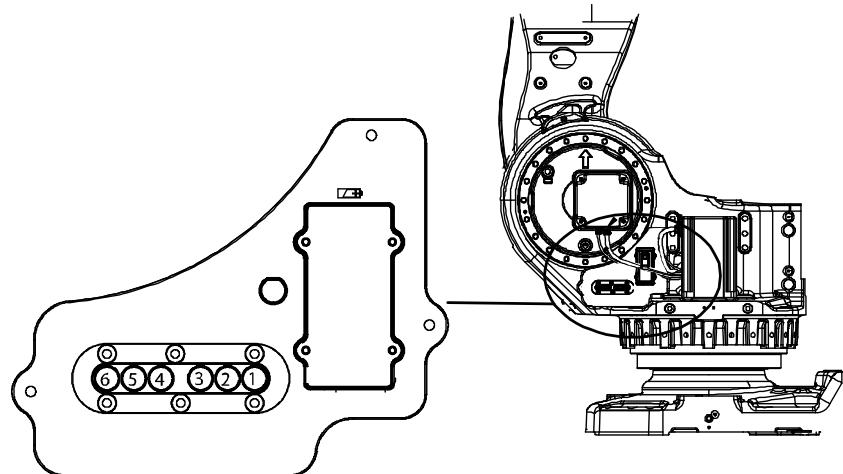
2 Installation and commissioning

2.4.6 Manually releasing the brakes

Continued

Brake release at frame

The figure below shows the unit located at the frame.



xx0200000376

-	Internal brake release unit with push buttons, located on the robot frame
---	---

Releasing the brakes

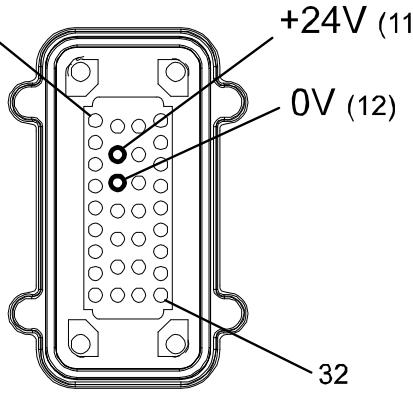
This procedure details how to release the holding brakes when the robot is equipped with an internal brake release unit.

Action	Note
1 The internal brake release unit is equipped with buttons for controlling the axes brakes. The buttons are numbered according to the numbers of the axes. If the robot is not connected to the controller, power must be supplied to the connector R1.MP according to the section Supplying power to connector R1.MP on page 107 .	Buttons are shown in figure Location of brake release unit on page 105 .
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 unit. The brake will function again as soon as the button is released.	

Continues on next page

Supplying power to connector R1.MP

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

Action	Note
1  DANGER Incorrect connections, such as supplying power to the wrong pin, may cause all brakes to be released simultaneously!	
2 Supply 0V on pin 12 and 24V on pin 11.	 xx0600002937

2 Installation and commissioning

2.4.7 Orienting and securing the robot

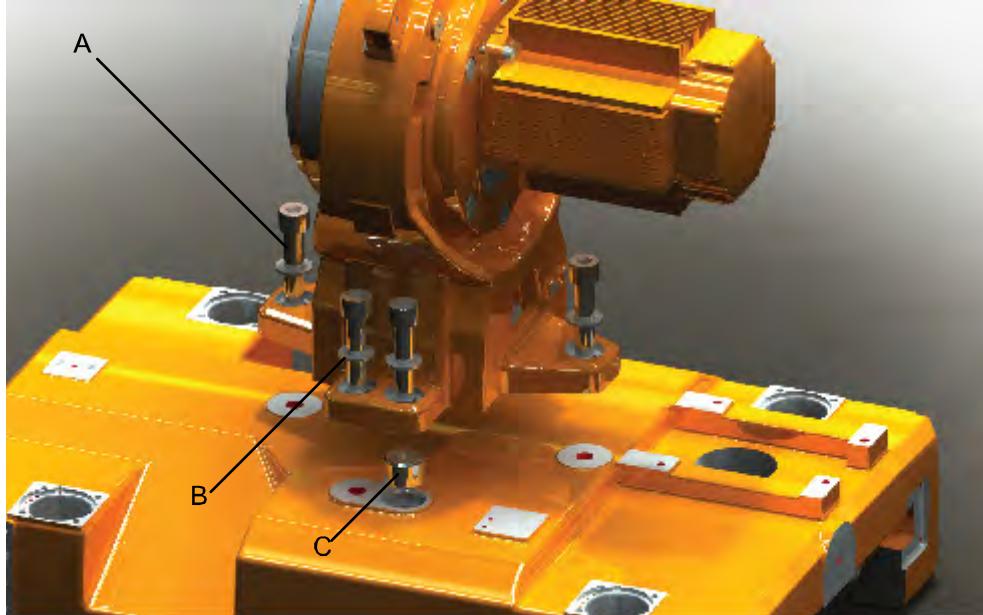
2.4.7 Orienting and securing the robot

General

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

Illustration, robot fitted to base plate

This illustration shows the robot base fitted to the carriage.



xx0900000171

A	6x Screw M24x100
B	6x Washer
C	2x Guide sleeve

Attachment screws

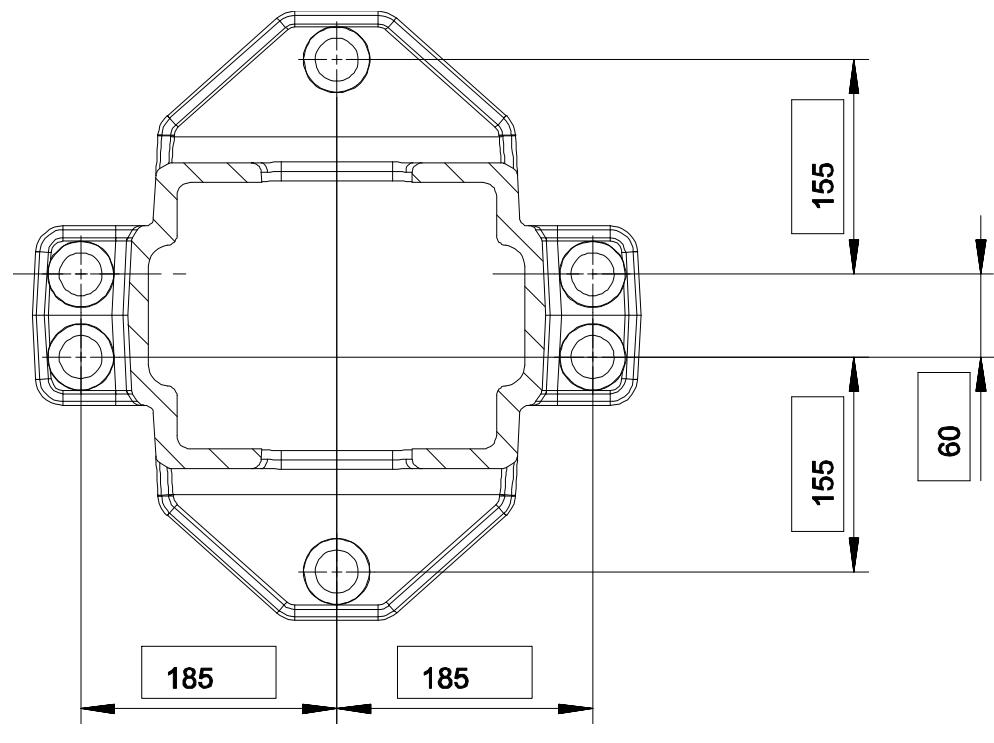
The table below specifies the type of securing screws and washers to be used for securing the robot to the base plate/foundation.

Suitable screws, lightly lubricated:	M24 x 100
Quality:	Quality 8.8
Suitable washer:	Thickness: 4 mm Outer diameter: 44 mm Inner diameter: 25 mm
Tightening torque:	725 Nm

Continues on next page

Hole configuration, base

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



xx0900000172

2 Installation and commissioning

2.4.8 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. The method for mounting the robot in a suspended (upside down) or tilted position is basically the same as for floor mounting, but the system parameters that describe the mounting angle (how the robot is oriented relative to the gravity) must be redefined.



Note

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



Note

The allowed mounting positions are described in the product specification for the robot. The requirements on the foundation are described in [Requirements, foundation on page 61](#).

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 Alpha

If the robot is mounted on a wall (rotated around the x-axis), then the robot base frame and the system parameter *Gravity Alpha* must be redefined. The value of *Gravity Alpha* should then be $\pm\pi/2$ ($\pm3.141593/2$).

Continues on next page

2.4.8 Setting the system parameters for a suspended or tilted robot

Continued

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



Note

The system parameter *Gravity Alpha* is not supported for all robot types. 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 following values are applicable for the IRB 6620LX.

Position of the robot	Gravity Alpha	Gamma Rotation
Suspended	+3.141592	-1.570796
Wall	+1.570796	-1.570796

Defining the parameter in the IRC5 software

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

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

The system parameters are redefined in the **Configuration Editor**, in RobotStudio or on the FlexPendant.

2 Installation and commissioning

2.4.9 Fitting equipment on robot

General

The robot features mounting holes for additional equipment.

Access to any of the following mounting holes may be obstructed by any additional cabling, equipment, etc., fitted by the robot user. Make sure the required mounting holes are accessible when planning the robot cell.



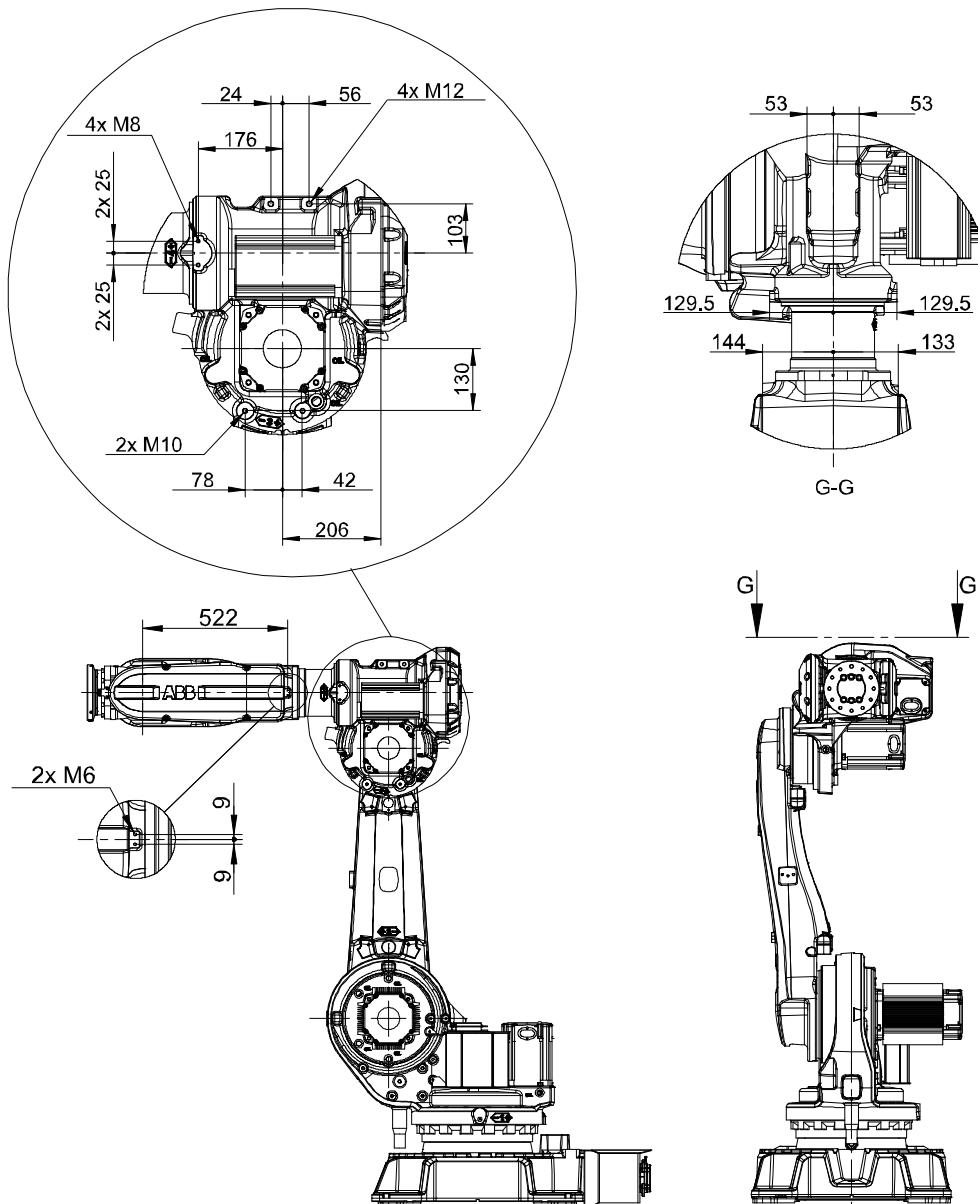
Note

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

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Illustration, fitting of extra equipment on upper arm

The illustration below shows the mounting holes available for fitting extra equipment on the upper arm.



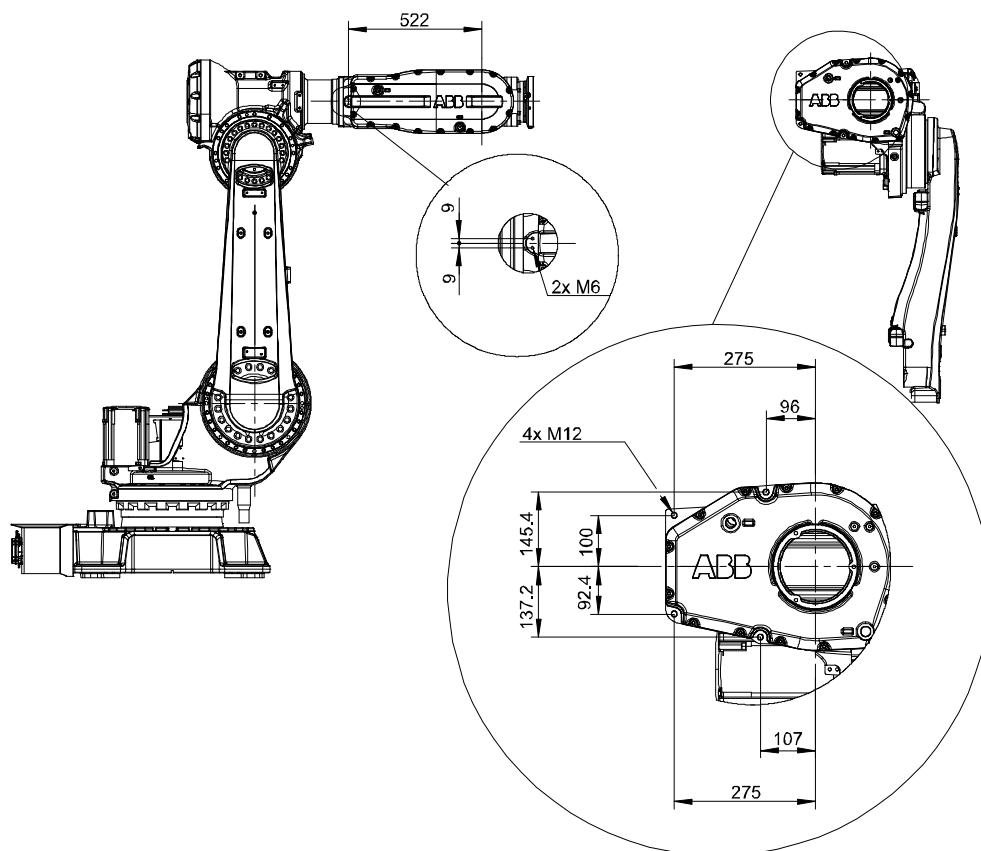
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2 Installation and commissioning

2.4.9 Fitting equipment on robot

Continued



xx0600002945

Fastener quality

When fitting tools on the turning disk (see the figures above), only use screws with quality 12.9.

Standard screws with quality 8.8 may be used when fitting other equipment to the mounting holes.

2.4.10 Installing the guide trough

Reference to documentation

How to install the guide trough is detailed in sub-supplier documentation. Assembly instructions are downloaded from sub-supplier web page (<http://www.igus.com>).

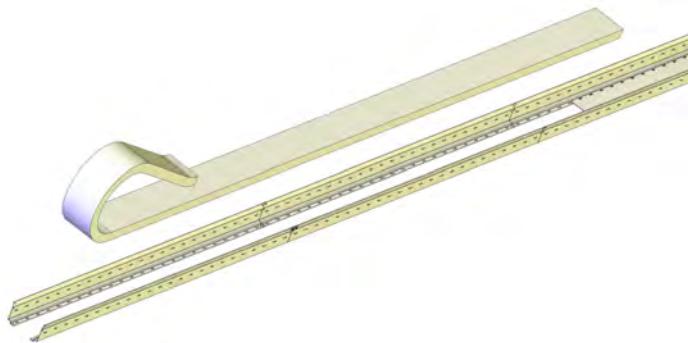
2 Installation and commissioning

2.4.11 Lifting and fitting the cable chain IGUS

2.4.11 Lifting and fitting the cable chain IGUS

Illustration, cable chain and cable tray made of aluminium profiles

The figure shows the cable chain IGUS and the cable tray designed for the cable chain.



xx1500000868

Plan the job

Cable chains are easily damaged through improper handling. Chains longer than 4 meters are heavy and cumbersome to move. In order to prevent personal injury and damage to the chain please pay attention while handling.

Read the procedure through closely before installing the chain and plan the job in advance, in regard to the actual installation site.

To move the chain from storage to track, use one of the methods described in this section. Method 2 requires an overhead crane.

Required equipment

Equipment	Art. no.	Note
Lifting slings, standard	-	Quantity depends on track motion length. Required if using lifting method 1.
Lifting sling, extra wide (50 mm)	-	Required if using lifting method 2.
Overhead crane	-	

Method 1: lifting the cable chain that is folded in half

	Action	Note
1	 CAUTION The complete cable chain weighs 8 - 15 kg / meter (depending on content). All lifting accessories used must be sized accordingly!	

Continues on next page

2 Installation and commissioning

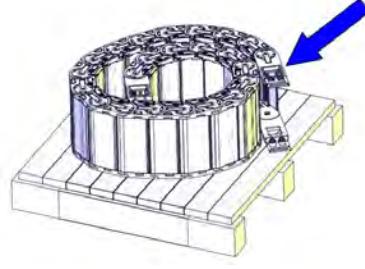
2.4.11 Lifting and fitting the cable chain IGUS

Continued

Action	Note
2 Place the chain so that it is folded in half lying flat.	
3 Place lifting slings on the two ends and in the middle. If the folded chain is longer than 4 meters then extra lifting slings should be placed so that the chain is supported every two meters.	 xx1300000887
4 Lift the cable chain to the installation position above the cable tray. The chain should be placed so that both ends are in the middle of the track, at the aluminium profile that has a cut-out.	 xx1300000932
5 There is no space for the lifting slings to stay fitted to the chain once it is lowered into the tray, therefore these must be removed before the cable chain is placed inside the tray. Lower the fixed and movable ends first, then continue lowering bit by bit until the complete chain is fitted into the tray, while at the same time removing the lifting slings one by one.	

Method 2: lifting the cable chain that is rolled

This procedure requires an overhead crane.

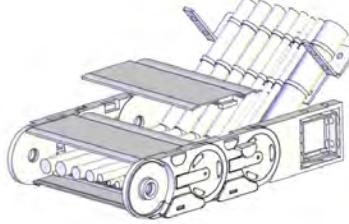
Action	Note
1  CAUTION The complete cable chain weighs 8 - 15 kg / meter (depending on content). All lifting accessories used must be sized accordingly!	
2 With the chain lying on its side, secure the loose end to ensure that the chain can not unroll during the lift.	 xx1300000888

Continues on next page

2 Installation and commissioning

2.4.11 Lifting and fitting the cable chain IGUS

Continued

Action	Note
3 Lift the chain so that it is standing upright and insert a wide lifting sling (50 mm) through the center of the chain.	 xx1300000889
4 Lift the cable chain to the installation position above the cable tray. The chain should be placed so that both ends are in the middle of the track, at the aluminium profile that has a cut-out.	
5 Lower the cable chain into the cable tray. The ends of the chain should be in the middle of the track.	
6 In order to keep the correct length for long chains that are to be rolled, the strapping plate as well as the first cover and clips are removed. Refit these parts during installation.	 xx1300000890

Installing the cable chain into the tray

How to install the cable chain into the tray is described in [Refitting the energy chain on page 300](#).

Also see additional installation information in documentation from IGUS: *Installation guide - Gliding applications (IGUS)*.

2.4.12 Inspecting and test running the e-chain before start-up

Inspection before test run

There are several inspection points of the e-chainsystem® prior to start-up. These are detailed in *Transport and startup - E-chainsystems (IGUS)*. Please read them through before start-up of the e-chain®.

Test run

Test run the e-chainsystem® at low speed, slowly increasing the speed, run to each end position:

- Check for sufficient e-chain® length: e-chain® must not be under mechanical stress or taught.
- Check complete e-chainsystem® is free from foreign objects or interfering edges.

Further information is found in *Transport and startup - E-chainsystems (IGUS)*.

2 Installation and commissioning

2.4.13 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 also be defined in the software as detailed in:

- *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 for the robot.

2.4.14 Optimizing the performance

Standard performance

The standard performance of a linear axis system should be more than enough for most material handling applications. However if the application requires higher accuracy, or if the installation is at the "weaker end" there are a number of possibilities to improve the performance. Factors affecting the performance are for example: height of the legs, position of the legs, length of the movement, speed, robot arm position, tool design, and floor stiffness.



CAUTION

If two IRB 6620LX are mounted on the same linear axis, then they may influence each other causing vibrations. Therefore, is the securing of the frame support extra important for applications where even small vibrations can cause disturbances.

How to improve performance

Improve the stability of the installation

The most important factor is the configuration of the legs. Installations with long distance between the legs in combination with high legs are more unstable. The floor stability and attachment of the lower legs are also important factors. The performance will in general be better when the robot is at a position close to a leg. See *Product specification - IRB 6620*, and *Product specification - Linear Axis*.

Reduce the acceleration

The instruction `AccSet` can be used in the RAPID program to temporarily reduce the acceleration and thus vibration of the system. This is especially efficient during shorter movements.

For example, `AccSet 50, 25` will limit the acceleration to 50% of the normal value and the ramp (acceleration rate) to 25% of the normal value.

Use reduced acceleration during the more sensitive movements and increase the value to the default (`AccSet 100, 100`) during longer movements or when the need of accuracy is less important.

For more information about `AccSet` see *Technical reference manual - RAPID Instructions, Functions and Data types*.

Continues on next page

2 Installation and commissioning

2.4.14 Optimizing the performance

Continued

Optimize the servo control

The argument `Type` in the instruction `TuneServo` can be defined as `TUNE_DF` to improve the accuracy, by damping oscillations of the axes due to mechanical resonances. `TUNE_DF` can be adjusted within the RAPID program during execution. This means that you can have different settings for `TuneServo` for different robot positions and movements. Adjusting `TUNE_DF` correctly will not affect the cycle time and path accuracy in any negative way.



Tip

The ABB software *TuneMaster* is a good tool for finding the optimal value of `TUNE_DF`. *TuneMaster* is included in the RobotWare distribution.

The argument `Type` in the instruction `TuneServo` can be defined as `TUNE_DH` to improve the smoothness of the robot path, by decreasing the effective bandwidth. Using `TUNE_DH` affects the path in corner zones, increasing the cycle time in fine points but not along the entire path.

For more information about `TuneServo` see *Technical reference manual - RAPID Instructions, Functions and Data types*.

2.4.15 Installation of signal lamp (option)

Signal lamp

See the assembly instruction delivered with the signal lamp.

2 Installation and commissioning

2.4.16 Automatic lubrication system

2.4.16 Automatic lubrication system

Power source for the lubrication system

The lubrication system for the linear axis is powered either by battery or by cable from external power source, depending of which option is chosen at delivery. IRC5 can control the lubrication if option 1070-1 for IRC5 is selected. Read more in *Product manual - IRC5*.

Handling the signal from the grease level sensor

The grease level sensor reports a completed cycle of the progressive distributor by changing the pulse twice. The software has to react on the second change of pulse.

The sensor can be connected either to the robot controller or to a PLC. Code must be written to handle the signal.

Setting up the lubrication interval

The general recommendation is to start with a time interval of 150 hours or a length interval of 100 km for the lubrication. These values are to be used for normal room conditions regarding temperature, humidity and dust. If the conditions are more severe, shorter intervals should be used.

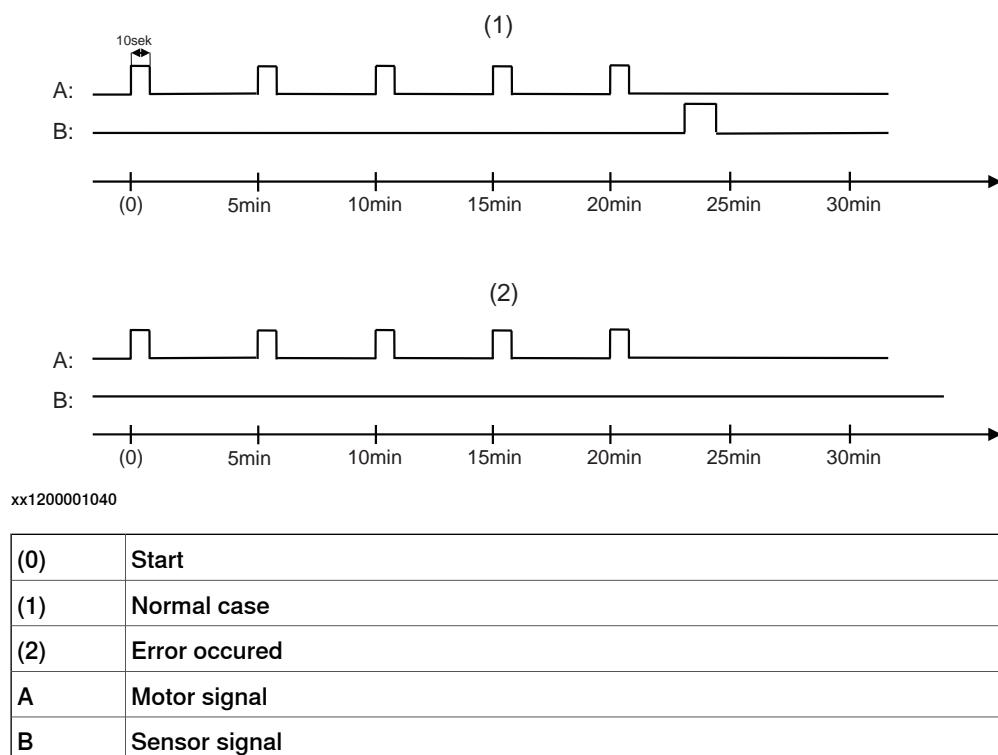
The flat rails and rack should be “wet” and have a thin oil film but not be soaked. If the lubrication is correctly adjusted a few floor drips may occur but not much more.

Continues on next page

Activating the lubrication and detecting lubrication errors

The recommendation is to send 5 pulses (10s) to the lubrication pump every 5 min or until the sensor responds. The sensor response at a successful lubrication is to change the output value twice. The initial output value can be either 0 or 1. This gives two scenarios for a completed sensor feedback: 0-1-0 or 1-0-1. In other words, a correct sensor feedback after a completed lubrication cycle will be that the sensor is changing the output value twice.

If no response has been received from the sensor after 5 pulses and 25 min, an error has occurred.



Further information

System functions, mechanical connection, signal diagram, function description, maintenance, information about programming and setting up for operation is described in *System manual - Automatic lubrication system (Güdel)*.

2 Installation and commissioning

2.5.1 Robot cabling and connection points

2.5 Electrical connections

2.5.1 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.

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 126 .
Customer cables (option)	Handles communication with equipment fitted on the robot by the customer, low voltage signals and high voltage power supply + protective ground. The customer cables also handle databus communication. See the product manual for the controller, see document number in References on page 10 .

Robot cables

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

Cable sub-category	Description	Connection point, cabinet	Connection point, robot
Robot cable, power	Transfers drive power from the drive units in the 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

Robot cable, power

Cable	Art. no.
Robot cable, power: 7 m	3HAC026787-001
Robot cable, power: 15 m	3HAC026787-002
Robot cable, power: 22 m	3HAC026787-003
Robot cable, power: 30 m	3HAC026787-004

Robot cable, signals

Cable	Art. no.
Robot cable signal, shielded: 7 m	3HAC7998-1
Robot cable signal, shielded: 15 m	3HAC7998-2
Robot cable signal, shielded: 22 m	3HAC7998-3
Robot cable signal, shielded: 30 m	3HAC7998-4

3 Maintenance

3.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 6620LX.

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

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

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

Safety information

Observe all safety information before conducting any service work!

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



Note

If the IRB 6620LX is connected to power, always make sure that the IRB 6620LX is connected to protective earth before starting any maintenance work!

For more information see:

- *Product manual - IRC5*

3 Maintenance

3.2.1 Specification of maintenance intervals

3.2 Maintenance schedule and expected component life

3.2.1 Specification of maintenance intervals

Introduction

The intervals are specified in different ways depending on the type of maintenance activity to be carried out and the working conditions of the IRB 6620LX:

- 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*.

3.2.2 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 damages 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 132](#)

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

- [Inspection activities on page 133](#)
- [Replacement/changing activities on page 152](#)
- [Cleaning activities on page 184](#)

Activities and intervals, robot

The following table specifies the required maintenance activities and intervals.

Maintenance activity	Equipment	Interval
Cleaning	Robot	Cleaning the IRB 6620LX on page 184
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 12 months.
Inspection	Oil level in axis-5 gearbox	Every 12 months.
Inspection	Oil level in axis-6 gearbox	Every 12 months.
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-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.
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	Every 24,000 hours.
Change	Oil in axis-5 gearbox	Every 24,000 hours.

Continues on next page

3 Maintenance

3.2.2 Maintenance schedule

Continued

Maintenance activity	Equipment	Interval
Change	Oil in axis-6 gear	First change when DTC ⁱⁱ reads: • 6,000 hours Second change when DTC ⁱⁱ reads: • 24,000 hours Following changes: • Every 24,000 hours.
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 132](#).
- 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 [Operating manual - IRC5 with FlexPendant](#) for instructions.

Activities and intervals, linear axis

The following table specifies the required maintenance activities and intervals.

Maintenance activity	Equipment	Interval
General inspection	Complete linear axis	100 hours after commissioning
Inspection	The flat rail tracks and the wiper	Every 12 months.
Change	Oil	Every 10,000 hours i
Replacement	Felt pinion	Every 12 months
Replacement	Auto lubrication battery and the lubricant dispenser (expansion ring)	Every 12 months
Replacement	Wiper and lubricating element	Every 2,000 hours i
Replacement	Lubricating pinion	Every 2,000 hours i
Lubrication	Ball bearings	Every 2,000 hours
Lubrication	Rollers	Every 2,000 hours i

- i Information about how to perform the maintenance activity is described in [Operating manual - TM-O Sizes 40-90 \(Güdel\)](#) or [Operating manual - TM-O 1-4 \(Güdel\)](#) (depending on production year).

Continues on next page

Activities and intervals, e-chain

The following table specifies the required maintenance activities and intervals.

Maintenance activity	Equipment	Interval	Reference
Inspection	Installed e-chain	Before start-up.	See document <i>Transport and startup - E-chainsystems (IGUS)</i>
Inspection	Cables and hoses	Before start-up and periodically.	See document <i>Transport and startup - E-chainsystems (IGUS)</i>
Inspection	Guide troughs	Before start-up and periodically.	See document <i>Transport and startup - E-chainsystems (IGUS)</i>

3 Maintenance

3.2.3 Expected component life

3.2.3 Expected component life

General

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

Expected component life - protection type Standard

Component	Expected life	Note
Cable harness Normal usage ⁱ	40,000 hours ⁱⁱ	Not including: <ul style="list-style-type: none">• Possible SpotPack harnesses• Optional upper arm harnesses
Cable harness Extreme usage ⁱⁱⁱ	20,000 hours ⁱⁱ	Not including: <ul style="list-style-type: none">• Possible SpotPack harnesses• Optional upper arm harnesses
Gearboxes ^{iv}	40,000 hours	

ⁱ Examples of "normal usage" in regard to movement: most material handling applications.

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

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

^{iv} The SIS for an IRC5 system is described in the *Operating manual - Service Information System*.

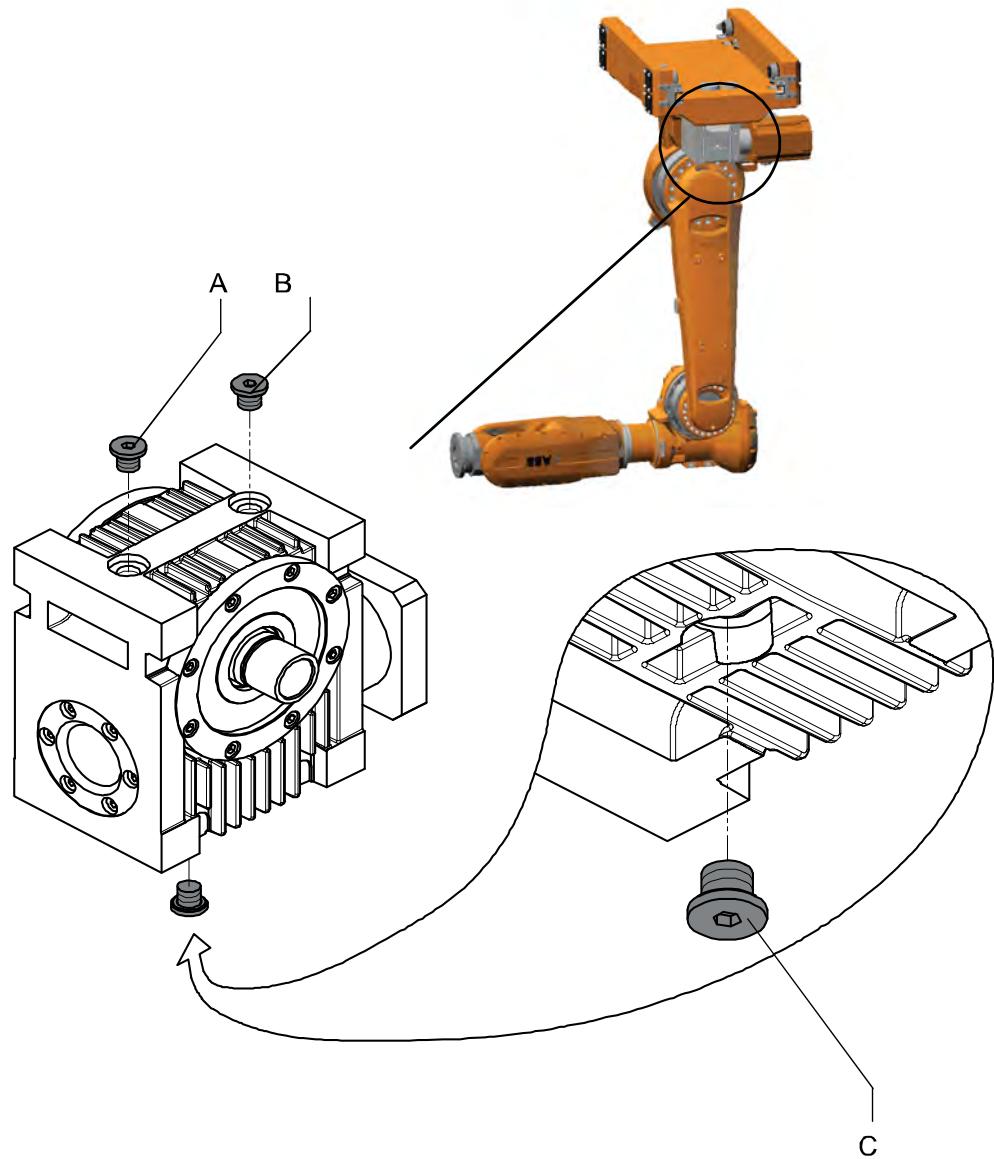
3.3.1 Inspecting the oil level in axis-1 gearbox

3.3 Inspection activities

3.3.1 Inspecting the oil level in axis-1 gearbox

Location of gearbox

The axis-1 gearbox is located between the frame and base. See oil plugs in the following figure.



xx0900000148

A	Vent screw
B	Filler plug
C	Discharge screw

Continues on next page

3 Maintenance

3.3.1 Inspecting the oil level in axis-1 gearbox

Continued

Required equipment

Equipment	Art. no.	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152 .	 Note Do not mix with other oils!
Standard toolkit	-	Content is defined in section Standard tools on page 350 .
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 in axis-1 gearbox

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

	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
3	Make sure that the oil temperature is $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$.	This is a precaution to reduce the temperature dependency of the measurement.
4	Remove the gearbox from the carriage.	See Changing oil, axis-1 gearbox on page 154 .
5	Open the <i>filler plug</i> .	Shown in figure Location of gearbox on page 133 .
6	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in Type of lubrication in gearboxes on page 152 . Further information about how to fill with oil is found in section Changing oil, axis-1 gearbox on page 154 .
7	Refit the oil plug.	Tightening torque: 24 Nm

3.3.2 Inspecting the oil level in axis-2 gearbox

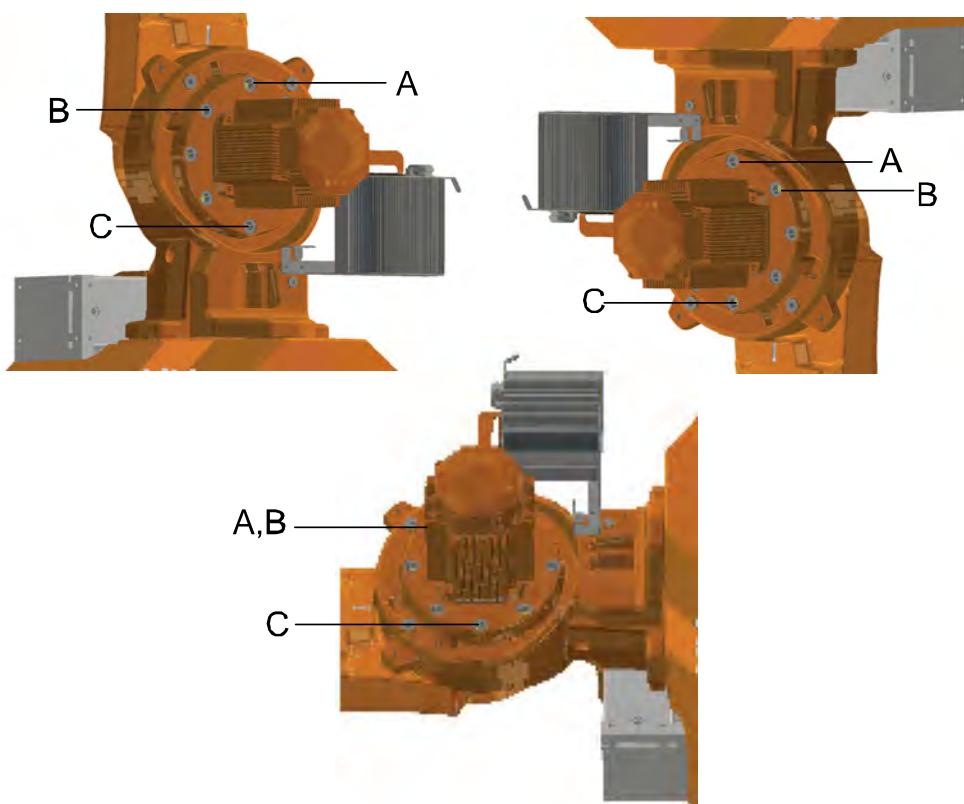
Location of gearbox

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

Location of gearbox on suspended mounted robot

The following figure shows suspended mounted robot.

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



xx0900000144

A	Oil plug, filling
B	Oil plug, inspection
C	Oil plug, draining

Required equipment

Equipment, etc.,	Art. no.	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152 .	Note! Do not mix with other oils!
Standard toolkit	-	Content is defined in section Standard tools on page 350 .

Continues on next page

3 Maintenance

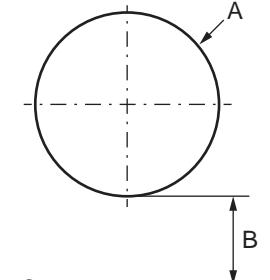
3.3.2 Inspecting the oil level in axis-2 gearbox

Continued

Equipment, etc.,	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.

Inspecting the oil level in axis-2 gearbox

Use this procedure to inspect the oil level in the axis-2 gearbox.

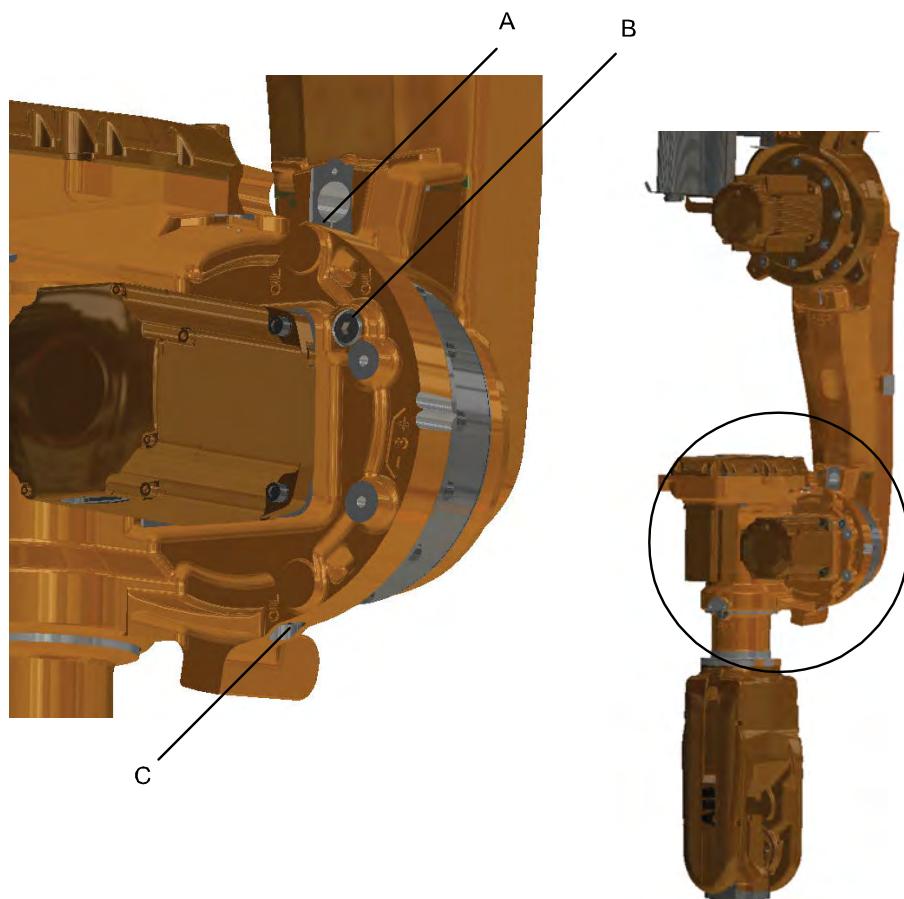
	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
2	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
4	Open the <i>oil plug, filling and inspection</i> .	Shown in the figure Location of gearbox on page 135 .
5	Measure the oil level. Required oil level: max. 5 mm below the inspection oil plug hole.	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil
6	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 152 . Filling of oil is detailed further in the section Filling, oil on page 159 .
7	Refit the oil plug.	Tightening torque: 24 Nm.

3.3.3 Inspecting the oil level in axis-3 gearbox

3.3.3 Inspecting the oil level in axis-3 gearbox

Location of gearbox

The axis 3 gearbox is located in the upper arm rotational center as shown in the figure.



xx0900000146

A	Oil plug, filling
B	Oil plug, inspection
C	Oil plug, draining

Required equipment

Equipment, etc.	Art. no.	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152 .	Note! Do not mix with other oils!
Standard toolkit	-	Content is defined in section Standard tools on page 350 .
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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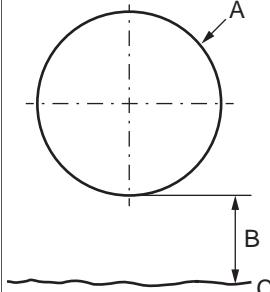
3 Maintenance

3.3.3 Inspecting the oil level in axis-3 gearbox

Continued

Inspecting the oil level in axis-3 gearbox

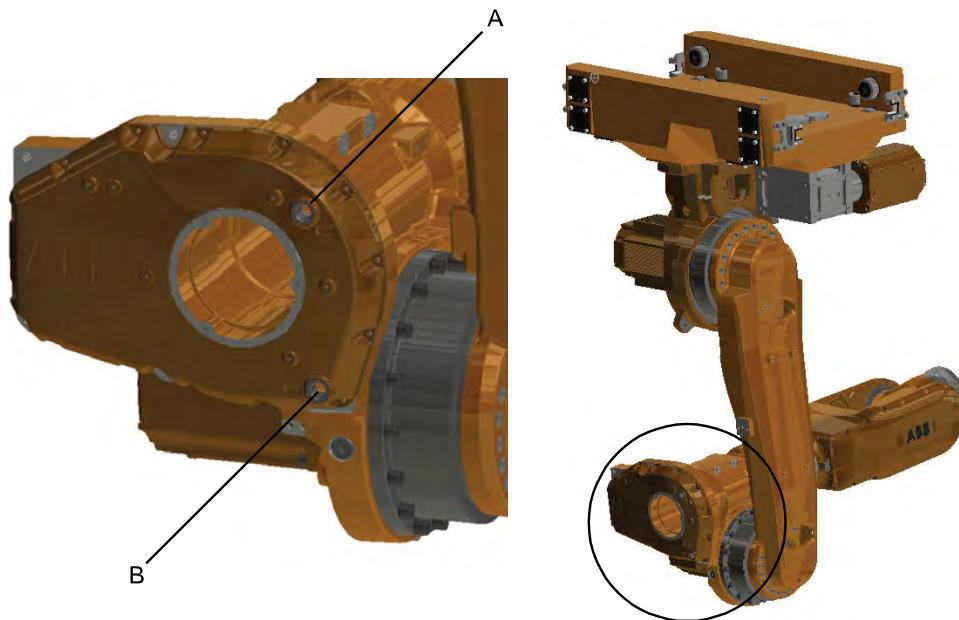
Use this procedure to inspect the oil level in the axis-3 gearbox.

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
2 Move the robot to a position according to the illustration in Location of gearbox on page 137 .	Detailed in the section Synchronization marks and synchronization position for axes on page 309 .
3  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
4 Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
5 Open the <i>oil plug, inspection</i> .	Shown in the figure Location of gearbox on page 137 .
6 Measure the oil level. Required oil level: max. 5 mm below the inspection oil plug hole.	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil
7 Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 152 . Further information about how to fill the oil may be found in the section Filling, oil on page 163 .
8 Refit the oil plug.	Tightening torque: 24 Nm

3.3.4 Inspecting the oil level in axis-4 gearbox

Location of gearbox

The axis-4 gearbox is located in the rear part of the upper arm as shown in the figure.



xx0900000147

A	Oil plug, filling and inspection
B	Oil plug, draining

Required equipment

Equipment, etc.	Art. no.	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152.	
Standard toolkit	-	Content is defined in section Standard tools on page 350.
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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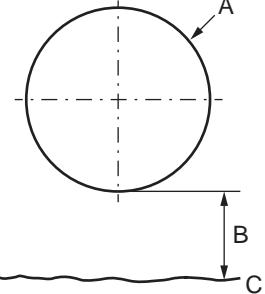
3 Maintenance

3.3.4 Inspecting the oil level in axis-4 gearbox

Continued

Inspecting the oil level in axis-4 gearbox

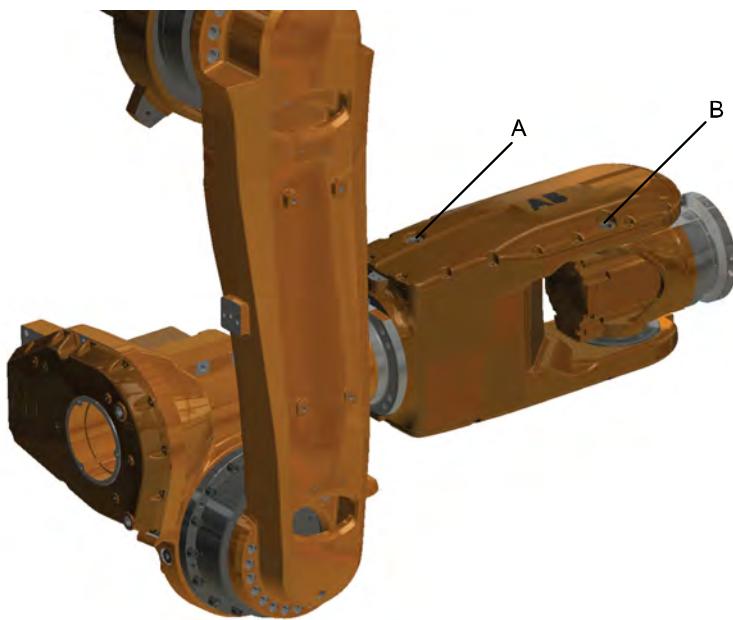
Use this procedure to inspect the oil level in the axis-4 gearbox.

	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
2	Move the robot to the calibration position.	This is detailed in section Synchronization marks and synchronization position for axes on page 309 .
3	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
4	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
5	Open the <i>oil plug, filling and inspection</i> .	Shown in the figure Location of gearbox on page 139 .
6	Measure the oil level. Required oil level: 0-10 mm	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil
7	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 152 . Further information about how to fill the oil may be found in the section Filling, oil on page 165 .
8	Refit the oil plug.	Tightening torque:24 Nm

3.3.5 Inspecting the oil level in axis-5 gearbox

Location of gearbox

The axis-5 gearbox is located in the wrist unit as shown in the figure.



xx0900000155

A	Oil plug, filling and inspection
B	Oil plug, draining

Required equipment

Equipment etc.	Art. no.	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152 .	
Standard toolkit	-	Content is defined in section Standard tools on page 350 .
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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3 Maintenance

3.3.5 Inspecting the oil level in axis-5 gearbox

Continued

Inspecting the oil level in axis-5 gearbox

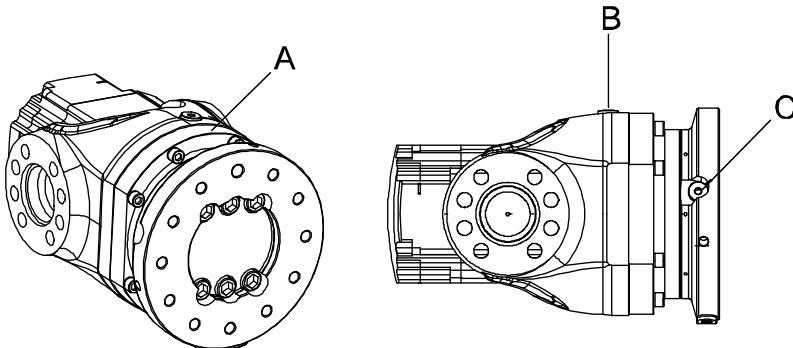
Use this procedure to inspect the oil level in the axis-5 gearbox.

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
2 Move the robot upper arm to a horizontal position.	
3 Turn the wrist unit in a way that both oil plugs are facing upwards.	
4  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
5 Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
6 Open the <i>oil plug, filling and inspection</i> .	Shown in the figure Location of gearbox on page 141 .
7 Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 152 . Further information about how to fill the oil may be found in the section Filling, oil, axis 5 on page 168 .
8 Refit the oil plug.	Tightening torque:24 Nm

3.3.6 Inspecting the oil level in axis-6 gearbox

Location of gearbox

The axis-6 gearbox is located in the wrist unit as shown in this figure.



xx0600002964

	Type 1
A	Axis-6 gearbox
B	Oil plug, filling and inspection
C	Oil plug, draining

Required equipment

Equipment	Art. no.	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152 .	
Standard toolkit	-	Content is defined in section Standard tools on page 350 .
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 in axis-6 gearbox

Use this procedure to inspect the oil level in the axis-6 gearbox.

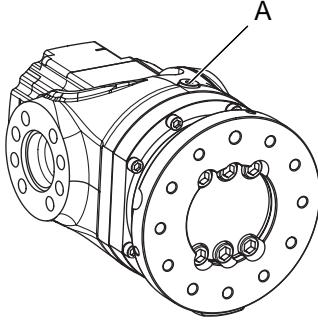
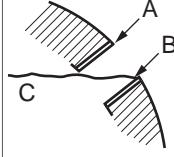
Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
2 Move axes 3 and 5 to a horizontal position, and make sure that the <i>oil plug, filling and inspection</i> is facing upwards.	

Continues on next page

3 Maintenance

3.3.6 Inspecting the oil level in axis-6 gearbox

Continued

Action	Note
<p>3  DANGER</p> <p>Turn off all:</p> <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot <p>Before entering the robot working area.</p>	
4 Make sure that the oil temperature is $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$.	This is a precaution to reduce the temperature dependency of the measurement.
5 Open the <i>oil plug, filling and inspection</i> .	 xx1300000244
6 Turn axis 6 so that the <i>oil plug, draining</i> faces upwards.	
7 Open the <i>oil plug, draining</i> .	<p>This is a precaution to avoid vacuum effects by allowing air to enter at the top of the gearbox.</p> <p> Note</p> <p>If equipment that covers the <i>oil plug, draining</i> is fitted on the robot so that the oil plug cannot be opened, then this step can be skipped.</p>
8 Slowly turn axis 4, while adjusting axis 6 so that the <i>oil plug, draining</i> always faces upwards. Turn axis 4 until the axis-4 angle reads -45° to -55° .	
<p>9 Inspect the oil level in the hole for the <i>oil plug, filling and inspection</i>.</p> <p>The oil should reach all the way up to the external edge of the thread for the <i>oil plug, filling and inspection</i>.</p> <p> Note</p> <p>If the <i>oil plug, draining</i> is not opened, then use a clean, narrow object, for example an oil stick or a cable tie, to gently poke the oil surface. This will avoid surface tension from stopping air to enter into the gearbox.</p>	 xx1400002786 <p>A Oil plug hole B Required oil level C Gearbox oil</p>

Continues on next page

3.3.6 Inspecting the oil level in axis-6 gearbox

Continued

	Action	Note
10	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in <i>Type and amount of oil in gearboxes on page 152</i> . Further information about how to fill the oil may be found in the section <i>Filling, oil, axis 6 on page 171</i> .
11	Refit the oil plugs.	Tightening torque: 24 Nm.
12	 WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i> .	

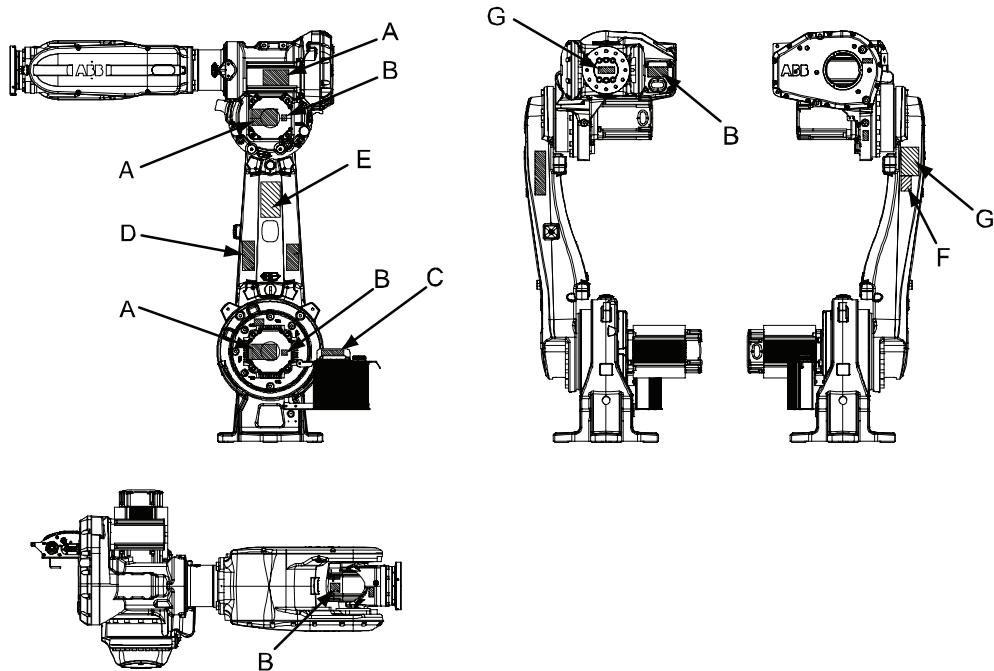
3 Maintenance

3.3.7 Inspecting the information labels

3.3.7 Inspecting the information labels

Location of labels

These figures show the location of the information labels to be inspected. The symbols are described in section [Safety symbols on product labels on page 41](#).



xx1100000036

A	Warning label concerning high temperature (3 pcs)
B	Warning sign, symbol of a flash (located on motor cover) (4 pcs)
C	Warning label concerning brake release
D	Warning label concerning risk of tipping
E	Instruction label concerning lifting
F	Label for calibration
G	Serial no. from rating label

Required tools and equipment

Visual inspection, no tools are required.

Continues on next page

Inspecting, labels

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
2	Inspect the labels, located as shown in the figures.	
3	Replace any missing or damaged labels.	Article numbers for the labels and plate set is specified in Spare part lists on page 353 .

3 Maintenance

3.3.8 Inspecting the axis-1 mechanical stop pin

3.3.8 Inspecting the axis-1 mechanical stop pin

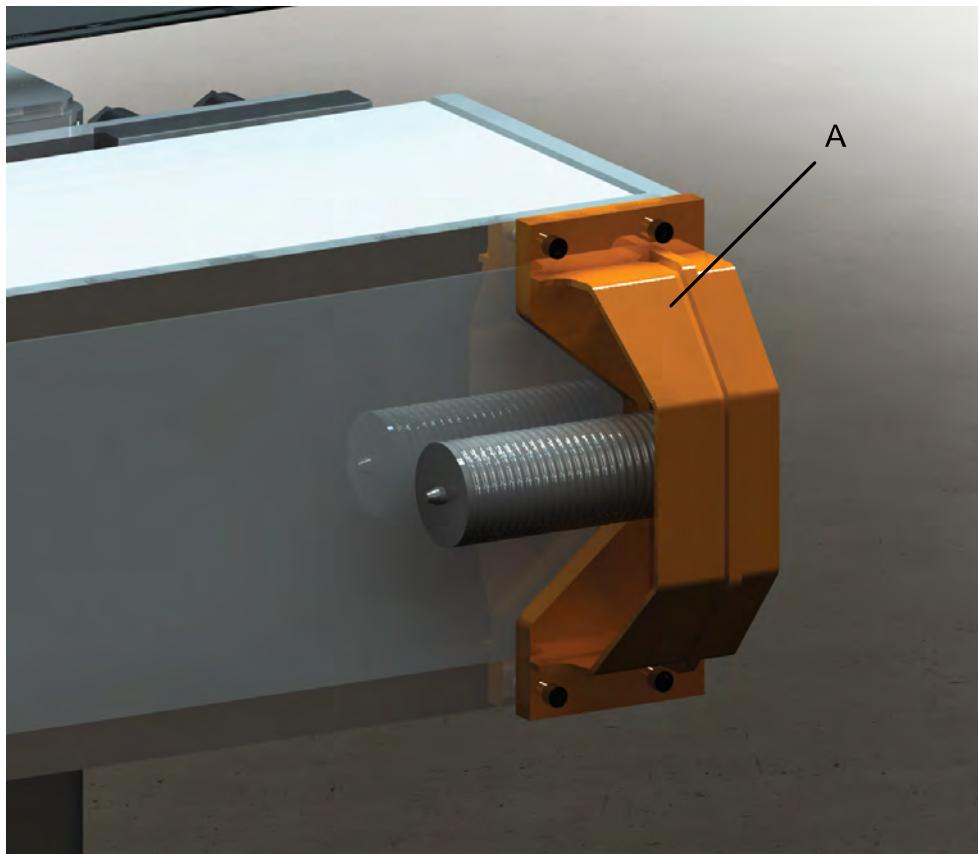


WARNING

Mechanical stop pin can not be fitted onto robot if option 810-1 *Electronic Position Switch* is used.

Location of mechanical stop pin

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



xx0900000176

A

Mechanical stop ax 1

Required equipment

Visual inspection, no tools are required.

Continues on next page

Inspecting, mechanical stop pin

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

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
2	Inspect the axis-1 mechanical stop pin. If the mechanical stop pin is bent or damaged, it must be replaced.  Note The expected life of gearboxes can be reduced after collision with the mechanical stop.	

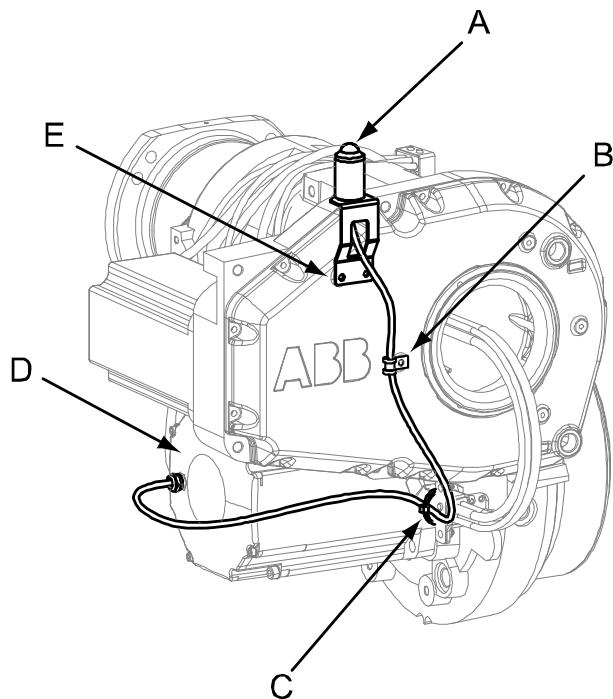
3 Maintenance

3.3.9 Inspecting, signal lamp

3.3.9 Inspecting, signal lamp

Location of signal lamp

The signal lamp is located as shown in this figure.



xx0600003071

A	UL signal lamp
B	Clamp
C	Cable strap, outdoor
D	Motor, axis 3
E	Attachment screw, M6x8 quality 8-A2F(2 pcs)

Required equipment

Equipment, etc.	Art. no.	Note
Standard toolkit	-	Content is defined in section Standard tools on page 350 .
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, signal lamp

Use this procedure to inspect the function of the signal lamp.

Action	Note
1 Check that signal lamp is lit when motors are put in operation ("MOTORS ON").	

Continues on next page

	Action	Note
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3	If the lamp is not lit, trace the fault by: <ul style="list-style-type: none">• Checking whether the <i>signal lamp</i> is broken. If so, replace it.• Checking cable connections.• Checking the cabling. Replace cabling if a fault is detected.	Art. no. is specified in Required equipment on page 150 .

3 Maintenance

3.4.1 Type of lubrication in gearboxes

3.4 Replacement/changing activities

3.4.1 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* on the Documentation DVD (released twice a year). The revision of the manual published on the Documentation DVD, will contain the latest updates when the Documentation DVD is released.

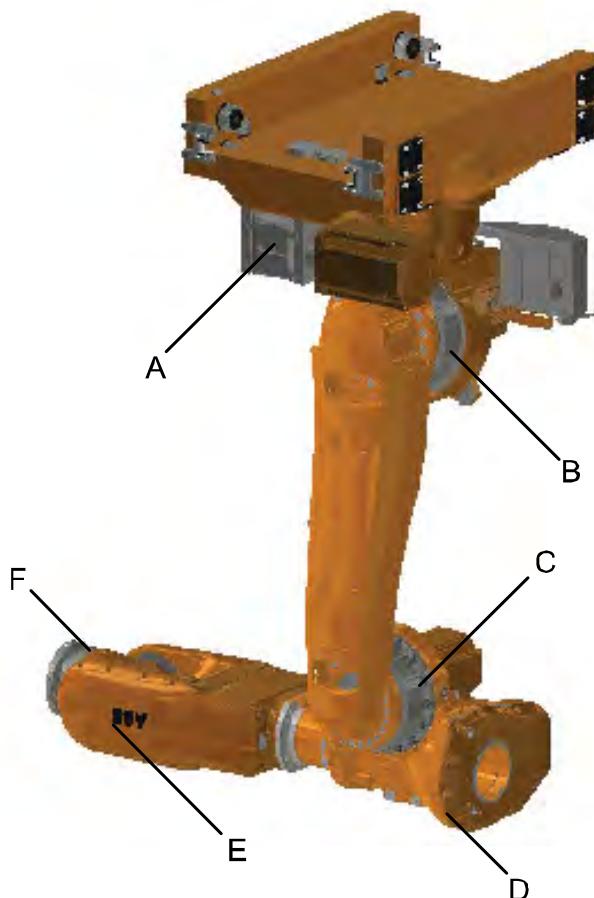
Before starting any inspection, maintenance, or changing activities of lubrication, **always** contact the local ABB Service organization for more information.

For ABB personnel: Always check ABB Library for the latest revision of the manual *Technical reference manual - Lubrication in gearboxes*, in order to always get the latest information of updates about lubrication in gearboxes. A new revision will be published on ABB Library immediately after any updates. Therefore the manual published on the documentation DVD may not contain the latest updates about lubrication.

Continues on next page

Location of gearboxes

The figure shows the location of the gearboxes.



xx0900000149

A	Gearbox, axis 1
B	Gearbox, axis 2
C	Gearbox, axis 3
D	Gearbox, axis 4
E	Gearbox, axis 5
F	Gearbox, axis 6

Equipment

Equipment	Note
Oil dispenser	Includes pump with outlet pipe. Use the suggested dispenser or a similar one: <ul style="list-style-type: none">Orion OriCan article number 22590 (pneumatic)
Nipple for quick connect fitting, with o-ring	

3 Maintenance

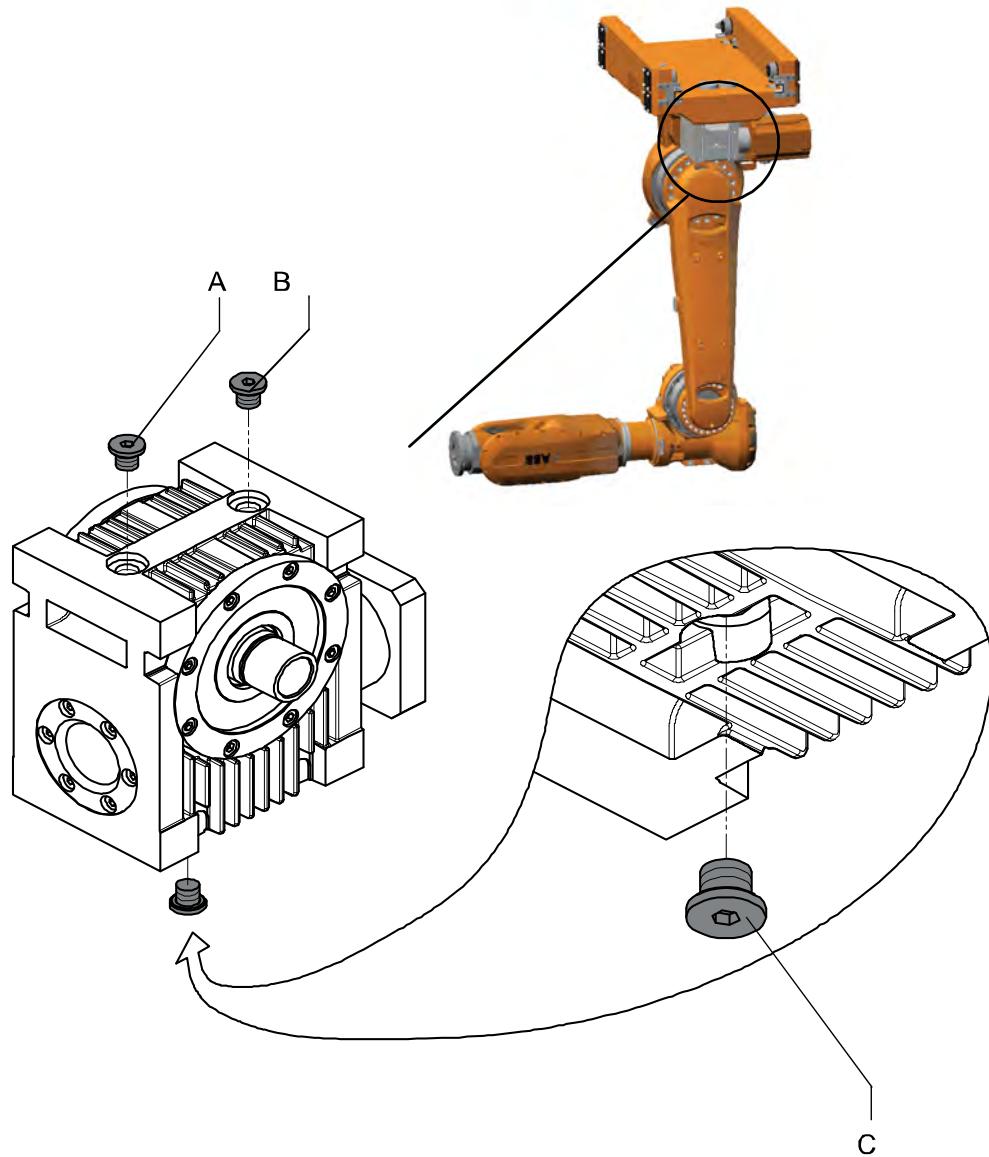
3.4.2 Changing oil, axis-1 gearbox

Note

This action demand recalibration of the robot.

Location of oil plugs

Axis 1 gearbox is located between the frame and base. Oil plugs are shown in the figure.



xx0900000148

A	Vent screw
B	Oil plug, filling
C	Oil plug, draining

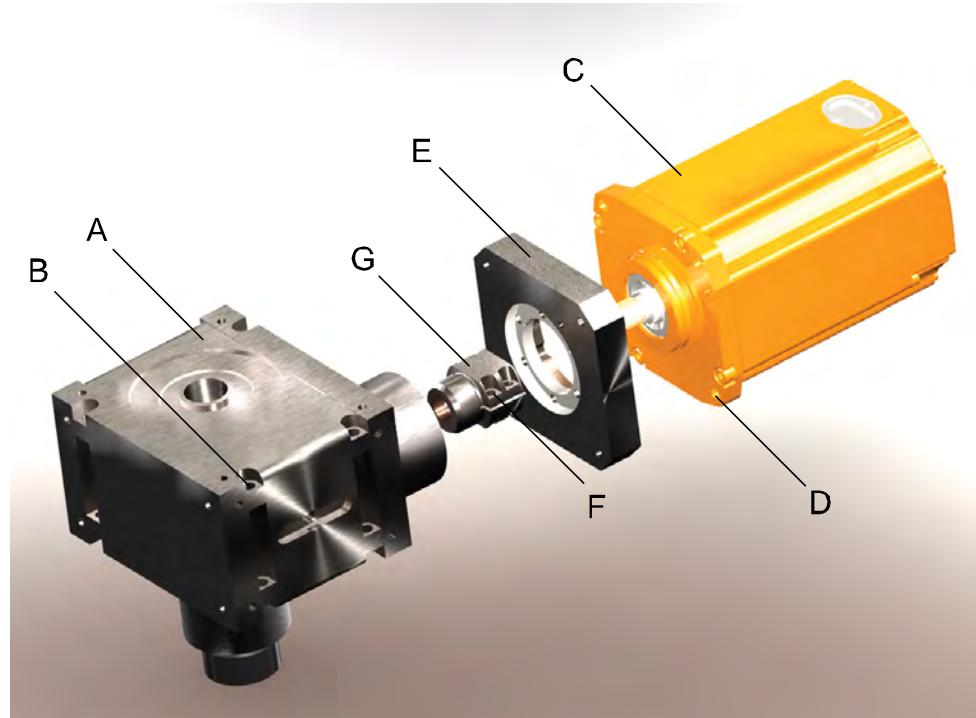
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Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152 .	See Type and amount of oil in gearboxes on page 152 .	 Note Do not mix with other oils!
Oil collecting vessel	-		Capacity: 8,000 ml.
Dial indicator	-		
Standard toolkit	-		Content is defined in section Standard tools on page 350 .

Changing oil, axis 1

Use this procedure to drain oil in gearbox axis 1.



xx0900000210

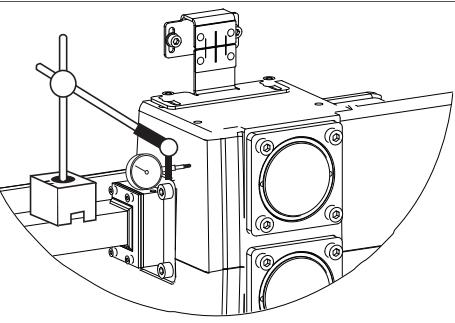
A	Gearbox axis 1
B	Attachment screws gearbox
C	AC motor
D	Attachment screws motor
E	Flank
F	Clutch locking screw
G	Clutch

Continues on next page

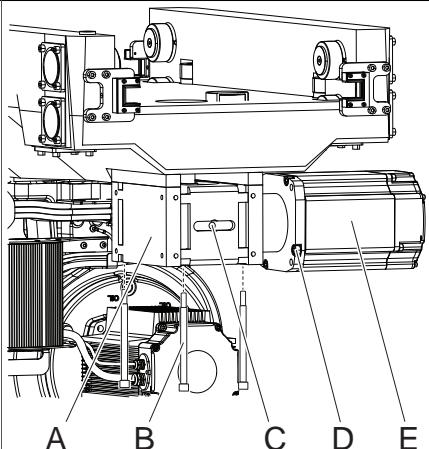
3 Maintenance

3.4.2 Changing oil, axis-1 gearbox

Continued

Action	Note
1	 WARNING
	<p>Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55.</p>
2	<p>Move carriage to the zero position, and use a dial indicator to make sure that the carriage remains in position when refitting the gearbox.</p>
	 xx1400000773
3	 DANGER
	<p>Turn off all:</p> <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply <p>to the robot, before entering the robot working area.</p>
4	<p>Remove R2.MP1 and R2.FB1 connectors from the motor.</p>
	<p>Described in section Replacement of motor, axis 1 on page 242</p>

Continues on next page

Action	Note
5 Loosen the four screws (B) and remove the gearbox (A) with motor (E).	 DANGER The gearbox weight 30 kg  Tip Use a forklift and a loading pallet to secure the gearbox from falling down.  xx1400000772
	<ul style="list-style-type: none"> • A: Gearbox axis 1 • B: 4x screws M12x180 • C: Oil plug, draining • D: 4x motor attachment screws • E: AC Motor
6 Loosen the oil plug and drain the gearbox.	 Tip Loosen the air screw on the top of the gearbox for easier draining.
7 Rinse the gearbox with fresh oil.	 Note Use the same oil type.
8 After rinsing the gearbox refit the air screw.	
9 Fill the gearbox with the correct amount of lubricating oil.	Where to find type of oil and total amount is detailed in Type of lubrication in gearboxes on page 152 .
10 Refit the oil plug, filling	
11 Refit the gearbox to the carriage using the four attachment screws M12x180.	Tightening torque: 83 Nm.
12 Refit R2.MP1 and R2.FB1 to the motor.	Described in section Replacement of motor, axis 1 on page 242
13 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .

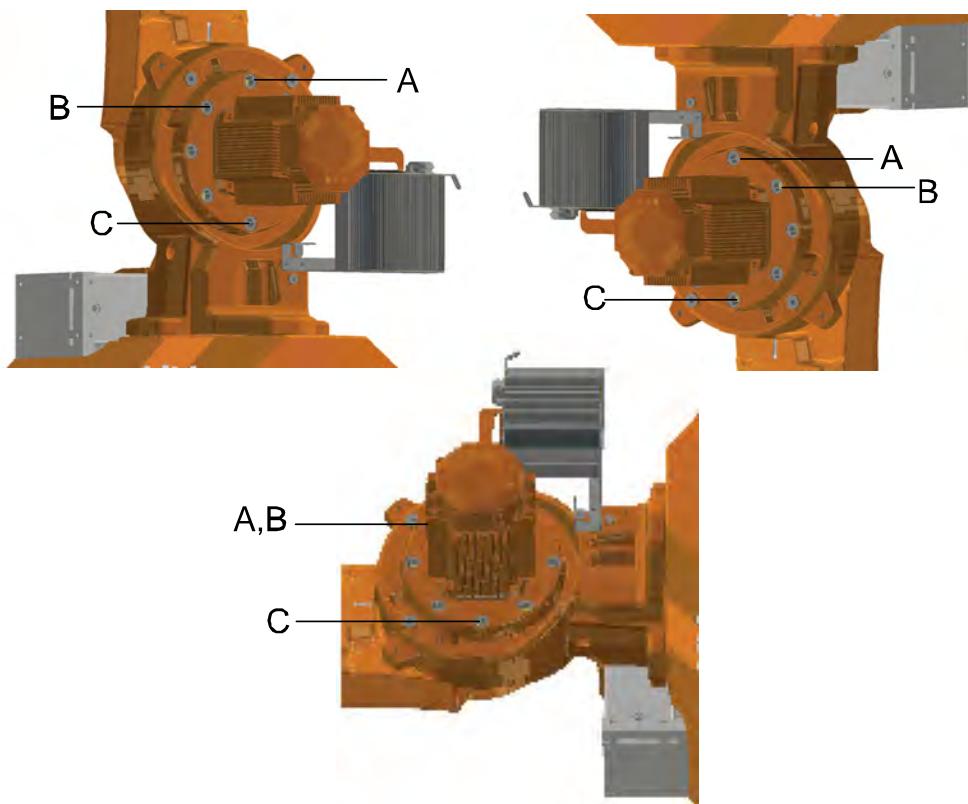
3 Maintenance

3.4.3 Changing oil, axis-2 gearbox

3.4.3 Changing oil, axis-2 gearbox

Location of oil plugs

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



xx0900000144

A	Oil plug, filling
B	Oil plug, inspection
C	Oil plug, draining

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152.	See Type and amount of oil in gearboxes on page 152.	Note! Do not mix with other oil types!
Oil collecting vessel	-		Capacity: 5,000 ml.
Oil exchange equipment	3HAC021745-001		Content is defined in section Special tools on page 351.
Standard toolkit	-		Content is defined in section Standard tools on page 350.

Continues on next page

Draining, oil

The procedure below details how to drain the oil in gearbox axis 2.

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 158](#).

Action	Note
 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
 CAUTION Remove the <i>oil plug, draining</i> , and drain the gearbox oil using a hose with nipple and an oil collecting vessel. Drain as much oil as possible. See WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	Shown in the figure Location of oil plugs on page 158 . Vessel capacity is specified in Required equipment on page 158 .  Note Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
Refit the oil plug.	Tightening torque: 24 Nm.

Filling, oil

Use this procedure to fill oil into the axis-2 gearbox.

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 158](#).

Action	Note
 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	

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3 Maintenance

3.4.3 Changing oil, axis-2 gearbox

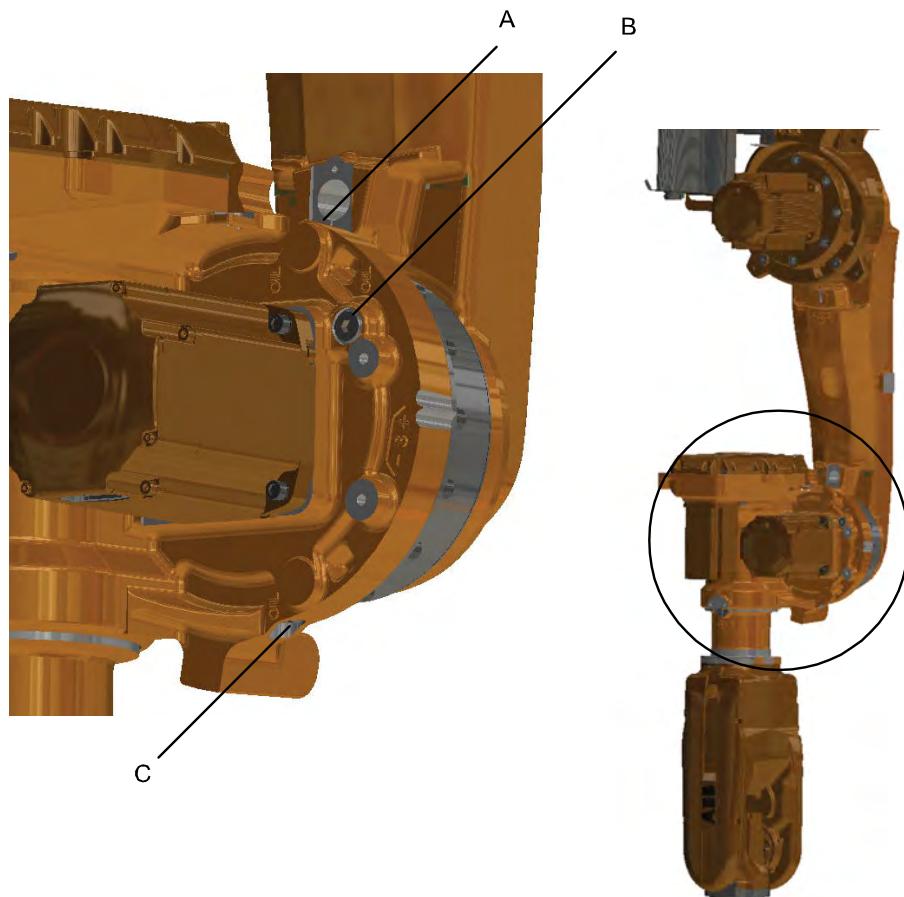
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Action	Note
2  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55.	
3 Remove the <i>oil plug for filling</i> and the <i>oil plug for inspection</i> .	Shown in the figure Location of oil plugs on page 158.
4 Refill the gearbox with clean <i>lubricating oil</i> . The correct oil level is detailed in section Inspecting the oil level in axis-2 gearbox on page 135.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 152.
5  Note Don't mix Kyodo Yushi TMO 150 with other oil types!	
6 Refit the oil plug.	Tightening torque: 24 Nm.

3.4.4 Changing oil, axis-3 gearbox

Location of gearbox

The axis-3 gearbox is located in the upper arm rotational center as shown in the following figure.



xx0900000146

A	Oil plug, filling
B	Oil plug, inspection
C	Oil plug, draining

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152.	See Type and amount of oil in gearboxes on page 152.	Note! Do not mix with other oil types!
Oil exchange equipment	3HAC021745-001		Content is defined in section Special tools on page 351.
Oil collecting vessel	-		Capacity: 3,000 ml.

Continues on next page

3 Maintenance

3.4.4 Changing oil, axis-3 gearbox

Continued

Equipment, etc.	Art. no.	Amount	Note
Standard toolkit	-		Content is defined in section Standard tools on page 350 .

Draining, oil

The procedure below details how to drain oil from the gearbox, axis 3.

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 161](#).

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
2	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
3	Remove the <i>oil plug, filling</i> .	
4	Remove the <i>oil plug, draining</i> , and drain the gearbox oil using a hose with nipple and an oil collecting vessel.  CAUTION Drain as much oil as possible. See WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	Shown in the figure Location of gearbox on page 161 . Vessel capacity is specified in Required equipment on page 161 .  Note Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
5	Refit the oil plug.	Tightening torque: 24 Nm.

Continues on next page

Filling, oil

The procedure below details how to fill oil into the gearbox, axis 3.

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 161](#).

Action	Note
<p>1  DANGER Turn off all:<ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.</p>	
<p>2  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55.</p>	
3 Remove the <i>oil plug, filling</i> .	Shown in the figure Location of gearbox on page 161 .
4 Refill the gearbox with clean <i>lubricating oil</i> . The correct oil level is detailed in section Inspecting the oil level in axis-3 gearbox on page 137 .	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 152 .
<p>5  Note Do not mix Kyodo Yushi TMO 150 with other oil types!</p>	
6 Refit the oil plug.	Tightening torque: 24 Nm.

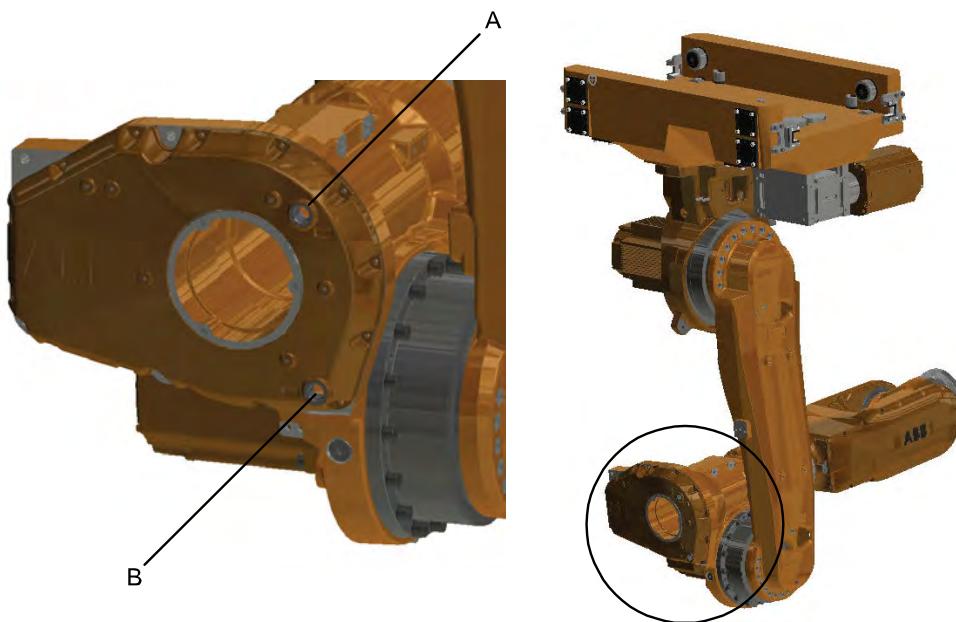
3 Maintenance

3.4.5 Changing oil, axis-4 gearbox

3.4.5 Changing oil, axis-4 gearbox

Location of gearbox

The axis 4 gearbox is located in the rearmost part of the upper arm as shown in the figure below.



xx0900000147

A	Oil plug, filling
B	Oil plug, draining

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152.	See Type and amount of oil in gearboxes on page 152.	
Oil exchange equipment	3HAC021745-001		Content is defined in section Special tools on page 351.
Oil collecting vessel	-		Capacity: 6,000 ml.
Standard toolkit	-		Content is defined in section Standard tools on page 350.

Continues on next page

Draining, oil

The procedure below details how to drain the oil in the gearbox, axis 4.

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 164](#).

	Action	Note
1	Run the upper arm -45° from the calibration position.	
2	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
4	Remove the <i>oil plug, filling</i> .	
5	Drain the oil from the gearbox into a vessel by opening the <i>oil plug, draining</i> .	Shown in the figure Location of gearbox on page 164 . Vessel capacity is specified in Required equipment on page 164 .
6	Run the upper arm back to its calibration position (horizontal position).	This is detailed in section Synchronization marks and synchronization position for axes on page 309 .
7	Refit the oil plug, draining.	Tightening torque: 24 Nm.

Filling, oil

The procedure below details how to fill the oil in the gearbox, axis 4.

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 164](#).

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	

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3 Maintenance

3.4.5 Changing oil, axis-4 gearbox

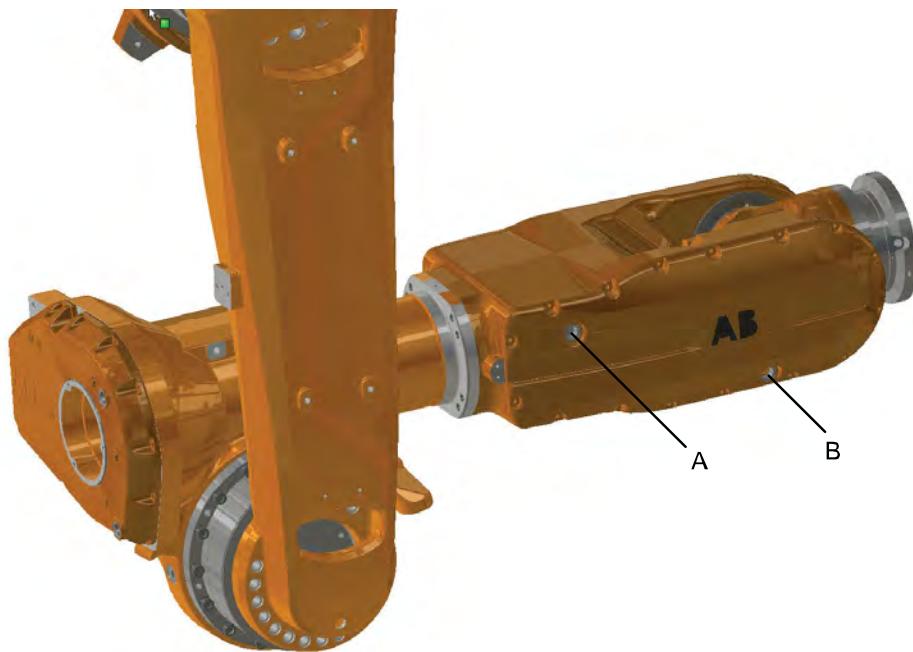
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Action	Note
2  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
3 Refill the gearbox with clean <i>lubricating oil</i> . The correct oil level is detailed in section Inspecting the oil level in axis-4 gearbox on page 139 .	Shown in the figure Location of gearbox on page 164 . Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 152 .
4 Refit the oil plug, filling.	Tightening torque: 24 Nm.

3.4.6 Changing oil, axis-5 gearbox

Location of gearbox

The axis 5 gearbox is located in the wrist unit as shown in the figure below.



xx0900000150

A	Oil plug, filling/inspection
B	Oil plug, draining

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152.	See Type and amount of oil in gearboxes on page 152.	
Oil exchange equipment	3HAC021745-001		Content is defined in section Special tools on page 351.
Oil collecting vessel	-		Capacity: 4,000 ml.
Standard toolkit	-		Content is defined in section Standard tools on page 350.

Continues on next page

3 Maintenance

3.4.6 Changing oil, axis-5 gearbox

Continued

Draining, oil, axis 5

The procedure below details how to change the oil in gearbox, axis 5.

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 167](#).

Action	Note
1 Run axis 4 to a position where the oil plug for draining is facing downwards.	
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
4 Remove the <i>oil plug, filling</i> .	
5 Drain the oil from the gearbox by opening the <i>oil plug, draining</i> .	Shown in the figure Location of gearbox on page 167 . Vessel capacity is specified in Required equipment on page 167 .
6 Refit the oil plug, draining.	Tightening torque: 24 Nm.

Filling, oil, axis 5

The procedure below details how to change the oil in gearbox, axis 5.

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 167](#).

Action	Note
1 Run axis 4 to a position where the oil plug, filling, is facing upwards.	
2  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	

Continues on next page

Action	Note
<p>3</p>  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
<p>4</p> Refill the gearbox with clean <i>lubricating oil</i> . The correct oil level is detailed in section Inspecting the oil level in axis-5 gearbox on page 141 .	Shown in the figure Location of gearbox on page 167 . Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 152 .
<p>5</p> Refit the oil plug, filling.	Tightening torque: 24 Nm.

3 Maintenance

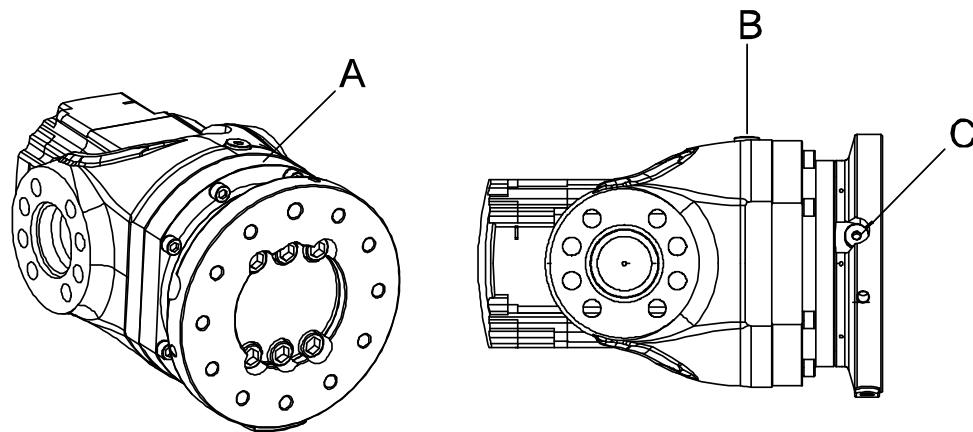
3.4.7 Changing oil, axis-6 gearbox

3.4.7 Changing oil, axis-6 gearbox

Location of gearbox

The axis 6 gearbox is located in the center of the wrist unit as shown in the figure below.

The figure shows gearbox axis 6 for IRB 6620 Foundry Plus.



xx0600002964

A	Gearbox axis 6
B	Oil plug, filling
C	Oil plug, draining

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 152.	See Type and amount of oil in gearboxes on page 152.	 Note Do not mix with other oils!
Oil exchange equipment	3HAC021745-001		Content is defined in section Special tools on page 351.
Oil collecting vessel	-		Vessel capacity: 500 ml
Standard toolkit	-		Content is defined in section Standard tools on page 350.

Draining, oil, axis 6

The procedure below details how to drain oil from the gearbox, axis 6.

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 170.](#)

	Action	Note
1	Run the robot to a position where the oil plug, filling of axis 6 gearbox is facing downwards.	Shown in the figure Location of gearbox on page 170.

Continues on next page

Action	Note
<p>2  DANGER Turn off all:<ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.</p>	
<p>3  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55.</p>	
4 Drain the oil from the gearbox into a vessel by removing the oil plug.	Vessel capacity is specified in Required equipment on page 170.
5 Refit the <i>oil plug, filling.</i>	Tightening torque: 24 Nm.

Filling, oil, axis 6

The procedure below details how to fill oil into the gearbox, axis 6.

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 170.](#)

Action	Note
<p>1  DANGER Turn off all:<ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.</p>	
<p>2  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55.</p>	
3 Remove the <i>oil plug, filling.</i>	Shown in the figure Location of gearbox on page 170.
4 Refill the gearbox with clean <i>lubricating oil.</i> The correct oil level is detailed in section Inspecting the oil level in axis-6 gearbox on page 143.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 152.

Continues on next page

3 Maintenance

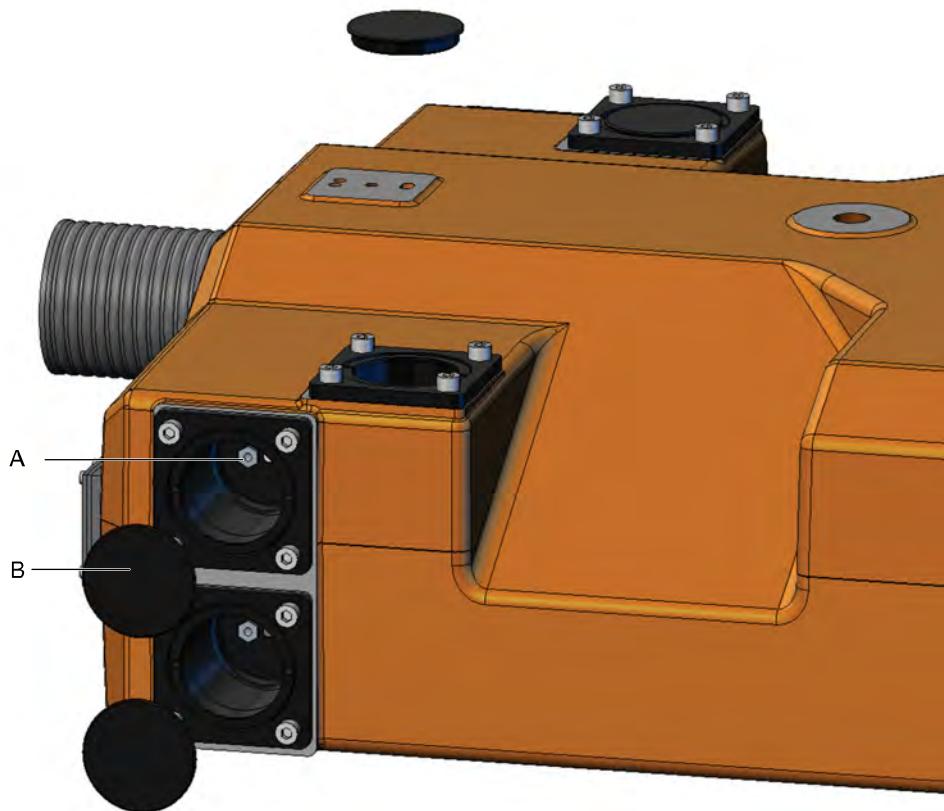
3.4.7 Changing oil, axis-6 gearbox

Continued

	Action	Note
5	 Note Do not mix Kyodo Yushi TMO 150 with other oil types!	Detailed in the section <i>Type of lubrication in gearboxes on page 152.</i>
6	Refit the oil plug.	Tightening torque: 24 Nm.
	Inspect the oil level.	Detailed in the section <i>Inspecting the oil level in axis-6 gearbox on page 143.</i>

3.4.8 Lubrication of ball bearings and surface rollers

Location of lubrication points



xx0900000431

A	Lubrication nipple
B	Cover

Required equipment

Equipment, etc.	Note
Lubricant	Lithium based grease.
Grease gun	
Standard tools	

2,000 h. lubrication procedure

	Action	Information
1	Remove all 12 covers.	
2	Manually press the grease using a grease gun into each lubrication nipple.	
3	Refit all 12 covers.	

3 Maintenance

3.4.9 Replacing the SMB battery



Note

The battery low alert (38213 **Battery charge low**) is displayed when the battery needs to be replaced. The recommendation to avoid an 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 *Operating manual - IRC5 with FlexPendant* for instructions.



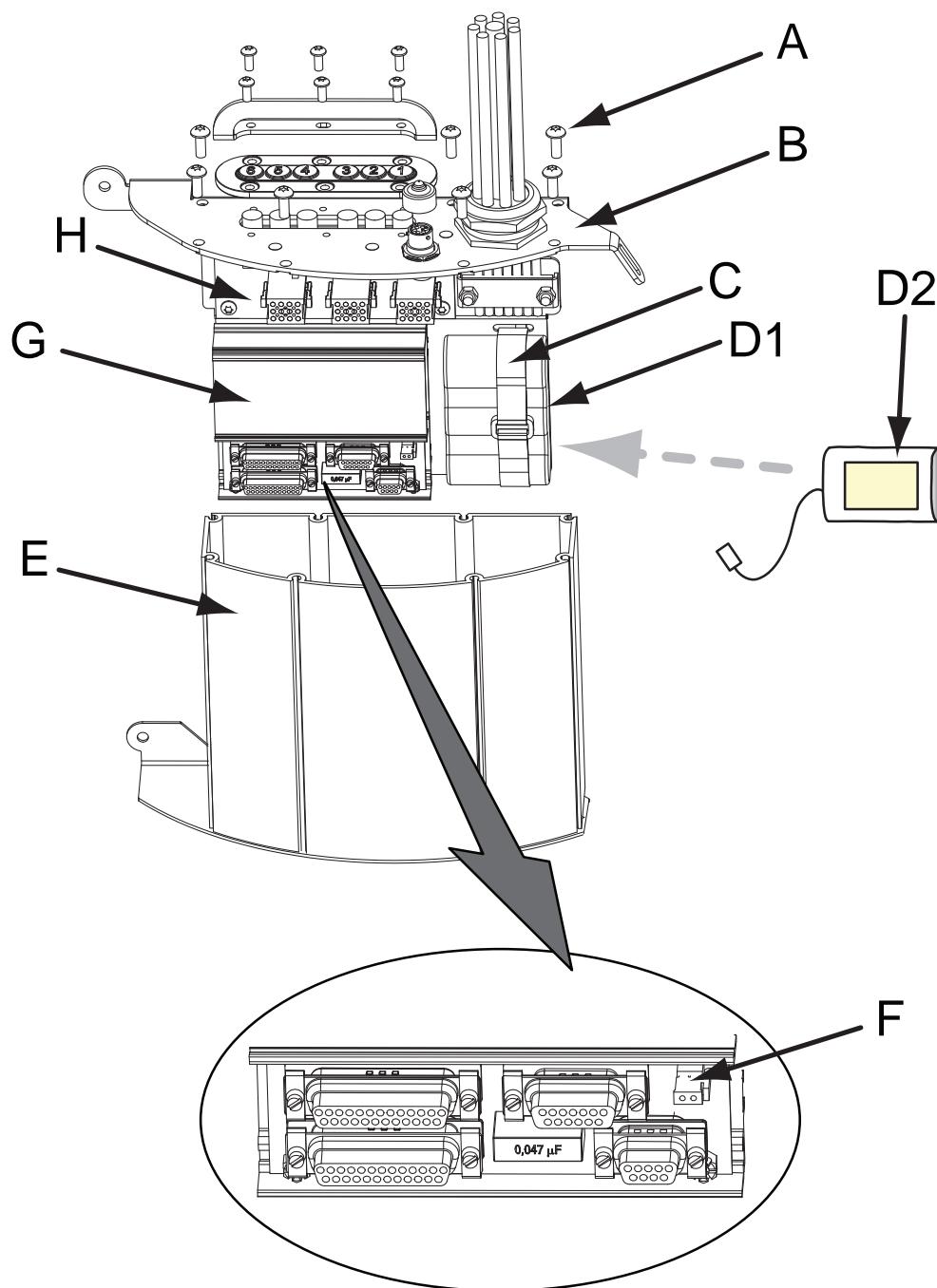
WARNING

See instructions for batteries, [WARNING - Safety risks during handling of batteries on page 54](#).

Continues on next page

Location of SMB battery

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



xx0900000151

A	Attachment screws
B	SMB/BU unit (complete)
C	Velcro strap
D1	Battery pack (2-pole battery contact)
D2	Battery pack (3-pole battery contact)

Continues on next page

3 Maintenance

3.4.9 Replacing the SMB battery

Continued

E	SMB/BU box
F	Connection point, battery cable
G	SMB (Serial measurement board)
H	BU unit (Brake release 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, etc.	Spare part no.	Note
Battery pack	For spare part no. see: <ul style="list-style-type: none">Spare part lists on page 353	Battery includes protection circuits. Only replace with a specified spare part or an ABB-approved equivalent.
Standard toolkit	-	Content is defined in section Standard tools on page 350 .
Circuit diagram	-	See chapter Circuit diagram on page 355 .

Removing, battery

Use this procedure to remove the SMB battery.

	Action	Note
1	Move the robot to its calibration position.	This is done in order to facilitate updating of the revolution counter.
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
3	 xx0200000023  WARNING The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 52	

Continues on next page

Action	Note
4 Remove SMB/BU box by unscrewing the attachment screws.	
5 Lift the <i>SMB/BU unit</i> out of its box and disconnect the battery cable.	
6 Remove the velcro strap that holds the battery.	
7 Remove the <i>SMB battery</i> . Battery includes protection circuits. Only replace with a specified spare part or with an ABB- approved equivalent.	Shown in figure Location of SMB battery on page 175 .

Refitting, battery

Use this procedure to refit the SMB battery.

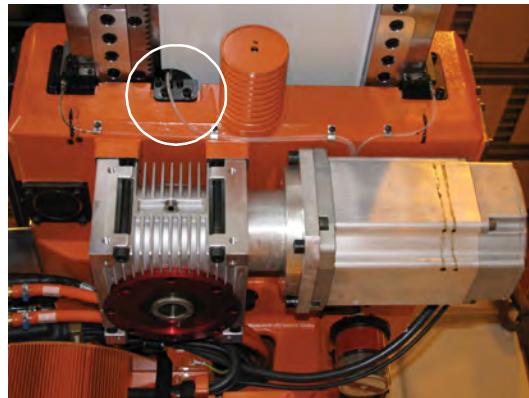
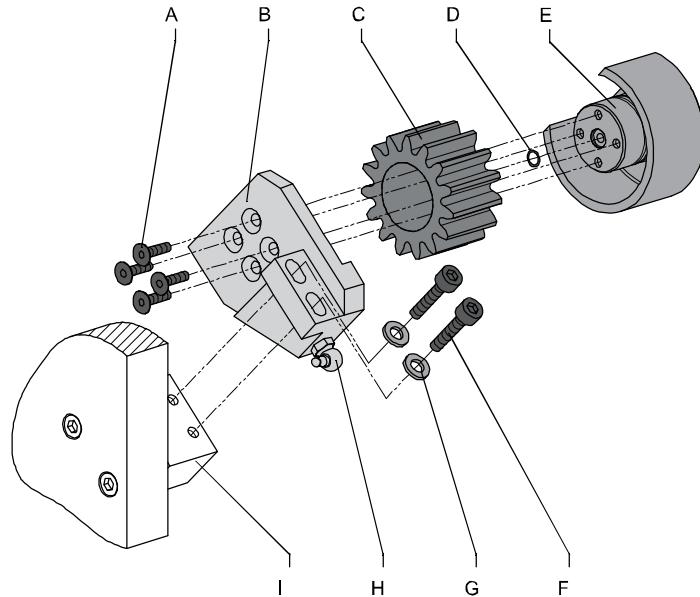
Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
2  xx0200000023  WARNING The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 52	
3 Reconnect the battery cable to the SMB battery pack and secure it with the <i>velcro strap</i> .	Art. no. is specified in Required equipment on page 176 . Shown in figure Location of SMB battery on page 175 .
4 Put the <i>SMB/BU unit</i> back into the box and secure it with its <i>attachment screws</i> .	Shown in figure Location of SMB battery on page 175 .
5 Update the revolution counter.	Detailed in chapter Calibration - section Updating revolution counters on page 320 .
6  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

3 Maintenance

3.4.10 Replacement of felt pinion

3.4.10 Replacement of felt pinion

Location



xx0900000277

A	Screws
B	Distance piece
C	Lubrication pinion
D	O-ring
E	Chamber
F	Fixing bolts
G	Washer
H	Lubrication fitting
I	Car plate

Continues on next page

Replacing the felt pinion

	Action	Information
1	 DANGER Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot.	
2	If available, separate the automatic lubrication.	
3	Remove the two fixing bolts.	(F) in figure.
4	Remove the lubrication pinion unit.	
5	Remove the four screws holding the distance piece.	(A) in figure.
6	Remove the chamber, o-ring and lubrication pinion.	(C, D, E) in figure.

3 Maintenance

3.4.11 Replacement of the lubricant cartridge and battery



WARNING

Lower red housing contains a loaded spring. Do not open.



WARNING

See instructions for batteries, [WARNING - Safety risks during handling of batteries on page 54](#).



Note

During the manual function test, lubricant may leak out. Point the MEMOLUB downwards and away from people.

L éq. < 70Db.

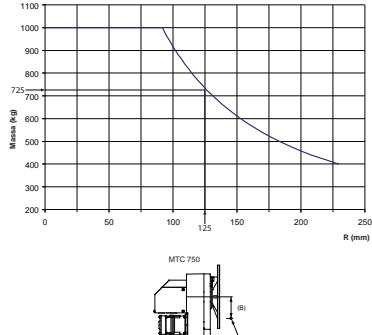
Use MEMOLUB only for the lubrication of machines. Use only factory pre-filled cartridges and battery packs with MEMOLUB® lubricator. Third party battery cells could destroy the electronics.

Replacement procedure

	Action	Information
1	Unscrew the MEMOLUB ® HPS (A) from the Power-Through MEMO (B) fitting. The MEMO stays in position.	 xx0900000279
2	To open, place the lubricator upright on a flat surface. Press firmly and turn locking ring counterclockwise while holding the ribbed surface.	 xx0900000280

Continues on next page

3.4.11 Replacement of the lubricant cartridge and battery
Continued

Action	Information
3 Remove the cartridge and batteries and dispose them in an environmental friendly way. Insert a new set of batteries according to the instructions on the red housing.	 xx0900000281
4 Remove the paper, disk-shaped label from the replacement cartridge and fill in the "Start Date" and "Change Date".	 xx0900000282
5 Hold the cartridge with the outlet facing up. Carefully remove the cartridge plug. Turn the red housing over and gently place it on the outlet of the cartridge.	 xx0900000286

Continues on next page

3 Maintenance

3.4.11 Replacement of the lubricant cartridge and battery

Continued

Action	Information
6 While holding the cartridge and red housing together, flip the assembly over and hold the cartridge in place.	 xx0900000287
7 Place the clear housing assembly over the lubricant cartridge and red housing.	 xx0900000288
8 Holding the locking ring by its ribbed surface, turn it clockwise until it clicks into the locked position.	 xx0900000289

Continues on next page

3.4.11 Replacement of the lubricant cartridge and battery
Continued

	Action	Information
9	Simulate a function test manually. Press the sensor pen against the bottom of the housing for approximately 5 seconds.	 xx0900000290
10	Screw the MEMOLUB® HPS (A) lubricator onto the Power-Through MEMO (B).	 xx0900000279
11	 Note If necessary, prime the MEMOLUB® HPS with a hand grease gun (grease cartridges only).	 xx0900000293

3 Maintenance

3.5.1 Cleaning the IRB 6620LX

3.5 Cleaning activities

3.5.1 Cleaning the IRB 6620LX

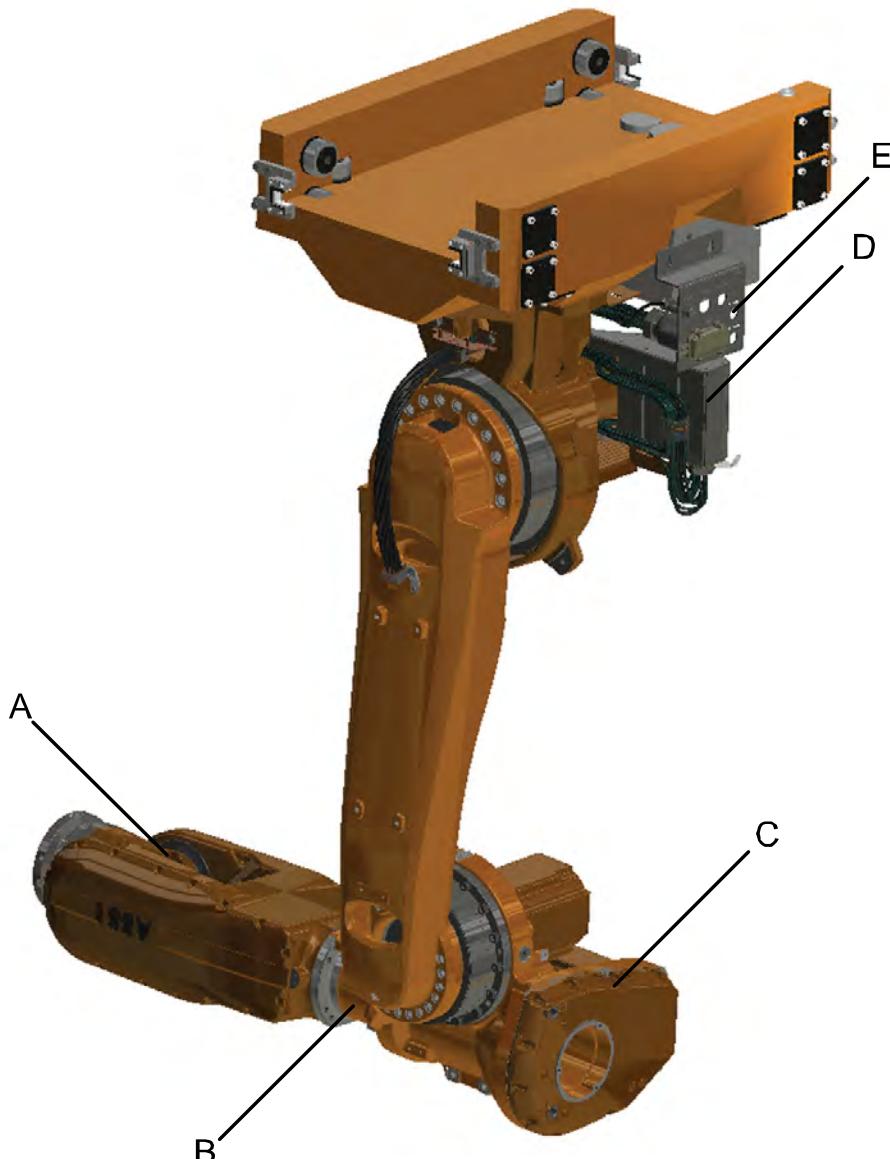


WARNING

Turn off all electrical power supplies to the manipulator before entering its work space.

Special points

Special points to be observed are shown in the figure below.



xx0900000152

Continues on next page

A	Spiral cables to motor 6
B	Inside of upper arm tube
C	Rear of upper arm tube
D	SMB/BU box
E	R1.MP/R1.SMB

General

To secure high uptime it is important that the IRB 6620LX is cleaned regularly. The frequency of cleaning depends on the environment in which the manipulator works.

Different cleaning methods are allowed depending on the type of protection of the IRB 6620LX.



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 133](#).
- 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.

Oil spills discolors painted surfaces

Oil spills on painted surfaces of the robot can result in discoloration.



Note

After all repair and maintenance work involving oil, always wipe the robot clean from all surplus oil.

Dos and don'ts!

This section specifies some special considerations when cleaning the robot.

Always!

- Always use cleaning equipment as specified! Any other cleaning equipment may shorten the life of the robot.
- Always check that all protective covers are fitted to the robot before cleaning!

Never!

- Never point the water jet at connectors, joints, sealings, or gaskets!
- Never use compressed air to clean the robot!
- Never use solvents that are not approved by ABB to clean the robot!

Continues on next page

3 Maintenance

3.5.1 Cleaning the IRB 6620LX

Continued

- Never spray from a distance closer than 0.4 meters!
- Never remove any covers or other protective devices before cleaning the robot!

Cleaning methods

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

Protection type	Cleaning method			
	Vacuum cleaner	Wipe with cloth	Rinse with water	High pressure water or steam
Standard	Yes	Yes. With light cleaning detergent.	Yes. It is highly recommended that the water contains a rust-prevention solution and that the manipulator is dried afterwards.	No
Foundry Plus	Yes	Yes. With light cleaning detergent or spirit.	Yes. It is highly recommended that the water contains a rust-prevention solution.	Yes ⁱ . It is highly recommended that the water and steam contains rust preventive, without cleaning detergents.

ⁱ Perform according to section [Cleaning with water and steam on page 186](#).

Cleaning with water and steam

Instructions for rinsing with water

ABB robots with protection types *Standard*, *Foundry Plus*, *Wash*, or *Foundry Prime* can be cleaned by rinsing with water (water cleaner).¹

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 700 kN/m² (7 bar)¹
- Fan jet nozzle should be used, min. 45° spread
- Minimum distance from nozzle to encapsulation: 0.4 meters
- Maximum flow: 20 liters/min¹

¹ Typical tap water pressure and flow

Instructions for steam or high pressure water cleaning

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

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 2500 kN/m² (25 bar)
- Fan jet nozzle should be used, min. 45° spread
- Minimum distance from nozzle to encapsulation: 0.4 meters
- Maximum water temperature: 80° C

¹ See [Cleaning methods on page 186](#) for exceptions.

² See [Cleaning methods on page 186](#) for exceptions.

Continues on next page

Cables

Movable cables need to be able to move freely:

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

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4 Repair

4.1 Introduction

Structure of this chapter

This chapter describes all repair activities recommended for the IRB 6620LX and any external unit.

It is made up of separate procedures, each describing a specific repair activity. Each procedure contains all 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. Otherwise damage to the mechanics and electronics may occur.

Required equipment

The details of the equipment required to perform a specific repair activity are listed in the respective procedures.

The details of equipment are also available in different lists in the chapter [Reference information on page 343](#).

Safety information

There are general safety information and specific safety information. The specific safety information describes the danger and safety risks while performing specific steps in a procedure. Make sure to read through the chapter [Safety on page 17](#) before commencing any service work.



Note

If the IRB 6620LX is connected to power, always make sure that the IRB 6620LX is connected to earth before starting any repair work.

For more information see:

- *Product manual - IRC5*

4 Repair

4.2.1 Performing a leak-down test

4.2 General procedures

4.2.1 Performing a leak-down test

When to perform a leak-down test

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

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.	
2 Remove the topmost oil plug on the gear and replace it with the <i>leak-down tester</i> . Regulators, which are included in the leak-down test, may be required.	
3 Use caution, apply compressed air and raise the pressure with the knob until the correct value is shown on the manometer.  CAUTION The pressure must under no circumstance be higher than 0.25 bar (20-25 kPa). Also during the time when the pressure is raised.	Correct value: 0.2-0.25 bar (20-25 kPa)
4 Disconnect the compressed air supply.	
5 Wait for approximately 8-10 minutes and make sure that no pressure loss occurs.	If the compressed air is significantly colder or warmer than the gearbox to be tested, a slight pressure increase or decrease may occur. This is quite normal.
6 If any pressure drop occurred, then localize the leak as described in step 7. If no pressure drop occurred, then remove the leak-down tester and refit the oil plug. The test is complete.	
7 Spray any suspected leak areas with the leak detection spray. Bubbles indicate a leak.	
8 When the leak has been localized, take the necessary measures to correct the leak.	

4.2.2 Mounting instructions for bearings

General

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

Equipment

Equipment, etc.	Article number	Note
Grease	3HAB3537-1	Used to grease the bearings, if not specified otherwise.

Assembly of all bearings

Follow 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

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.

Continues on next page

4 Repair

4.2.2 Mounting instructions for bearings

Continued

- During operation, the bearing should be filled to 70-80% of the available volume.
- Ensure that grease is handled and stored properly to avoid contamination.

Grease the different types of bearings as following description:

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

4.2.3 Mounting instructions for seals

General

This section describes how to mount different types of seals onto the robot.

Equipment

Equipment, etc.	Article number	Note
Grease	3HAB3537-1	Used to lubricate the seals.

Rotating seals

The procedure below describes how to fit rotating seals.



CAUTION

Please observe the following before commencing any assembly of seals:

- Protect the sealing surfaces during transport and mounting.
- Keep the seal in its original wrappings or protect it well before actual mounting.
- The fitting of seals and gears must be carried out on clean workbenches.
- Use a protective sleeve for the sealing lip during mounting, when sliding over threads, keyways, etc.

	Action	Note
1	Check the seal to ensure that: <ul style="list-style-type: none"> • The seal is of the correct type (provided with cutting edge). • There is no damage to the sealing edge (feel with a fingernail). 	
2	Inspect the sealing surface before mounting. If scratches or damage are found, the seal must be replaced since it may result in future leakage.	
3	Lubricate the seal with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the seal.) Fill 2/3 of the space between the dust tongue and sealing lip with grease. The rubber coated external diameter must also be greased, unless otherwise specified.	Article number is specified in Equipment on page 193 .
4	Mount the seal correctly with a mounting tool. Never hammer directly on the seal as this may result in leakage.	

Continues on next page

4 Repair

4.2.3 Mounting instructions for seals

Continued

Flange seals and static seals

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

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

O-rings

The following procedure describes how to fit o-rings.

Action	Note
1 Ensure that the correct o-ring size is used.	
2 Check the o-ring for surface defects, burrs, shape accuracy, and so on.	Defective o-rings may not be used.
3 Check the o-ring grooves. The grooves must be geometrically correct and should be free of pores and contamination.	Defective o-rings may not be used.
4 Lubricate the o-ring with grease.	
5 Tighten the screws evenly while assembling.	

4.3 Complete robot

4.3.1 Replacement of cable harness, lower end (axes 1-2)

4.3 Complete robot

4.3.1 Replacement of cable harness, lower end (axes 1-2)

General

The cable harness 1-6 is undivided.

Replacement of the cable harness is detailed in two steps - lower end and upper end.

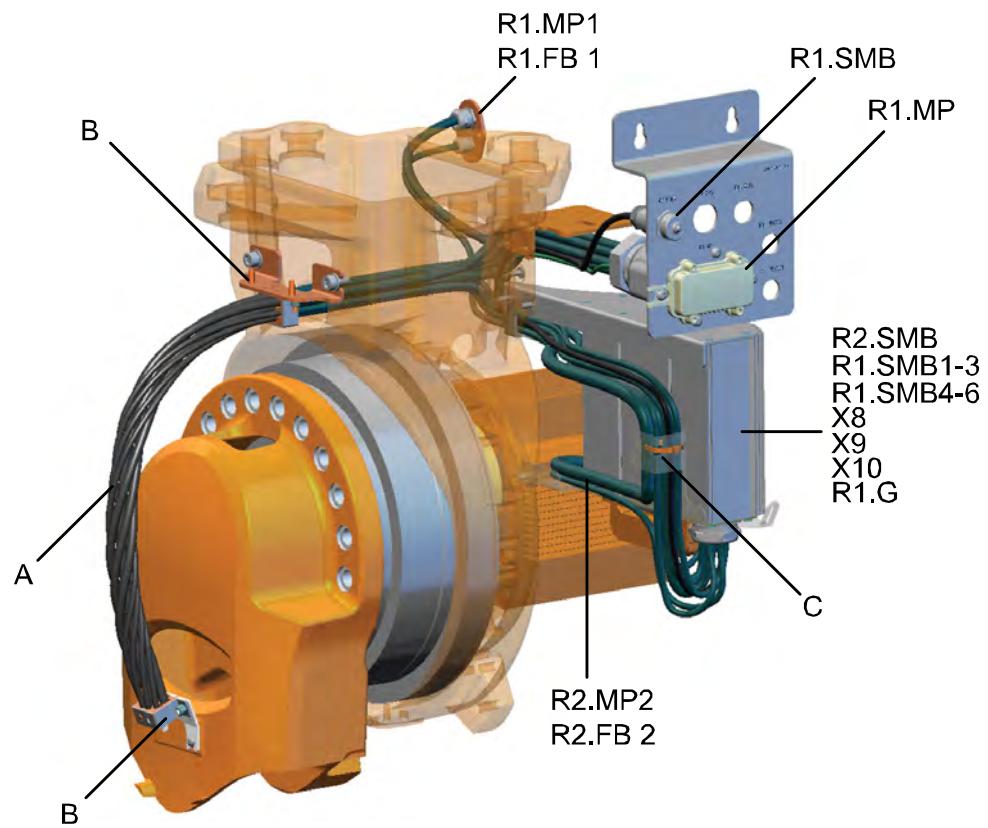
The procedure below details replacement of the lower end of the cable harness.

The procedure for replacing the upper end is detailed in the section [Replacement of cable harness, upper end on page 201](#).

Location of cable harness, axes 1-2

The cable harness for axes 1-2 is run throughout the base and frame as shown in the figure below.

The figure shows the upper routing of the cable harness



A	Upper arm cable harness
B	Metal clamp, lower arm (2 pieces)
C	Cable bundle

Continues on next page

4 Repair

4.3.1 Replacement of cable harness, lower end (axes 1-2)

Continued

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Cable harness	See Spare part lists on page 353 .		
Standard toolkit		-	Content is defined in section Standard tools on page 350 .
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 chapter Circuit diagram on page 355 .

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal

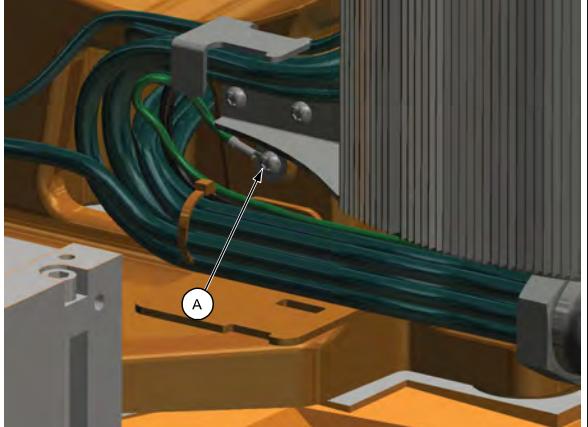
The procedure below details how to remove the cable harness, axes 1-2.

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

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4.3.1 Replacement of cable harness, lower end (axes 1-2)

Continued

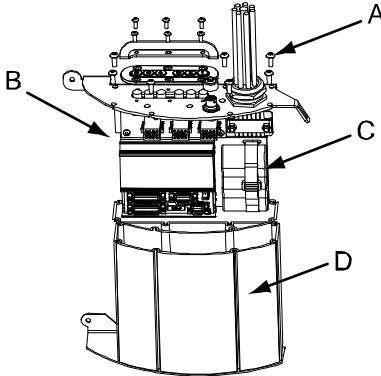
Action	Note
2 In order to facilitate refitting of the cable harness, run the robot to the specified positions: <ul style="list-style-type: none">• Axis 1: no significance• Axis 2: 0°• Axis 3: 0°• Axis 4: 0°• Axis 5: +90°• Axis 6: no significance	
3  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
4 Disconnect the earth cable.	 xx0900000163 <ul style="list-style-type: none">• A: Earth connection
5 Disconnect connectors <i>R1.MP</i> and <i>R1.SMB</i> on the <i>connection plate, base</i> .	Shown in the figure Location of cable harness, axes 1-2 on page 195 .
6 Disconnect all connectors at motors 1 <i>R2.MP1</i> , <i>R2.FB1</i> and 2 <i>R2.MP2</i> , <i>R2.FB2</i> .	Shown in the figure Location of cable harness, axes 1-2 on page 195 .
7 Remove the <i>metal clamps</i> on the frame, securing the cable harness.	Shown in the figure Location of cable harness, axes 1-2 on page 195 .

Continues on next page

4 Repair

4.3.1 Replacement of cable harness, lower end (axes 1-2)

Continued

Action	Note
8 Remove the <i>attachment screws</i> holding the <i>SMB/BU unit</i> in its <i>box</i> . The cable between the battery and the SMB/BU unit may stay connected in order to avoid an update of the revolution counter. If the battery cable is disconnected, an update of the revolution counter is necessary!	 <ul style="list-style-type: none"> A: Attachment screws, M5x12 quality 8.8 (7 pcs) B: SMB/BU unit C: Battery unit D: Box
9 Carefully lift the <i>SMB/BU unit</i> out of its <i>box</i> , while at the same time lifting the cables of the harness.	
10 Pull the <i>cable harness</i> and its <i>connectors</i> carefully up through the <i>cable guide</i> in the center of the frame.	Shown in the figure Location of cable harness, axes 1-2 on page 195 .
11 Continue removal of the cable harness, axes 3-6.	Detailed in the section Replacement of cable harness, upper end on page 201 .

Refitting

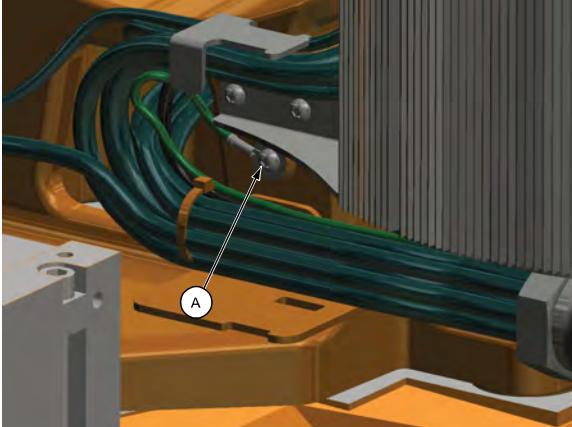
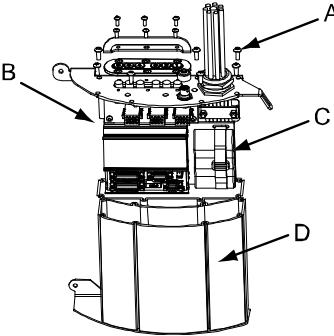
The procedure below details how to refit the cable harness axes 1-2.

Action	Note
1 Push the <i>cable harness</i> axes 1-2 carefully down through the <i>cable guide</i> in the center of the frame.	Shown in the figure Location of cable harness, axes 1-2 on page 195 .
2 Reconnect the connectors <i>R1.MP</i> and <i>R1.SMB</i> at the <i>connection plate, base</i> .	Tightening torque for R1.SMB: 10 Nm. Shown in the figure Location of cable harness, axes 1-2 on page 195 .

Continues on next page

4.3.1 Replacement of cable harness, lower end (axes 1-2)

Continued

Action	Note
3 Reconnect the earth cable.	 <p>xx0900000163</p> <ul style="list-style-type: none"> A: Earth connection
4 Put the <i>SMB/BU unit</i> carefully back into its <i>box</i> and refit its <i>attachment screws</i> .	 <p>xx0600003026</p> <ul style="list-style-type: none"> A : Attachment screws, M5x12 quality 8.8 (7 pcs) B : SMB/BU unit C : Battery unit D : Box
5 Reconnect all connectors at motors 1 R2.MP1, R2.FB1 and 2 R2.MP2, R2.FB2.	Shown in the figure Location of cable harness, axes 1-2 on page 195 .
6 Refit the <i>metal clamps</i> on the frame, securing the cable harness.	Shown in the figure Location of cable harness, axes 1-2 on page 195 .
7 Refit the <i>top cover, connection box</i> .	Shown in the figure Location of cable harness, axes 1-2 on page 195 .
8 Recalibrate the robot.	<p>Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i>, enclosed with the calibration tools.</p> <p>Axis Calibration is described in Calibrating with Axis Calibration method on page 326.</p> <p>General calibration information is included in section Calibration on page 305.</p>

Continues on next page

4 Repair

4.3.1 Replacement of cable harness, lower end (axes 1-2)

Continued

	Action	Note
9	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48.	

4.3.2 Replacement of cable harness, upper end

4.3.2 Replacement of cable harness, upper end

Introduction

The cable harness 1-6 is undivided.

Replacing the cable harness is described in two steps:

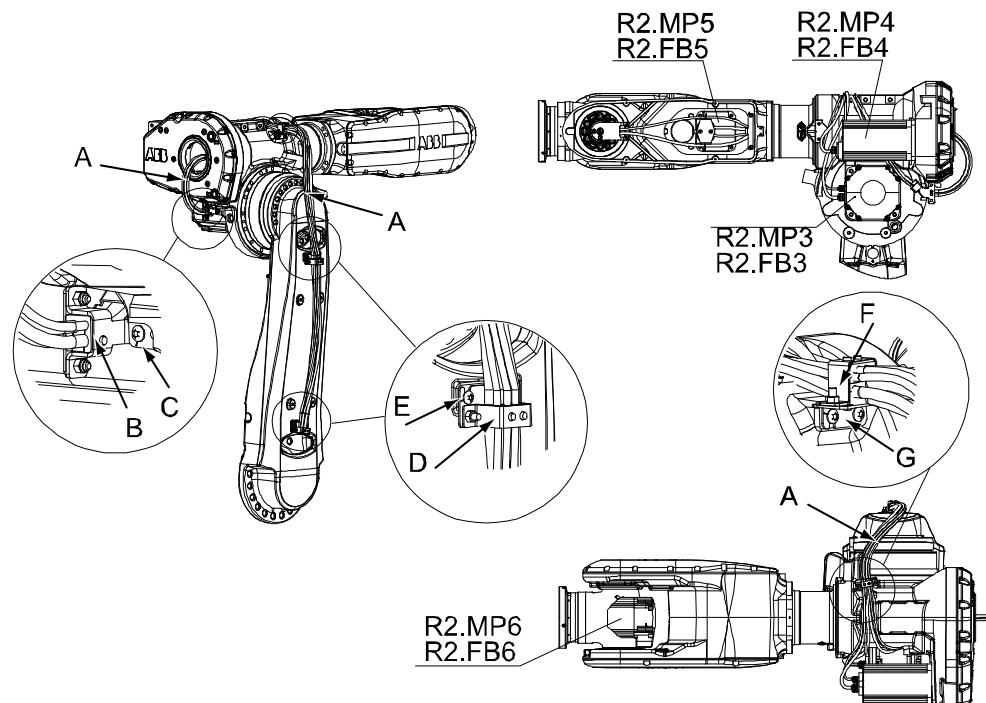
- lower end (axes 1-2)
- upper end (axes 3-6)

This procedure details how to replace the upper end.

For description of how to replace the lower end, see [Replacement of cable harness, lower end \(axes 1-2\) on page 195](#).

Location of cable harness

The cable harness for the axes 3 to 6 runs throughout the lower and upper arm as shown in the figure below:



xx0600003078

A	Cable harness
B	Metal clamp, at gearbox axis 3
C	Attachment screws, metal clamp at gearbox axis 3, M6x16 quality 8.8 (2 pcs)
D	Metal clamp, lower arm (2 pcs)
E	Attachment screws, metal clamp lower arm, M6x16 quality 8.8 (2+2 pcs)
F	Metal clamp, armhouse
G	Attachment screws, metal clamp armhouse, M6x16 quality 8.8 (2 pcs)

Continues on next page

4 Repair

4.3.2 Replacement of cable harness, upper end

Continued

Required equipment

Equipment, etc.	Note
Cable harness axes 1-6	See Spare part lists on page 353 .
Gasket	Motors axes 1-5 See Spare part lists on page 353 .
Gasket	Motor axis 6. Recommended to be changed for Foundry Plus. See Spare part lists on page 353 .
Retrofit set Foundry Plus, wrist	See Spare part lists on page 353 .
Retrofit set Foundry Plus, upper arm axis 4	See Spare part lists on page 353 .
Standard toolkit	Content is defined in section Standard tools on page 350 .
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 chapter Circuit diagram on page 355 .

Deciding calibration routine

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

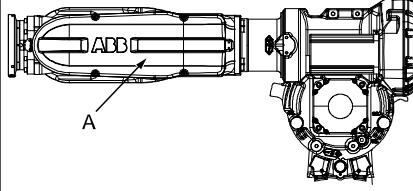
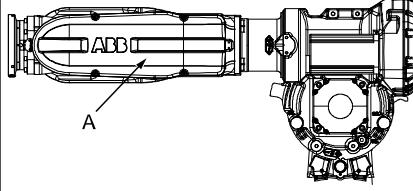
Action	Note
1 Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

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4.3.2 Replacement of cable harness, upper end Continued

Removal

The procedure below details how to remove the cable harness.

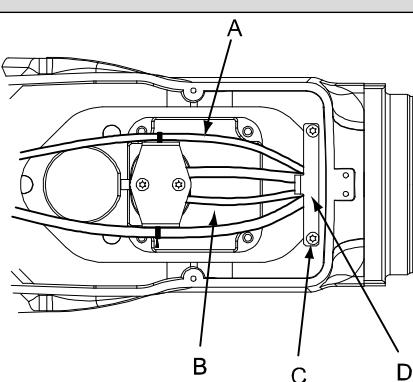
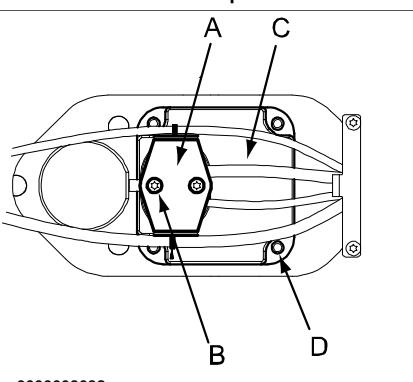
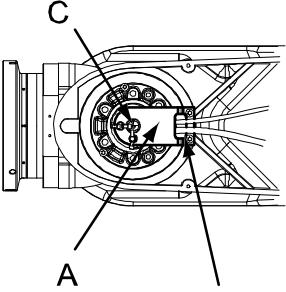
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	In order to facilitate refitting of the cable harness, run the robot to the specified positions: <ul style="list-style-type: none"> • Axis 1: no significance • Axis 2: 0° • Axis 3: 0° • Axis 4: 0° • Axis 5: +90° • Axis 6: no significance 	
3	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Before starting the removal of cable harness axes 3-6, first remove cable harness axes 1-2.	Detailed in the section <i>Replacement of cable harness, lower end (axes 1-2) on page 195.</i>
5	 Note Foundry Plus Make sure not to lose the washers placed in the holes of the foundry gasket.  xx0600003024	 xx0600003024 <ul style="list-style-type: none"> • A : Cover, wrist unit

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4 Repair

4.3.2 Replacement of cable harness, upper end

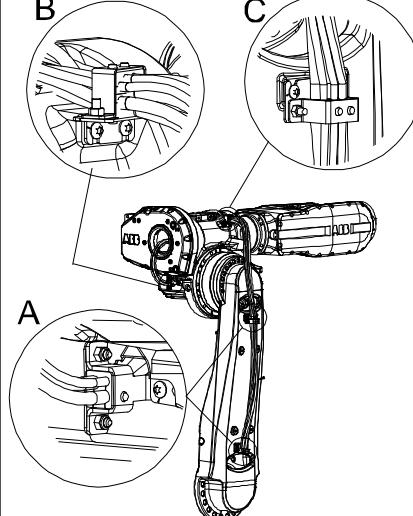
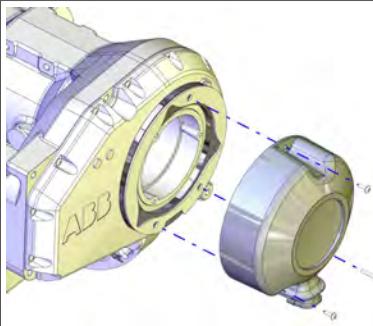
Continued

Action	Note
6 Remove the <i>metal clamp</i> securing the <i>cable harness</i> at axis 5 by removing its <i>attachment screws</i> .	 <p>xx0600003030</p> <ul style="list-style-type: none"> • A : Cable harness • B : Motor, axis 5 • C : Attachment screw, M6x16 8.8 (2 pcs) • D : Metal clamp
7 Remove the <i>cover</i> at motor axis 5 by removing its <i>attachment screws</i> . Also remove the <i>cover motor, axis 5</i> by removing its attachment screws and disconnect the motor cables R2.MP5 and R2.FB5.	 <p>xx0600003032</p> <ul style="list-style-type: none"> • A : Cover • B : Attachment screw M6X30 8.8 (2 pcs) • C : Cover motor, axis 5 • D : Attachment screws motor
8 Remove the <i>cable holder</i> in the wrist unit by unscrewing the three <i>attachment screws</i> . Two of the attachment screws (M6x16) are visibly located at the rear of the cable holder. The third screw (M4x12) is located at the bottom of the cable holder, securing the carrier.	 <p>xx0600003034</p> <ul style="list-style-type: none"> • A : Cable holder • B : Attachment screws M6x16, 8.8 (2 pcs) • C : Attachment screw M4x12, 8-A2F (securing the carrier)

Continues on next page

4.3.2 Replacement of cable harness, upper end

Continued

Action	Note
9 Remove the back cover motor, axis 6 by removing its attachment screws.	
10 Pull out the cabling R2.MP6 and R2.FB6 from motor axis 6 .	Shown in the figure Location of cable harness on page 201
11 Disconnect all connectors at motor axis 6 R2.MP6 and R2.FB6.	Shown in the figure Location of cable harness on page 201
12 Remove the cover of motor axes 3 and 4 by removing its attachment screws.	
13 Disconnect all connectors at motor axes 3 R2.MP3, R2.FB3 and 4 R2.MP4, R2.FB.4.	Shown in the figure Location of cable harness on page 201
14 Remove the <i>metal clamps</i> , two on the lower arm, one on gearbox axis 3 and one on the armhouse.	 <p>xx0600003083</p> <ul style="list-style-type: none"> A : Metal clamp, lower arm (2 pcs) B : Metal clamp, gearbox axis 3 C : Metal clamp, armhouse
15 <i>Foundry Plus</i> Remove the Foundry Plus arm house cover.	 <p>xx1400002582</p>
16 Use caution and pull out the cable harness of the upper arm.	
17 Tie the connectors into a bundle, to avoid damaging them during further removal.	

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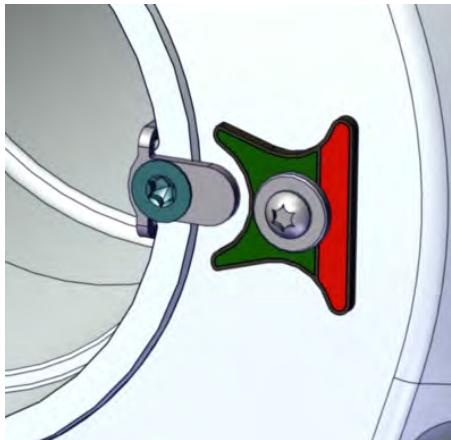
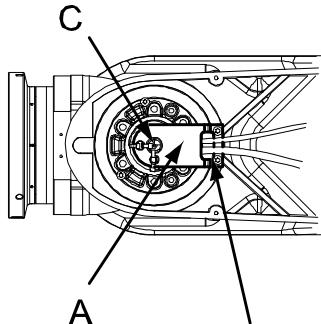
4 Repair

4.3.2 Replacement of cable harness, upper end

Continued

Refitting

The procedure below details how to refit the cable harness.

Action	Note
1 Begin by refitting the cable harness lower end (axes 1-2).	Detailed in the section Replacement of cable harness, lower end (axes 1-2) on page 195 .
2 Insert the cable harness gently from the rear into the upper arm.	Arrange the cable harness as shown in the figure Location of cable harness on page 201
3 Place the cabling to motor axis 6 correctly on the upper arm and pull the connectors carefully through the hole on top of the wrist unit to motor, axis 6.	Shown in the figure Location of cable harness on page 201 We recommend changing the gasket on the cover for Foundry Plus robots.
4 Reconnect all connectors at motor axes 3 (<i>R2.MP3, R2.FB3</i>) and 4 (<i>R2.MP4, R2.FB4</i>).	
5 Refit covers motor axes 3 and 4. Make sure to turn the revolution indicator with the green side towards axis 4 center.	 xx1500002404
6 Refit the cable holder wrist unit with the three attachment screws. Two of the attachment screws (M6x16) are visibly located at the rear of the cable holder. The third screw (M4x10) is located at the bottom of the cable holder, securing the carrier.	 xx0600003034 <ul style="list-style-type: none"> • A : Cable holder • B : Attachment screws M6x16, quality 8.8 (2 pcs) • C . Attachment screws M4x10, quality 8-A2F (securing the carrier)
7 Reconnect the motor cables axis 6 <i>R2.MP6</i> and <i>R2.FB6</i> .	Shown in the figure Location of cable harness on page 201
8 Refit cover motor, axis 6.	

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4.3.2 Replacement of cable harness, upper end

Continued

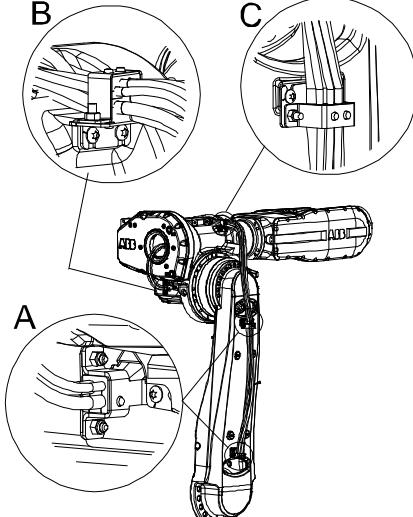
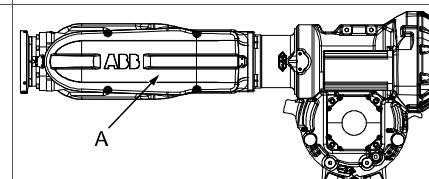
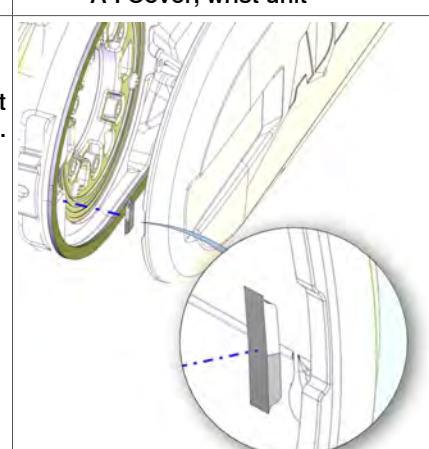
Action	Note
9 Reconnect the motor cables axis 5 <i>R2.MP5</i> and <i>R2.FB5</i> .	Shown in the figure Location of cable harness on page 201
10 Refit the <i>cover motor, axis 5 (C)</i> and <i>cover (A)</i> .	<p>xx0600003032</p> <ul style="list-style-type: none"> • A : Cover • B : Attachment screws M6x30, 8.8 (2 pcs) • C : Cover motor, axis 5 • D : Attachment screws
11 Refit the <i>metal clamp</i> securing the cable harness at axis 5.	<p>xx0600003030</p> <ul style="list-style-type: none"> • A : Cable harness • B : Motor, axis 5 • C : Attachment screws M6x16, 8.8 (2 pcs) • D : Metal clamp

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4 Repair

4.3.2 Replacement of cable harness, upper end

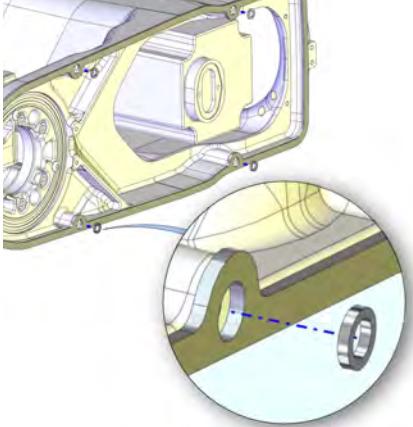
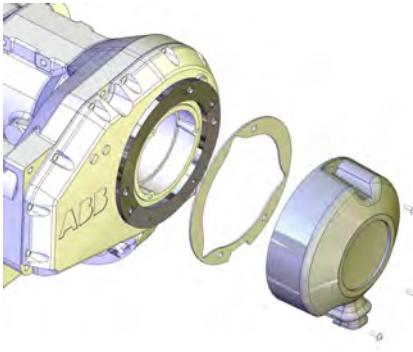
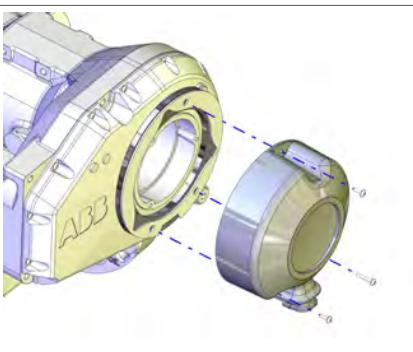
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Action	Note
12 Refit the four <i>metal clamps</i> , two on the lower arm, one on gearbox axis 3 and one on the armhouse.	 <p>xx0600003083</p> <ul style="list-style-type: none"> • A : Metal clamp, lower arm (2 pcs) • B : Metal clamp, gearbox axis 3 • C : Metal clamp, armhouse
13 <i>Standard</i> Fit the wrist cover.	 <p>xx0600003024</p> <ul style="list-style-type: none"> • A : Cover, wrist unit
14 <i>Foundry Plus</i> Make sure the wrist cover gasket and the small gasket fitted in the recess of the wrist cover are undamaged. Replace if damaged.	 <p>xx1400002579</p>

Continues on next page

4.3.2 Replacement of cable harness, upper end

Continued

	Action	Note
15	<p><i>Foundry Plus</i></p> <p>Make sure the washers are fitted in the gasket holes.</p>	 xx1400002580
16	<p><i>Foundry Plus</i></p> <p>Fit the wrist cover, Foundry Plus.</p> <p>Make sure the gasket stays undamaged after fitting. Replace if damaged.</p>	
17	<p><i>Foundry Plus</i></p> <p>Make sure the gasket on the adapter ring is undamaged. Replace if damaged.</p>	 xx1400002581
18	<p><i>Foundry Plus</i></p> <p>Fit the Foundry Plus cover on the adapter ring.</p>	 xx1400002582
19	<p>Make sure the gasket on the adapter ring is undamaged. Replace if damaged.</p>	

Continues on next page

4 Repair

4.3.2 Replacement of cable harness, upper end

Continued

	Action	Note
20	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in <i>Calibrating with Axis Calibration method on page 326</i> . General calibration information is included in section <i>Calibration on page 305</i> .
21	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 48</i> .	

4.4.1 Replacing the turning disk

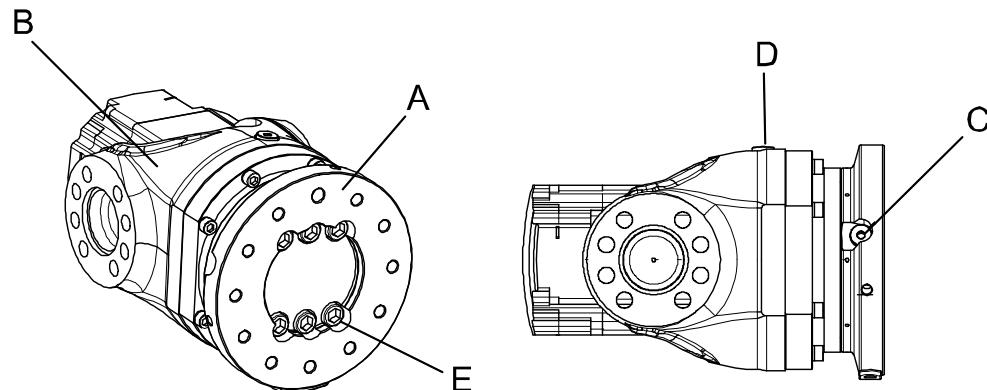
4.4 Upper and lower arm

4.4.1 Replacing the turning disk

Location of turning disk

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

The figure shows the turning disk on an IRB 6620 Foundry Plus/IRB 6620LX.



xx0600003082

A	Turning disk
B	Wrist unit
C	Oil plug, draining
D	Oil plug, filling
E	Attachment screws, turning disk (6 pcs)

Required equipment

Equipment, etc.	Art. no.	Note
Turning disk	For spare part no. see: Spare part lists on page 353 .	O-rings are not included!
O-ring Wrist, type 1	3HAB3772-65 (1pc) 21520431-20 (6 pcs)	Must be replaced when replacing the turning disk!
O-ring Wrist, type 2	3HAB3772-64 (1 pc) 3HAB3772-61 (12 pcs)	For IRB 6620 Foundry Plus. Must be replaced when replacing the turning disk!
Grease	3HAB3537-1	Used to lubricate the o-rings.
Flange sealant	3HAC034903-001	Loctite 574
Standard toolkit	-	Content is defined in section Standard tools on page 350 .
Other tools and procedures may be required. See references to these procedures in the step- by-step instructions below.		These procedures include refer- ences to the tools required.

Continues on next page

4 Repair

4.4.1 Replacing the turning disk

Continued

Removing, turning disk

Use this procedure to remove the turning disk.

Action	Note
1 Run the robot to a position where the <i>oil plug, draining</i> of axis 6 gearbox faces downwards.	Shown in the figure Location of turning disk on page 211 .
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
3 Remove any equipment fitted to the turning disk.	
4 Drain the axis 6 gearbox.	See section <ul style="list-style-type: none">• Changing oil, axis-6 gearbox on page 170
5 Remove the <i>attachment screws</i> that secure the turning disk.	Shown in the figure Location of turning disk on page 211 .
6 Remove the <i>turning disk</i> .	
7 <i>Foundry Plus:</i> Remove old flange sealant residues and other contamination from the contact surfaces.	

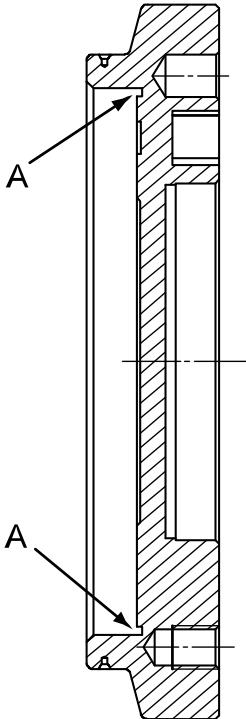
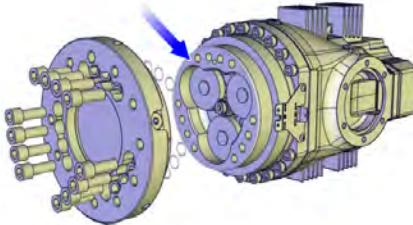
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4.4.1 Replacing the turning disk

Continued

Refitting, turning disk

Use this procedure to refit the turning disk.

Action	Note
1 Lubricate the <i>o-ring</i> of the turning disk with grease and fit it to the turning disk. Also fit the six o-rings, when refitting the attachment screws.	Art. no. is specified in Required equipment on page 211 .  • A: Sealing surface, o-ring
2 Foundry Plus: Apply Loctite 574 flange sealant on the contact surface.	
3 Secure the turning disk with its <i>attachment screws</i> .	6 pcs M14 x 25, 12.9 quality. Tightening torque: 175 Nm Reused screws may be used, providing they are lubricated as detailed in section Screw joints on page 346 before fitting.
4 Perform a <i>leak-down test</i> of the gearbox axis 6.	Detailed in the section Performing a leak-down test on page 190 .
5 Refill the axis 6 gearbox with oil.	See section • Changing oil, axis-6 gearbox on page 170
6 Refit any equipment removed during disassembly to the turning disk.	

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4 Repair

4.4.1 Replacing the turning disk

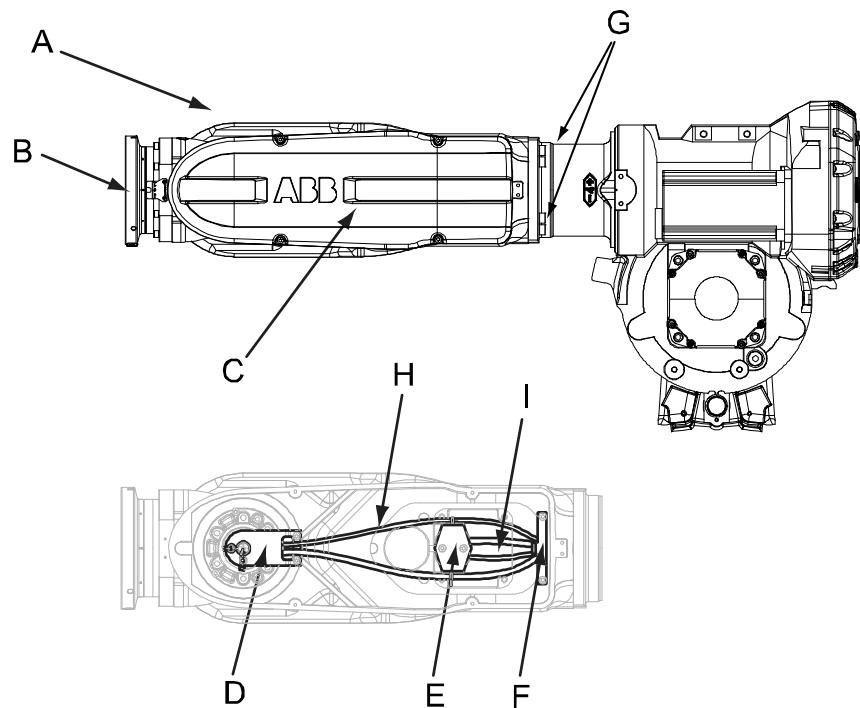
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Action	Note
7  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage!</i> on page 48.	

4.4.2 Replacement of wrist unit

Location of wrist unit

The wrist unit is located in the foremost part of the upper arm as shown in the figure below.



xx0600003055

A	Wrist unit
B	Turning disk
C	Cover, wrist unit
D	Cable holder
E	Cover, cable gland
F	Metal clamp
G	Wrist unit, attachment screws
H	Cable harness, axis 6
I	Cable harness, axis 5

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Wrist unit	See Spare part lists on page 353 .		
Wrist unit, insulated	See Spare part lists on page 353 .		
Retrofit set Foundry Plus, wrist	See Spare part lists on page 353 .		

Continues on next page

4 Repair

4.4.2 Replacement of wrist unit

Continued

Equipment, etc.	Spare part no.	Art. no.	Note
Retrofit set Foundry Plus, upper arm axis 4	See Spare part lists on page 353 .		
Roundsling		-	
Grease		3HAB 3537-1	Used to lubricate o-rings.
Standard toolkit		-	Content is defined in section Standard tools on page 350 .
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.

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal

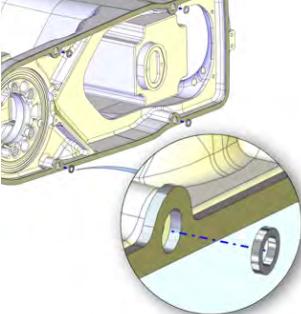
The procedure below details how to remove the wrist unit.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Move the robot to a suitable position for removal of the wrist unit.	

Continues on next page

4.4.2 Replacement of wrist unit

Continued

	Action	Note
3	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Remove all equipment fitted to the <i>wrist unit</i> .	Shown in the figure in Location of wrist unit on page 215 .
5	Remove the <i>cover, wrist unit</i> in order to reach the cable harness.  Note Foundry Plus Make sure not to lose the washers placed in the holes of the Foundry Plus gasket.	Shown in the figure Location of wrist unit on page 215 .
	 xx1400002580	
6	Remove the cable harness, axes 5 and 6.	Detailed in section Replacement of cable harness, upper end on page 201 .
7	 CAUTION The complete wrist unit weighs 96 kg! All lifting equipment used must be sized accordingly!	
8	Secure the wrist unit with a roundsling in an overhead crane.	
9	Unscrew the eight <i>attachment screws</i> securing the <i>wrist unit</i> .	Shown in the figure Location of wrist unit on page 215 .
10	Remove the wrist unit from the upper arm by moving it a little back and forth until it is loose.	Note! Do not damage the cylindrical pin in the process.

Refitting

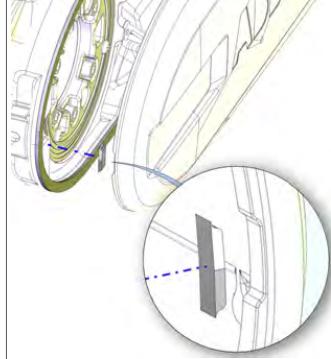
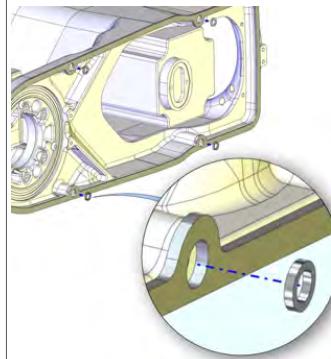
	Action	Note
1	Secure the wrist unit with a roundsling in an overhead crane and lift it to its mounting position.	

Continues on next page

4 Repair

4.4.2 Replacement of wrist unit

Continued

	Action	Note
2	 CAUTION The complete wrist unit weighs 96 kg! All lifting equipment used must be sized accordingly!	
3	Put some <i>grease</i> on the surface of the fit.	
4	Check the cylindrical pin.	If the pin is damaged replace it.
5	Fit the wrist with its 8 attachment screws and washers.	M12x50 12.9 gleitmo (8 pcs) Tightening torque: 120 Nm
6	Refit the cable harness, axes 5 and 6.	Detailed in the section Replacement of cable harness, upper end on page 201 .
7	Standard Fit the wrist cover.	Shown in the figure Location of wrist unit on page 215 .
8	Foundry Plus Make sure the wrist cover gasket and the small gasket fitted in the recess of the wrist cover are undamaged. Replace if damaged.	 xx1400002579
9	Foundry Plus Make sure the washers are fitted in the gasket holes. Refit the wrist cover, Foundry Plus.	 xx1400002580
10	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .

Continues on next page

	Action	Note
11	Refit any equipment previously removed from the wrist unit.	
12	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 48.</i>	

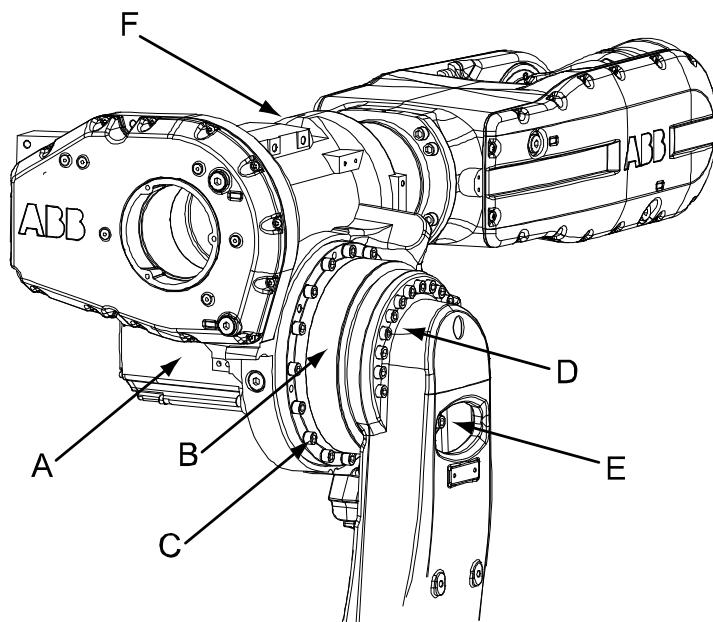
4 Repair

4.4.3 Replacement of the upper arm

4.4.3 Replacement of the upper arm

Location of the upper arm

The upper arm is located on top of the robot as shown in the figure below.



xx0600003057

A	Motor, axis 3
B	Gearbox, axis 3
C	Attachment screws, M12x50 quality 12.9 Gleitmo (20 pcs)
D	Attachment screws, M16x50 quality 12.9 Gleitmo (16 pcs)
E	Hole in the lower arm
F	Upper arm

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Upper arm (Axes 3-4)	See Spare part lists on page 353 .		
O-ring			Replace only if damaged.
Lifting tool		3HAC026597-001	Instruction 3HAC026600-002 is enclosed.
Lifting chain		-	
Roundsling		-	
Guiding pins			Always use in pairs.
Hoisting block		-	
Grease		3HAB3537-1	Used to lubricate o-rings.

Continues on next page

Equipment, etc.	Spare part no.	Art. no.	Note
Standard toolkit		-	Content is defined in section Standard tools on page 350 .
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.

Deciding calibration routine

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

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	<p>If the robot is to be calibrated with reference calibration:</p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327.</p> <p>Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum.</p>
	<p>If the robot is to be calibrated with fine calibration:</p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removal

The procedure below details how to remove the upper arm.

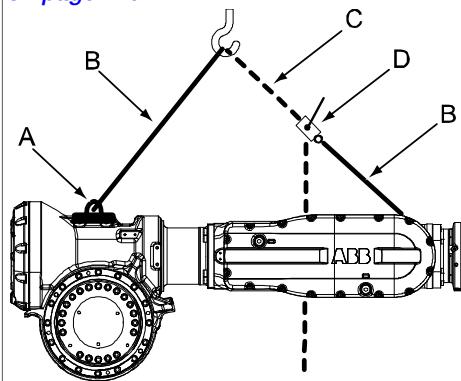
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Lift away the robot from the track using the lifting and turning tool 3HAC034648-001.	This is detailed in section Dismantle procedure suspended on page 91 .

Continues on next page

4 Repair

4.4.3 Replacement of the upper arm

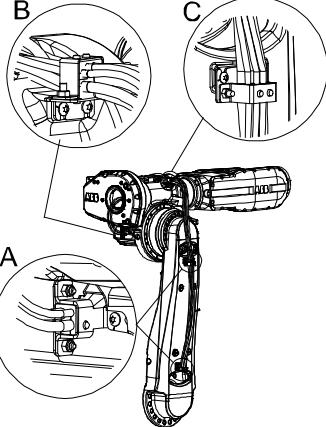
Continued

Action	Note	
<p>3</p>  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.		
4	Drain the oil from gearbox axis 3. Detailed in the section Changing oil, axis-3 gearbox on page 161 .	
5	Raise the upper arm to a position where it is parallel to the floor by releasing the brake of the axis 3 motor. In order to release the brake of the axis 3 motor, connect the 24 VDC power supply. Note! When releasing the brake, the position of the upper arm can change suddenly! Perform the procedure carefully!	Connect to connector R2.MP3: <ul style="list-style-type: none"> • + : pin 2 • - : pin 5
6	 CAUTION The complete upper arm (incl. gearbox axis 3) weighs 282 kg without any additional equipment fitted! Use a suitable lifting device to avoid injury to personnel!	
7	Fit the <i>lifting tool</i> on the upper arm as detailed in the enclosed instructions. Also fit a <i>hoisting block</i> to the front which is used to adjust the balance of the upper arm in order to lift it completely level.	Art. no. is specified in Required equipment on page 220 .  xx0600003102 <ul style="list-style-type: none"> • A : Lifting tool • B : Roundsling • C : Lifting chain • D : Hoisting block
8	Remove the cable harness, axes 3-6.	Detailed in the section Replacement of cable harness, upper end on page 201 .

Continues on next page

4.4.3 Replacement of the upper arm

Continued

Action	Note
9 Remove the three metal clamps securing the cable harness on the lower arm and armhouse.	 xx0600003083 <ul style="list-style-type: none"> • A: Metal clamp, lower arm (2 pcs) • B: Metal clamp, gearbox axis 3 • C: Metal clamp, armhouse
10 Remove motor, axis 3.	Detailed in the section Replacement of motor, axis 3 on page 256 .
11 Remove the attachment screws securing the upper arm to the gearbox axis 3. Note! Do not forget to remove the four screws inside the hole in the lower arm.	Shown in the figure Location of the upper arm on page 220 .
12 Remove the complete upper arm and put it on the floor. Let the upper arm lean on its side.	

Refitting

The procedure below details how to refit the upper arm.

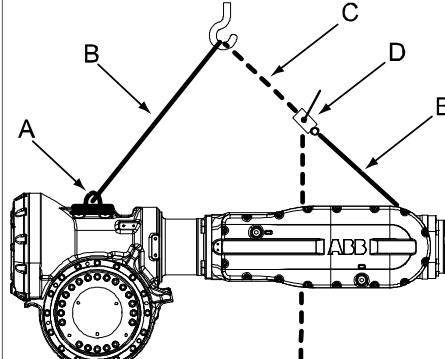
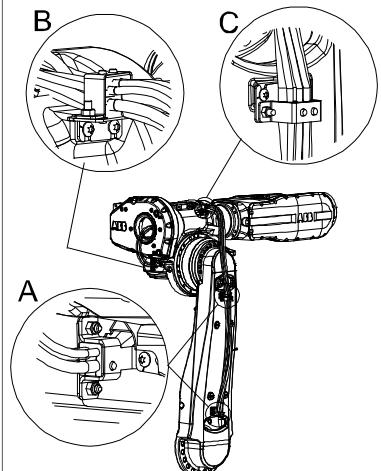
Action	Note
1 Make sure the o-ring is fitted to the gearbox. Lightly lubricate the o-ring with grease.	
2  CAUTION The complete upper arm (incl. gearbox axis 3) weighs 282 kg without any additional equipment fitted! Use a suitable lifting device to avoid injury to personnel!	

Continues on next page

4 Repair

4.4.3 Replacement of the upper arm

Continued

Action	Note
3 Fit the <i>lifting tool</i> on the upper arm as detailed in the enclosed instructions and lift it to its mounting position. Also fit a <i>hoisting block</i> to the front which is used to adjust the balance of the upper arm in order to lift it completely level.	Art. number is specified in Required equipment on page 220 .  xx0600003102 <ul style="list-style-type: none"> • A : Lifting tool • B : Roundsling • C : Lifting chain • D : Hoisting block
4 Fit the guiding pins in gearbox axis 3.	
5 Refit the attachment screws securing the upper arm to the gearbox. Note! Do not forget the four screws inside the hole in the upper arm.	Shown in the figure Location of the upper arm on page 220 .
6 Remove the guiding pins.	
7 Refit motor, axis 3.	Detailed in the section Replacement of motor, axis 3 on page 256 .
8 Refit the metal clamps securing the cable harness on the lower arm and armhouse.	 xx0600003083 <ul style="list-style-type: none"> • A: Metal clamp, lower arm (2 pcs) • B: Metal clamp, gearbox axis 3 • C: Metal clamp, armhouse
9 Perform a leak-down test of the axis-3 gearbox.	Detailed in section Performing a leak-down test on page 190 .
10 Refit the cable harness, axes 3-6.	Detailed in section Replacement of cable harness, upper end on page 201 .

Continues on next page

4.4.3 Replacement of the upper arm

Continued

Action	Note
11 Fill gearbox, axis 3 with oil.	Detailed in section Changing oil, axis-3 gearbox on page 161 .
12 Refit the robot to the track using the lifting and turning tool 3HAC034648-001.	Detailed in section Installation procedure on page 85
13 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .
14  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

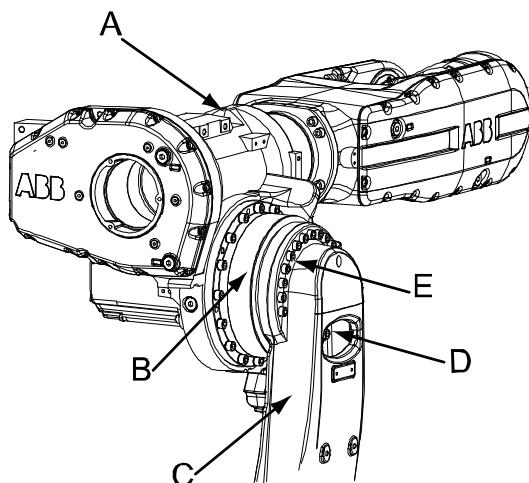
4 Repair

4.4.4 Replacement of lower arm

4.4.4 Replacement of lower arm

Location of lower arm

The location of the lower arm is shown in the figure below.



xx0600003058

A	Upper arm
B	Gearbox, axis 3
C	Lower arm
D	Hole in lower arm
E	Attachment screws, M16x50 quality 12.9 Gleitmo (16 pcs)

Required equipment

Equipment, etc.	Spare part no.	Art no.	Note
Lower arm	See Spare part lists on page 353 .		
Grease		3HAB3537-1	Used to lubricate o-rings.
Lifting tool		3HAC026597-001	Instruction 3HAC026600-002 is enclosed.
Lifting chain		-	
Hoisting block		-	
Roundslings		-	
Guiding pins			Always use in pairs.
Standard toolkit		-	Content is defined in section Standard tools on page 350 .
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

Deciding calibration routine

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

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	<p>If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	<p>If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removal

The procedure below details how to remove the lower arm.

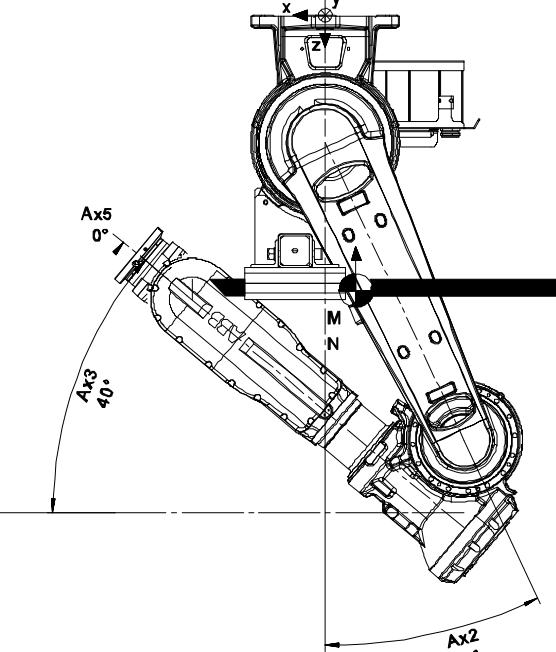
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	

Continues on next page

4 Repair

4.4.4 Replacement of lower arm

Continued

Action	Note
2 Move the robot to the position shown in the figure to the right.	 xx0900000178
3 Remove the robot from the carriage using the turning and lifting tool.	This is detailed in section Dismantle procedure suspended on page 91 .
4  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
5 Remove the cable harness axes 3-6.	Detailed in the section Replacement of cable harness, upper end on page 201 .
6 Let the cable harness hang loose, without it getting damaged in the proceeded removal procedure.	
7 Remove the upper arm.	Detailed in the section Replacement of the upper arm on page 220 .
8 Secure the robot in upright position on the transportation plate.	
9 Secure the lower arm with a roundsling in an overhead crane.	

Continues on next page

4.4.4 Replacement of lower arm

Continued

Action	Note
10  CAUTION The lower arm weighs 75 kg (gearboxes axes 2-3 excluded)!	
11 Remove the attachment screws and washers securing the lower arm to gearbox axis 2.	Shown in the figure Location of lower arm on page 226 .
12 Remove the lower arm.	

Refitting

The procedure below details how to refit the lower arm.

Action	Note
1 Secure the lower arm with a roundsling and lift it to its mounting position.	
2  CAUTION The lower arm weighs 75 kg (gearboxes axes 2-3 excluded)!	
3 Make sure the o-ring is fitted to the gearbox. Lightly lubricate the o-ring with grease.	
4 Fit guiding pins in two of the holes in gearbox axis 2.	
5 Lift the lower arm on to the guiding pins.	
6 Refit the attachment screws and washers securing the lower arm to gearbox axis 2.	Shown in the figure Location of lower arm on page 226 . M16x50, quality 12.9 gleitmo (16 pcs). Tightening torque: 300 Nm.
7 Remove the guiding pins.	
8 Secure the upper arm with a roundsling and lift it to its mounting position.	
9 Refit the upper arm.	Detailed in the section Replacement of the upper arm on page 220 .
10 Refit the robot to the carriage.	Detailed in the section Installation procedure on page 85 .
11 Refit the cable harness axes 3-6.	Detailed in the section Replacement of cable harness, upper end on page 201 .

Continues on next page

4 Repair

4.4.4 Replacement of lower arm

Continued

	Action	Note
12	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .
13	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

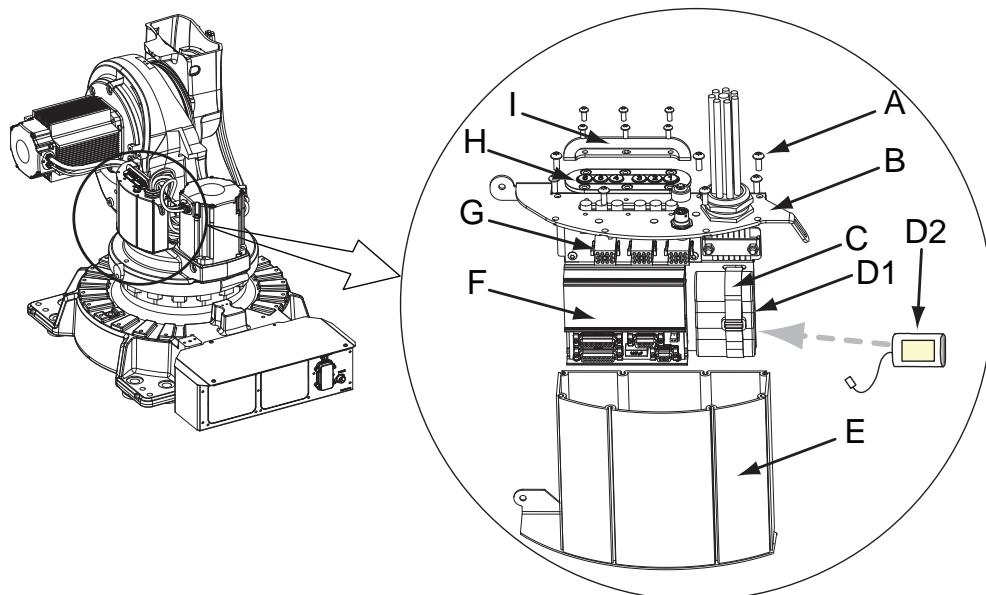
4.5 Frame and base

4.5.1 Replacement of SMB unit

Location of SMB unit

The SMB/BU unit (SMB = serial measurement board, BU = brakerelease unit) is located on the left-hand side of the frame as shown in the figure below.

The SMB unit and the BU unit are both located inside the SMB/BU box.



xx0600003052

A	Attachment screws (4 pcs)
B	SMB/BU unit
C	Velcro strap
D1	Battery pack (2-pole battery contact)
D2	Battery pack (3-pole battery contact)
E	SMB/BU box
F	Serial measurement unit (SMB), DSQC 633A
G	Brakerelease unit (BU), DSQC 563
H	Push button guard
I	Cover, push button guard
J	Gasket (Foundry Plus)

Continues on next page

4 Repair

4.5.1 Replacement of SMB unit

Continued

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, etc.	Spare part no.	Art. no.	Note
Serial measurement unit (SMB)		Spare part lists on page 353.	
Standard toolkit		-	Content is defined in section Special tools on page 351.
Circuit diagram			See chapter Circuit diagram on page 355.

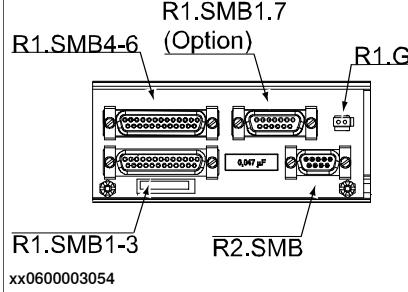
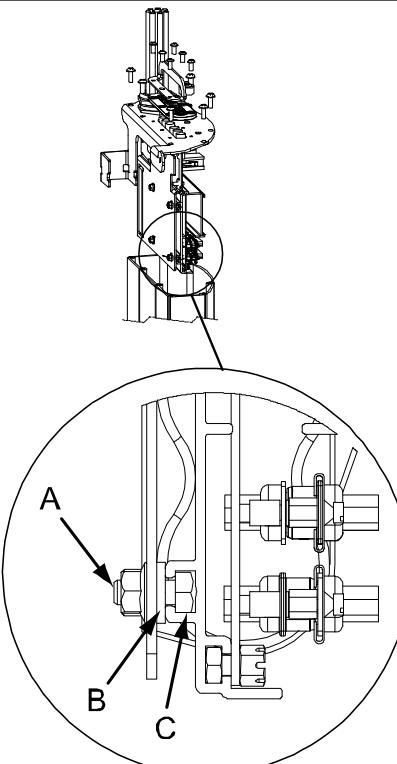
Removal, SMB unit

The procedure below details how to remove the SMB unit.

	Action	Note
1	Move the robot to the calibration position.	
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3	 xx0200000023 WARNING! The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 52	
4	Unscrew the attachment screws of the SMB/BU unit and carefully lift it out of its box.	Shown in the figure Location of SMB unit on page 231 .

Continues on next page

4.5.1 Replacement of SMB unit
Continued

Action	Note
5 Carefully disconnect the connectors from the SMB unit.	Connectors R1.SMB1-3, R1.SMB4-6 and R2.SMB 
6 Disconnect the battery cable from the SMB unit.	Connector R1.G
7 Unscrew the hexagon nuts securing the SMB unit just enough to pull the SMB unit out.	 xx0600003053 <ul style="list-style-type: none"> • A: Hexagon nut, M5 • B: Tooth lock washer, 6.4 fzb • C: Hexagon screw, M5x12 quality 8.8
8 Pull the SMB unit out carefully.	

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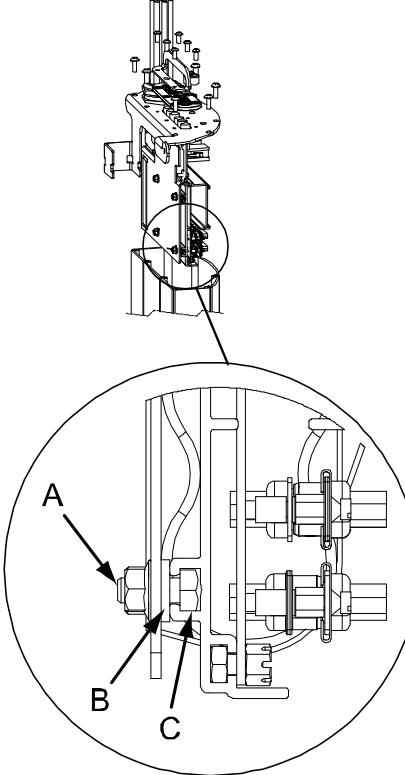
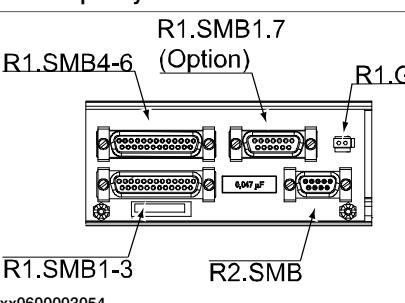
4 Repair

4.5.1 Replacement of SMB unit

Continued

Refitting, SMB unit

The procedure below details how to refit the SMB unit.

Action	Note
1 Push the SMB unit into its tracks and secure it with its hexagon nuts.	 <p>xx0600003053</p> <ul style="list-style-type: none"> A : Hexagon nut, M5 B : Tooth lock washer, 6.4 fzb C : Hexagon screw, M5x12 quality 8.8
2 Reconnect the connectors to the SMB unit. If cabling is used for 7th axis (option), refit the connector R2.FB7 to the SMB cover and tighten with 6 Nm.	 <p>R1.SMB1.7 (Option)</p> <p>R1.SMB4-6</p> <p>R1.G</p> <p>R1.SMB1-3</p> <p>R2.SMB</p> <p>xx0600003054</p>
3 Reconnect the battery cable.	Connector R1.G
4 Put the SMB/BU unit back into its box and refit the attachment screws.	Shown in the figure Location of SMB unit on page 231 .
5 Update the revolution counters!	Detailed in section Updating revolution counters on page 320 .

Continues on next page

	Action	Note
6	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 48.</i>	

4 Repair

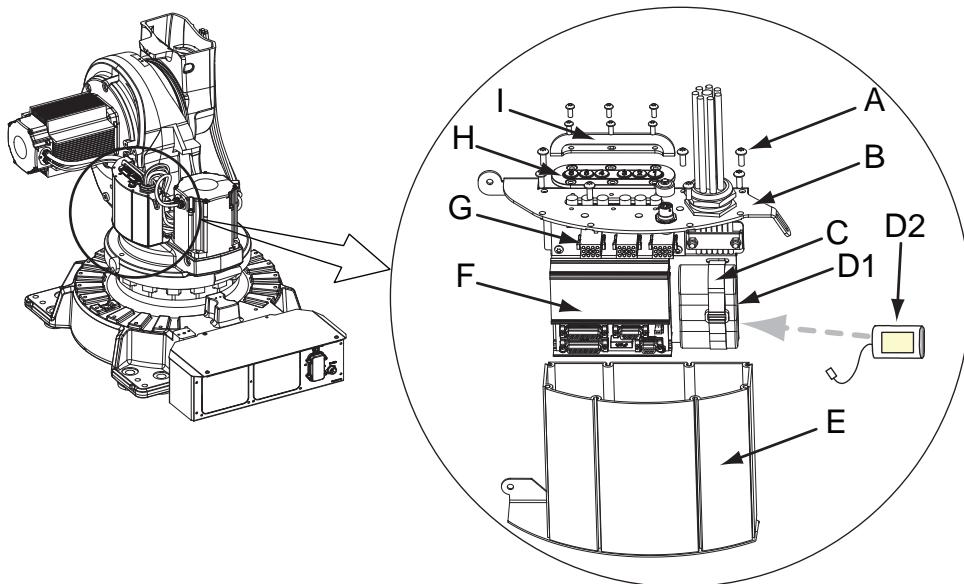
4.5.2 Replacing the brake release board

4.5.2 Replacing the brake release board

Location of brake release board

The SMB/BU unit (SMB = serial measurement board, BU = brake release unit) is located on the left hand side of the frame as shown in the figure below.

The SMB unit and the BU unit are both located inside the SMB/BU box.



xx0600003052

A	Attachment screws (4 pcs)
B	SMB/BU unit
C	Velcro strap
D	Battery pack
E	SMB/BU box
F	Serial measurement unit (SMB), DSQC 633
G	Brakerelease unit (BU), DSQC 563
H	Push button guard
I	Cover, push button guard
J	Gasket (Foundry Plus)

Required equipment

Equipment, etc.	Art. no.	Note
Brake release board with buttons	For spare part no. see: • Spare part lists on page 353	
Standard toolkit	-	Content is defined in section Standard tools on page 350 .

Continues on next page

4.5.2 Replacing the brake release board

Continued

Equipment, etc.	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, brake release board

Use this procedure to remove the brake release board.

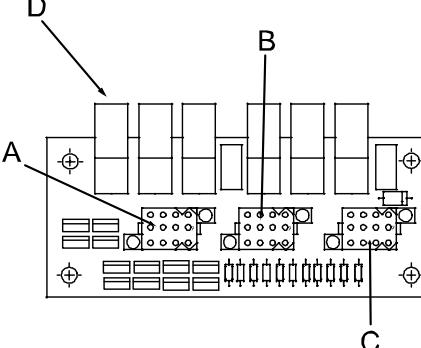
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit read the safety information in section <i>WARNING - The unit is sensitive to ESD! on page 52</i>	
3	Remove the cover for the push button guard.	
4	Remove the push button guard from the SMB cover.	Shown in the figure Location of brake release board on page 236 . The guard must be removed to ensure a correct refitting of the brake release board.
5	Unscrew the attachment screws of the SMB/BU unit and carefully lift the unit out of its box. Let the battery stay connected, to avoid the need of synchronization of the robot!	Shown in the figure Location of brake release board on page 236 .

Continues on next page

4 Repair

4.5.2 Replacing the brake release board

Continued

Action	Note
6 Disconnect the connectors X8, X9 and X10 from the <i>brake release board</i> .	 <p>xx0200000129</p> <ul style="list-style-type: none"> • A: Connector X8 • B: Connector X9 • C: Connector X10 • D: Push buttons <p>Location of the brake release unit is shown in the figure Location of brake release board on page 236.</p>
7 Remove the brake release board from the bracket by removing the four attachment screws.	

Refitting, brake release board

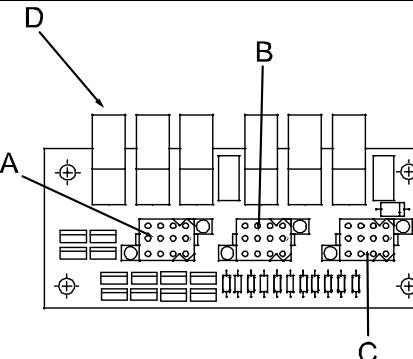
Use this procedure to refit the brake release board.

Action	Note
1  ELECTROSTATIC DISCHARGE (ESD)	
2 The unit is sensitive to ESD. Before handling the unit read the safety information in section WARNING - The unit is sensitive to ESD! on page 52	
2 Fasten the <i>brake release board</i> on the bracket with the attachment screws. Make sure the board is positioned as straight as possible on the bracket! The push buttons can otherwise get jammed when the SMB cover is refitted.	<p>Shown in the figure Location of brake release board on page 236.</p> <p>Art. no. is specified in Required equipment on page 236.</p>

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4.5.2 Replacing the brake release board

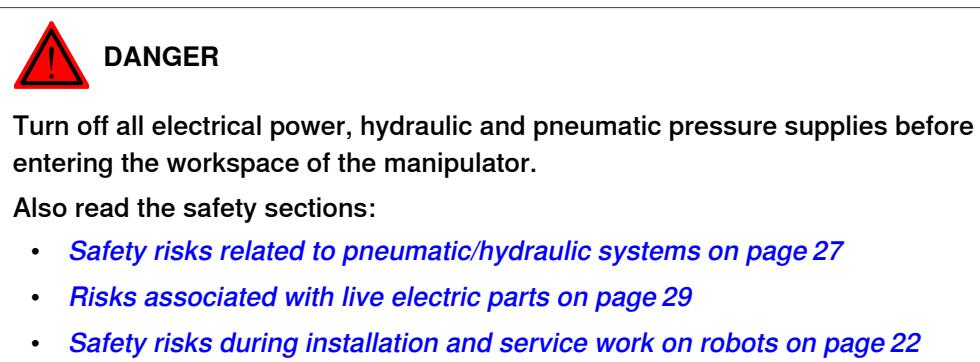
Continued

Action	Note
3 Connect the connectors X8, X9 and X10 to the brake release board.	 <p>xx0200000129</p> <ul style="list-style-type: none"> • A: Connector X8 • B: Connector X9 • C: Connector X10 • D: Push buttons
4 Put the SMB/BU unit carefully back into its box and refit its attachment screws. The push button guard must not be mounted on the cover before the check described in following warning is made!	Shown in the figure Location of brake release board on page 236 .
5  WARNING Before continuing any service work, please observe the safety information in section WARNING - The brake release buttons may be jammed after service work on page 49 !	
6 Refit the <i>push button guard</i> to the SMB cover.	Shown in the figure Location of brake release board on page 236 .
7 Refit the <i>cover, push button guard</i> .	
8 If the battery has been disconnected the revolution counter must be updated.	Detailed in the Calibration chapter - section Updating revolution counters on page 320 .
9  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

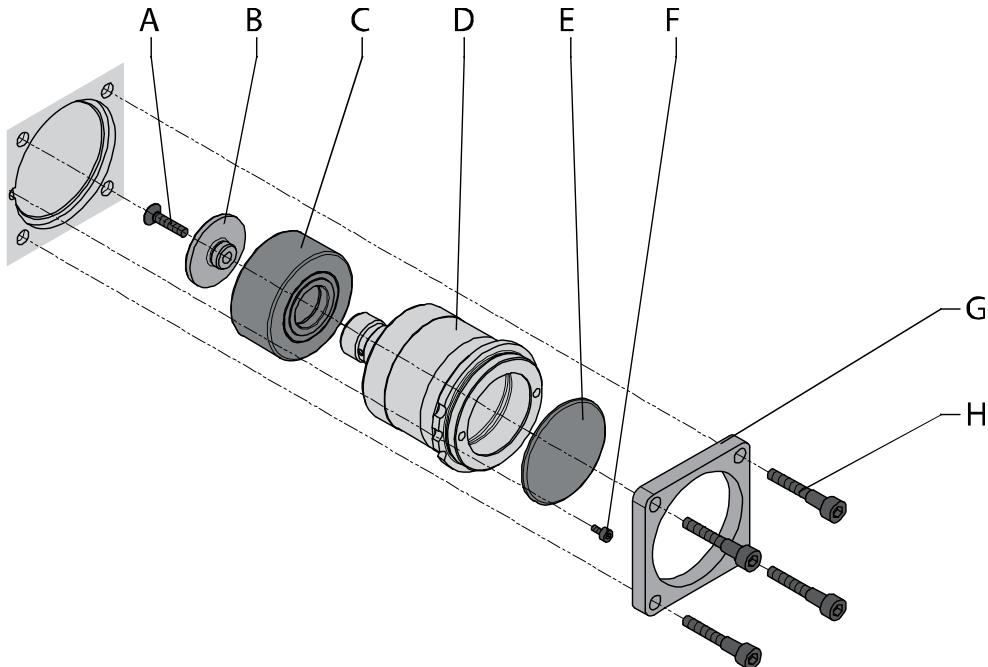
4 Repair

4.5.3 Replacement of support roller in carriage

4.5.3 Replacement of support roller in carriage



Location of ball bearings



xx0900000440

A	Tap screw
B	Tap
C	Support roller
D	Roller holder
E	Cover
F	Locking screw
G	Flange
H	Screw

Continues on next page

Required equipment

Equipment, etc.	Spare part no.	Note
Gauge		
Adjusting tool		
Hexagon socket head screw key		
Standard tools		

Removal

	Action	Note
1	Remove the pressure from the supporting roller using a overhead crane or a fork lift. Lifting weight more then 600 kg.  WARNING Do not remove more then one support roller at the time, or the carriage will bee separated from the linear guide.	Only necessary if the specific support roller has a supporting function.
2	Remove the four screws holding the flange.	
3	Remove the locking screw.	If mounted.
4	Remove the cover.	
5	Remove the complete roller holder.	
6	Remove the tap screw and tap holding the support roller.	

Refitting

	Action	Note
1	Fit a new support roller on to the roller holder.	
2	Refit the complete roller holder.	Adjust the roller holder maximal open and lock it temporary using the locking screw.
3	Adjust the support roller using a gauge.	
4	Refit the cover.	
5	Refit the flange using the four screws.	

Torque data for roller holder

Roller holder size	Torque data
BR 40	87
BR 52	120
BR 62	220
BR 72	220
BR 90	450

4 Repair

4.6.1 Replacement of motor, axis 1

Note

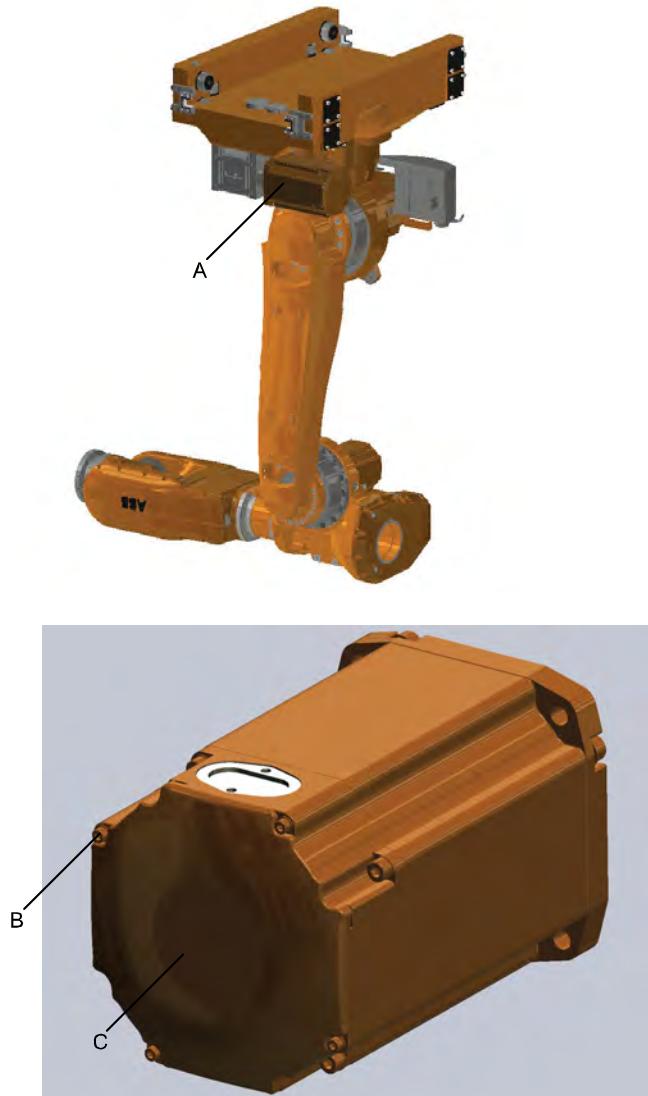
This procedure requires calibration of the robot.

The robot is calibrated by either Calibration Pendulum or Axis Calibration at factory. Always use the same calibration method as used at the factory.

Information about valid calibration method is found on the calibration label or in the calibration menu on the FlexPendant.

Location of motor

The motor axis 1 is located as shown in the figure below.



xx0900000216

Continues on next page

A	AC Motor, axis 1
B	Cover attachment screws
C	Cover for R1.MP1 and R1.FB 1.

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor, axis 1	See Spare part lists on page 353 .		NOTE! Pinion not used.
O-ring	21522012-430		Must be replaced when reassembling the motor.
Mobilux EP 2	-	-	Used to lubricate the motor clutch.
Grease		3HAB3537-1	Used to lubricate the o-ring.
Removal tool, motor M12x		3HAC14973-1	Always use the removal tools in pairs!
Power supply		-	24 VDC, max. 1,5 A For releasing the brakes.
Standard toolkit		-	Content is defined in section Standard tools on page 350 .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
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 chapter Circuit diagram on page 355 .

Continues on next page

4 Repair

4.6.1 Replacement of motor, axis 1

Continued

Deciding calibration routine

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

Action	Note
1 Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, motor axis 1

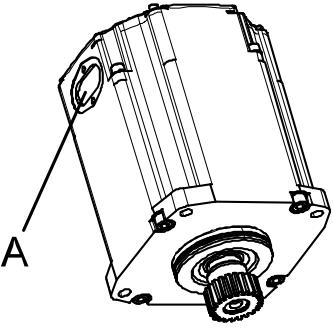
The procedure below details how to remove motor, axis 1.

Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3 Remove the cover for connector access on top of the motor by unscrewing its four attachment screws.	

Continues on next page

4.6.1 Replacement of motor, axis 1

Continued

Action	Note
4 Remove the cable gland cover at the cable exit by unscrewing its two attachment screws.	 Note Make sure the gasket is not damaged!  <p>xx0200000199</p> <ul style="list-style-type: none"> A: Cable gland cover
5 Disconnect all connectors beneath the motor cover.	
6 Use a forklift and a loading pallet to secure the motor from falling.	
7 Remove the motor by unscrewing its four <i>attachment screws</i> and plain washers.	Shown in the figure Location of motor on page 242 .
8 If required, press the motor out of position by fitting <i>removal tool, motor</i> to the motor attachment screw holes.	Art. no. is specified in Required equipment on page 243 . Always use the removal tools in pairs!
9  CAUTION The motor weighs 25 kg! All lifting equipment used must be sized accordingly!	
10 Remove the motor and clutch by gently pulling it out.	

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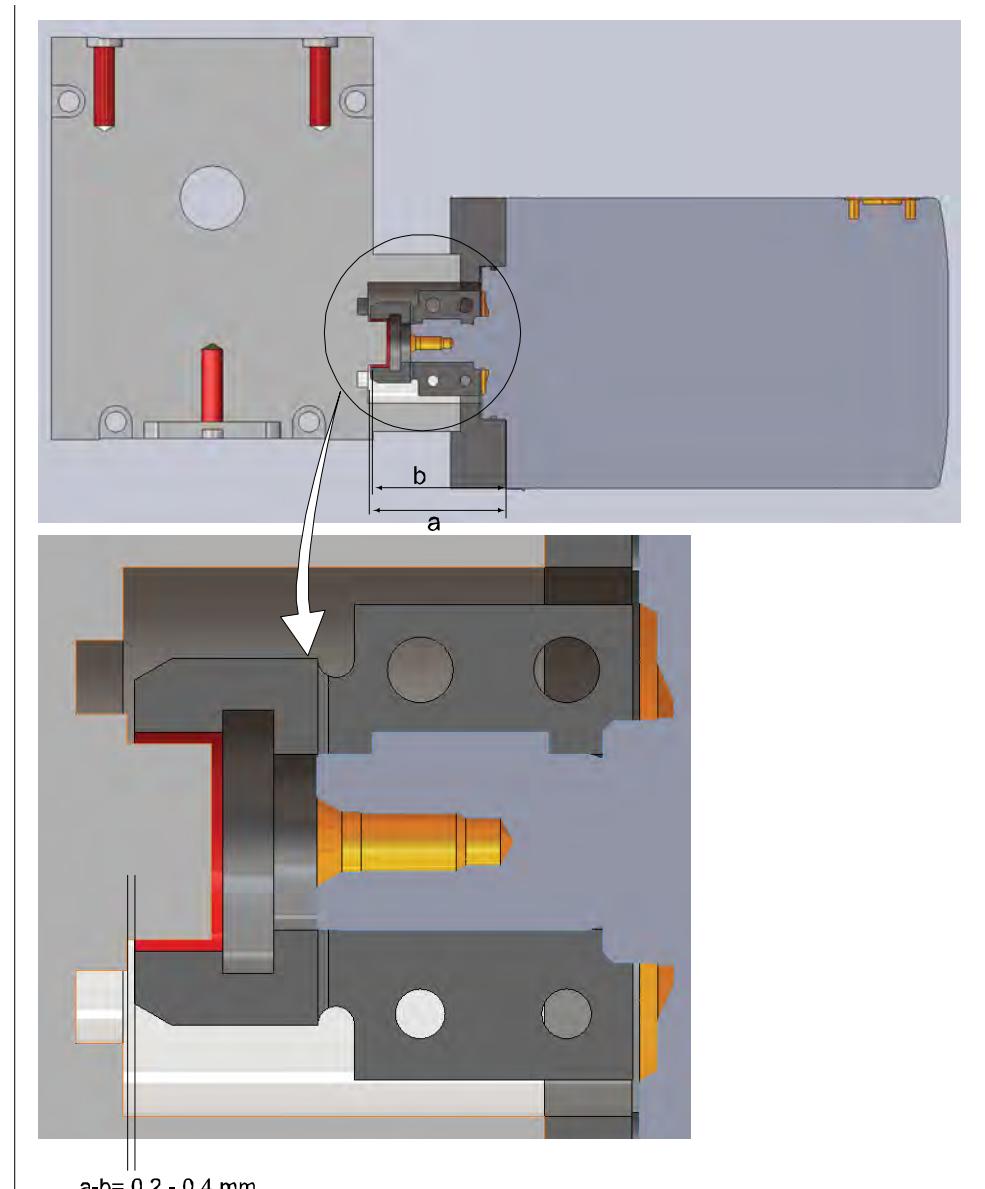
4 Repair

4.6.1 Replacement of motor, axis 1

Continued

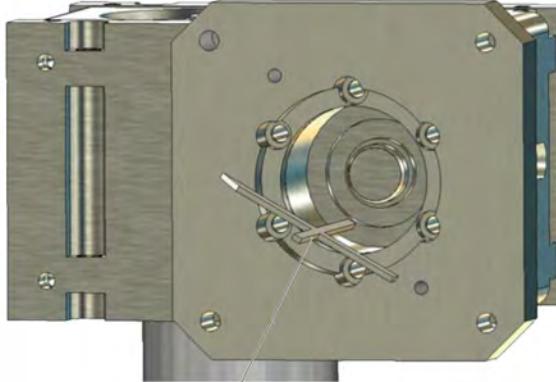
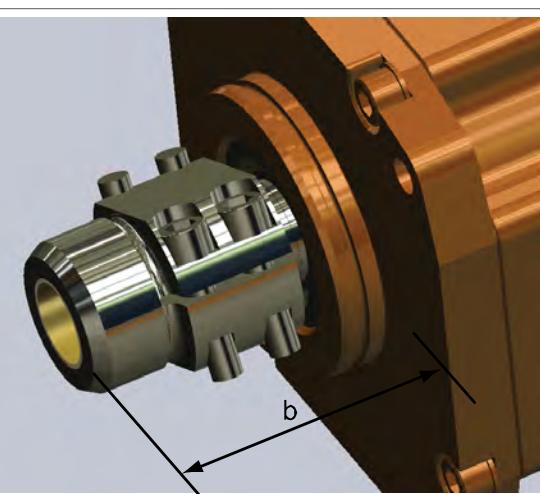
Adjusting the clutch on the motor

The procedure below details how to adjust the clutch on the axis on the motor.



xx0900000214

Continues on next page

Action	Note
1 Measure the distance between the face of the attachment plate and the gearbox using a slide caliper (A). The measured distance can be noted down as $a = x \text{ mm}$.	 xx0900000219
2 Measure the distance between the end of the clutch and the flank of the motor. The measured distance can be written down as $b = x \text{ mm}$.	 xx0900000218
3 The distance b should be 0.2-0.4 mm less than distance a.	Described in the sectioned figure.
4 If the distance b is greater than distance a, loosen the clutch locking screws and reduce the distance.	
5 Tighten the clutch locking screws.	Tightening torque 26 Nm.

Refitting, motor axis 1

The procedure below details how to refit motor, axis 1.

Action	Note
1  DANGER Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	

Continues on next page

4 Repair

4.6.1 Replacement of motor, axis 1

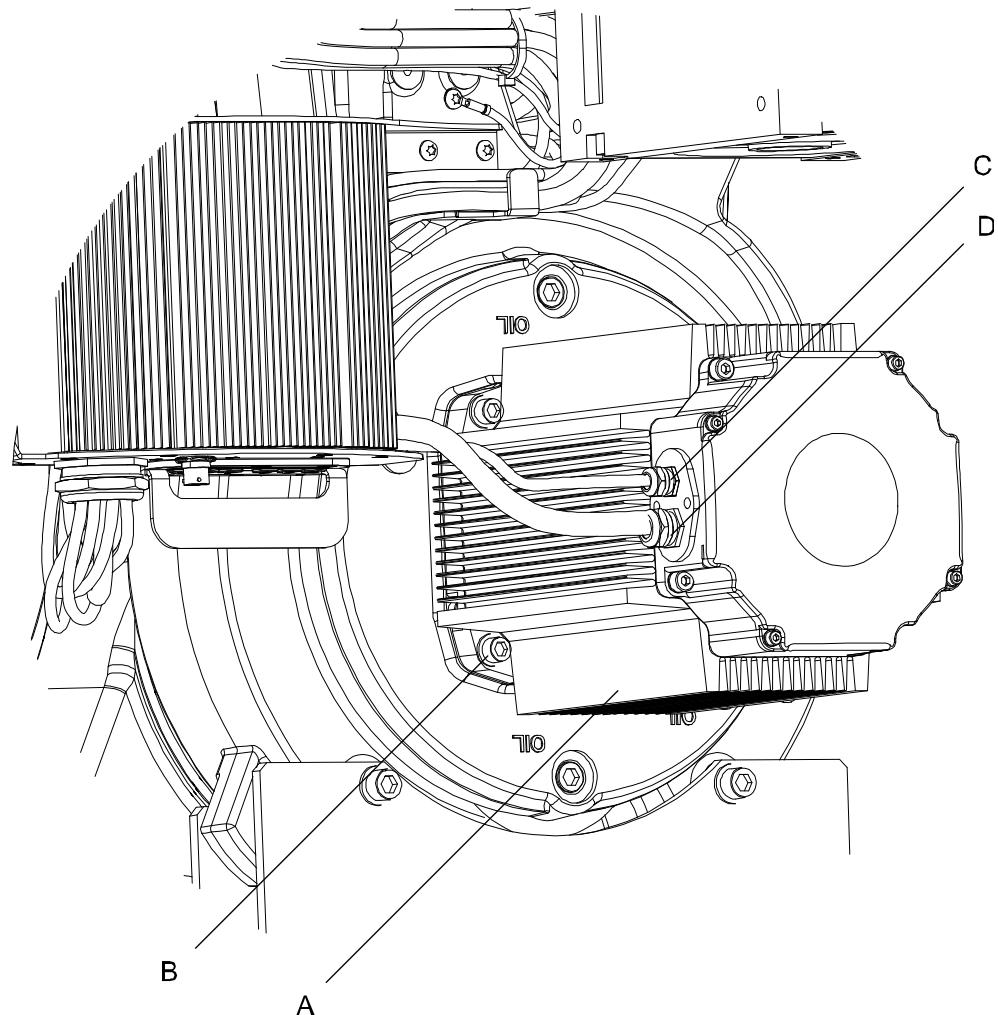
Continued

	Action	Note
2	 CAUTION The motor weighs 25 kg! All lifting equipment used must be sized accordingly!	
3	Adjust the clutch on the motor.	Described in the section Adjusting the clutch on the motor on page 246
4	Lubricate the clutch using a brush.	Mobilux EP 2
5	Push the motor and the mounted clutch onto the clutch counterpart of the gear by means of a slight turning movement.	
6	Mount all screws.	
7	Fasten all screws crosswise.	Tightening torque 26 Nm
8	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .

4.6.2 Replacement of motor axis 2

Location of motor

The motor, axis 2, is located on the left-hand side of the robot as shown in the figure below.



xx0900000190

A	Motor, axis 2
B	Motor attachment holes (4 pcs)
C	R2.FB2
D	R2.MP2

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor including pinion	See Spare part lists on page 353 .		
O-ring	21522012-430		Must be replaced when reassembling motor!

Continues on next page

4 Repair

4.6.2 Replacement of motor axis 2

Continued

Equipment, etc.	Spare part no.	Art. no.	Note
Grease		3HAB3537-1	For lubricating the o-ring.
Removal tool, motor M12x			Always use the removal tools in pairs!
Guide pins M10 x 150		3HAC15521-2	For guiding the motor. Guides are to be used in pairs!
Extension bar, 300 mm for bits 1/2"		3HAC12342-1	
Power supply		-	24 VDC, 1.5 A For releasing the brakes.
Rotation tool		3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with 24VDC power supply.
Standard toolkit		-	Content is defined in section Standard tools on page 350 .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
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 chapter Circuit diagram on page 355 .

Deciding calibration routine

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

Action	Note
1 Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	

Continues on next page

4.6.2 Replacement of motor axis 2

Continued

Action	Note
<p>If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
<p>If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removal, motor

The procedure below details how to remove the motor, axis 2.

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

Continues on next page

4 Repair

4.6.2 Replacement of motor axis 2

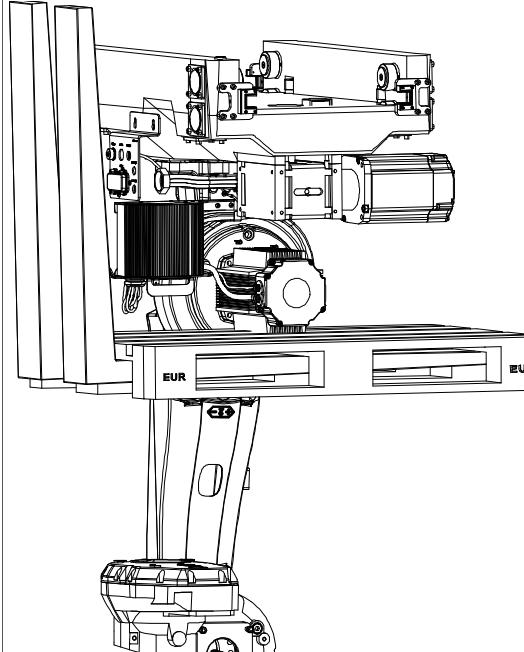
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Action	Note
<p>2 1) Move the robot to a position close enough to the position showed in the figure.</p> <p> DANGER</p> <p>2) Clear the area before releasing the brakes, the robot is going to collapse.</p> <p>3) Release the brakes for axis 2-6, releasing brakes are detailed in the section Manually releasing the brakes on page 105.</p>	<p>The robot will extracted as shown in the figure.</p>  <p>xx0900000191</p>
<p>3  DANGER</p> <p>Turn off all:</p> <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot <p>Before entering the robot working area.</p>	
4 Drain the oil from gearbox, axis 2.	Detailed in the section Changing oil, axis-2 gearbox on page 158 .
5 Remove the cover on top of the motor by unscrewing its four attachment screws.	
6 Remove the <i>cable gland cover</i> at the cable exit by unscrewing its two attachment screws.	Shown in the figure Location of motor on page 249 . Make sure the gasket is not damaged!

Continues on next page

4.6.2 Replacement of motor axis 2

Continued

Action	Note
7 Disconnect all connectors beneath the motor cover.	
8 Use a fork lift to place a loading pallet below (approx. 3mm) the motor as in the figure. ! CAUTION Do not lift the motor in this state, the risk of damage the motor is immediate.	 xx0900000192
9 Remove the motor by unscrewing its four attachment screws and plain washers.	
10 Fit the two <i>guide pins</i> in two of the <i>motor attachment holes</i> .	Art. no. is specified in Required equipment on page 249 . Shown in the figure Location of motor on page 249 .
11 If required, press the motor out of position by fitting the <i>removal tool, motor</i> to the remaining <i>motor attachment holes</i> .	Art. no. is specified in Required equipment on page 249 . Shown in the figure Location of motor on page 249 . Always use the removal tools in pairs!
12 ! CAUTION The motor weighs 38 kg! All lifting equipment used must be sized accordingly!	
13 Lift the motor to get the pinion away from the gear.	Make sure the motor pinion does not get damaged!
14 Remove the motor by gently pulling it onto the loading pallet.	

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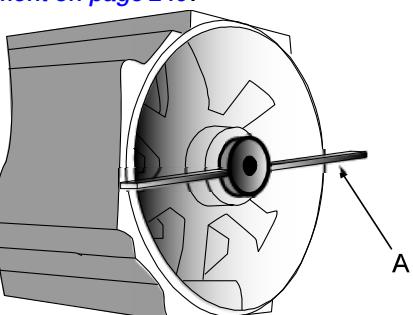
4 Repair

4.6.2 Replacement of motor axis 2

Continued

Refitting, motor

The procedure below details how to refit the motor axis 2.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
2 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the o-ring with <i>grease</i> .	Art. no. is specified in Required equipment on page 249 .
3 In order to release the brake, remove the cover on top of the motor and connect the 24 VDC power supply.	Connect to connector R2.MP2 <ul style="list-style-type: none">• +: pin 2• -: pin 5
4 Fit the two <i>guide pins</i> in the two lower <i>motor attachment holes</i> .	Art. no. is specified in Required equipment on page 249 . Shown in the figure Location of motor on page 249 .
5  CAUTION The motor weighs 38 kg! All lifting equipment used must be sized accordingly!	
6 Lift the motor and guide it onto the guide pins, as close to the correct position as possible without pushing the motor pinion into the gear. Make sure that the motor is turned the right direction, that is the cables facing .	
7 Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear (see the figure to the right). Fit the motor, making sure the motor pinion is properly mated to the gear of gearbox axis 2 and that it does not get damaged.	Art. no. is specified in Required equipment on page 249 .  xx0200000165
8 Remove the guide pins.	The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in the figure above. <ul style="list-style-type: none">• A: Rotation tool

Continues on next page

4.6.2 Replacement of motor axis 2

Continued

	Action	Note
9	Secure the motor with four attachment screws and plain washers.	M10 x 40, tightening torque: 50 Nm. Reused screws may be used, providing they are lubricated as detailed in section Screw joints on page 346 before fitting.
10	Disconnect the brake release voltage.	
11	Reconnect all connectors beneath the motor cover.	Connect in accordance with markings on connectors.
12	Refit the <i>cable gland cover</i> at the cable exit with its two attachment screws.	Shown in the figure Location of motor on page 249 .
13	Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
14	Perform a leak down test.	Detailed in Performing a leak-down test on page 190 .
15	Refill the gearbox with oil.	Detailed in the section Changing oil, axis-2 gearbox on page 158 .
16	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .
17	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

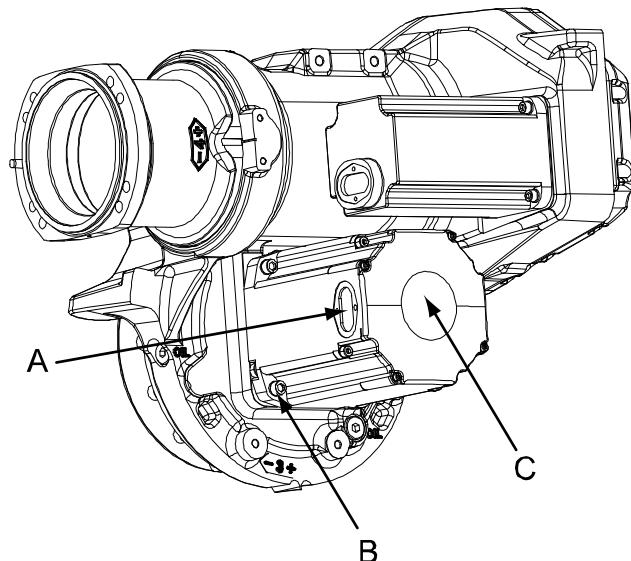
4 Repair

4.6.3 Replacement of motor, axis 3

4.6.3 Replacement of motor, axis 3

Location of motor

The motor axis 3 is located on the left hand side of the robot as shown in the figure below.



xx0600003051

A	Cable gland cover, motor axis 3
B	Motor attachment holes (4 pcs)
C	Motor, axis 3

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor, axis 3	See Spare part lists on page 353 .		Includes: <ul style="list-style-type: none">• motor• pinion• o-ring 21522012-430
O-ring	21522012-430		Must be replaced when reassembling motor!
Grease		3HAB3537-1	For lubricating the o-ring.
Bolts M16x60 (for mechanical stop axis 3)		3HAB3409-86	
Guide pins M10 x 100		3HAC15521-1	For guiding the motor.
Guide pins M10 x 150		3HAC15521-2	For guiding the motor.
Rotation tool		3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with 24 VDC power supply.

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Equipment, etc.	Spare part no.	Art. no.	Note
Power supply		-	24 VDC, max. 1.5 A For releasing the brakes.
Standard toolkit		-	Content is defined in section Standard tools on page 350 .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
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 chapter Circuit diagram on page 355 .

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

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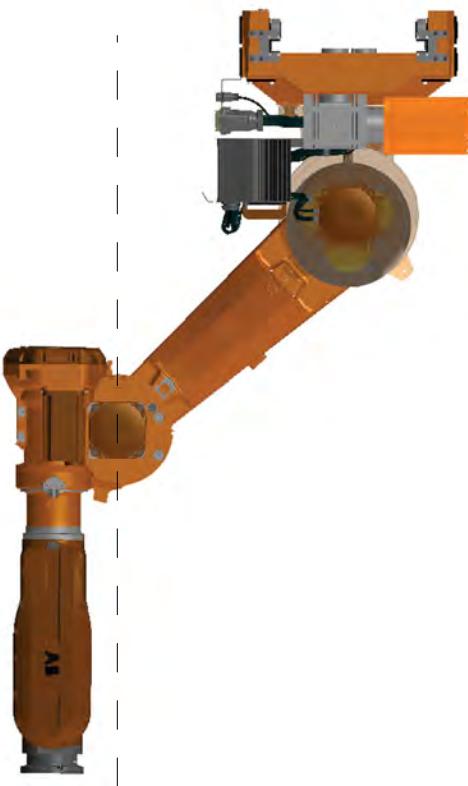
4 Repair

4.6.3 Replacement of motor, axis 3

Continued

Removal, motor

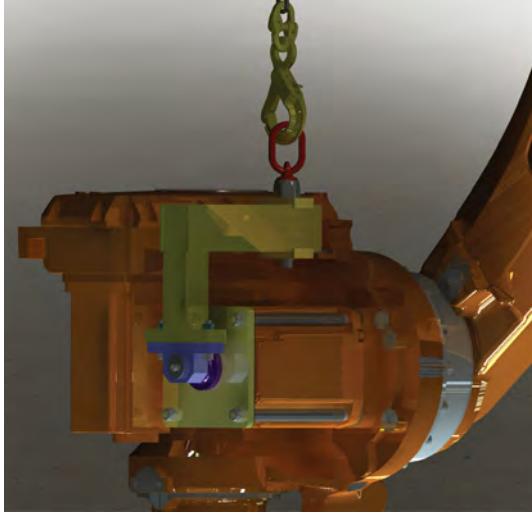
The procedure below details how to remove motor, axis 3.

Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2 Move the robot to the position shown in the figure. This is done in order to drain all oil from the gearbox axis 3.	 xx0900000197
3 Drain the oil from gearbox axis 3.	Detailed in the section Changing oil, axis-3 gearbox on page 161 .
4  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
5 Remove any equipment hindering access to motor axis 3.	
6 Remove the cover on top of the motor by unscrewing its four attachment screws.	

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4.6.3 Replacement of motor, axis 3

Continued

	Action	Note
7	Remove the <i>cable gland cover</i> at the cable exit by unscrewing its two securing screws.	Shown in the figure Location of motor on page 256 . Make sure the gasket is not damaged!
8	Disconnect all connectors beneath the motor cover.	
9	Unscrew the motors four <i>attachment screws and plain washers</i> .	Shown in the figure Location of motor on page 256 .
10	Fit the two <i>guide pins</i> in two of the motor attachment screw holes.	Art. no. is specified in Required equipment on page 256 .
11	Press the motor out of position by fitting <i>removal tool, motor</i> to the remaining motor attachment screw holes.	Art. no. is specified in Required equipment on page 256 . Always use the removal tools in pairs!
12	Apply the <i>lifting tool, motor axis 2, 3, 4</i> to the motor.	Art. no. is specified in Required equipment on page 256 .
		 xx0900000196
13	 CAUTION The motor weighs 25 kg! All lifting equipment used must be sized accordingly!	
14	Lift the motor to get the pinion away from the gear.	
15	Remove the motor by gently lifting it straight out and disconnect the brake release voltage.	Make sure the motor pinion is not damaged!

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4 Repair

4.6.3 Replacement of motor, axis 3

Continued

Refitting, motor

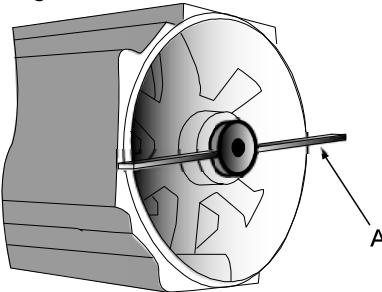
The procedure below details how to refit motor, axis 3.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
2 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate it with <i>grease</i> .	Art no. is specified in Required equipment on page 256 .
3 Fit the <i>lifting tool, motor axis 2, 3, 4</i> to the motor.	Art no. is specified in Required equipment on page 256 .
4 Fit the two <i>guide pins</i> in the two lower <i>motor attachment holes</i> .	Art no. is specified in Required equipment on page 256 . Shown in the figure Location of motor on page 256
5  CAUTION The motor weighs 25 kg! All lifting equipment used must be sized accordingly!	
6 Lift the motor and guide it onto the guide pins, as close to the correct position as possible without pushing the motor pinion into the gear.	
7 Remove the lifting tool and allow the motor to stay on the guide pins.	
8 In order to release the brake, connect the 24 VDC power supply.	Connect to connector R2.MP3 <ul style="list-style-type: none">• +: pin 2• -: pin 5

Continues on next page

4.6.3 Replacement of motor, axis 3

Continued

Action	Note
9 Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear! Fit the motor, making sure the motor pinion is properly mated to the gear of gearbox, axis 3.	Art no. is specified in Required equipment on page 256 . Make sure the motor pinion does not get damaged! Make sure the motor is turned the right direction, that is the cables facing forwards.  xx0200000165 The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in figure above. • A: Rotation tool.
10 Remove the guide pins.	
11 Secure the motor with four attachment screws and plain washers.	4 pcs: M10 x 40, tightening torque: 50 Nm.
12 Disconnect the brake release voltage.	
13 Reconnect all connectors beneath the motor cover.	Connect in accordance with markings on connectors.
14 Refit the <i>cable gland cover</i> at the cable exit with its two attachment screws.	Make sure the cover is tightly sealed! Shown in the figure Location of motor on page 256 .
15 Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
16 Remove the equipment used to unload the upper arm.	
17 Perform a leak-down test.	Detailed in the section Performing a leak-down test on page 190 .
18 Refill the gearbox with oil.	Detailed in the section Changing oil, axis-3 gearbox on page 161 .
19 Recalibrate the robot!	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .

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4 Repair

4.6.3 Replacement of motor, axis 3

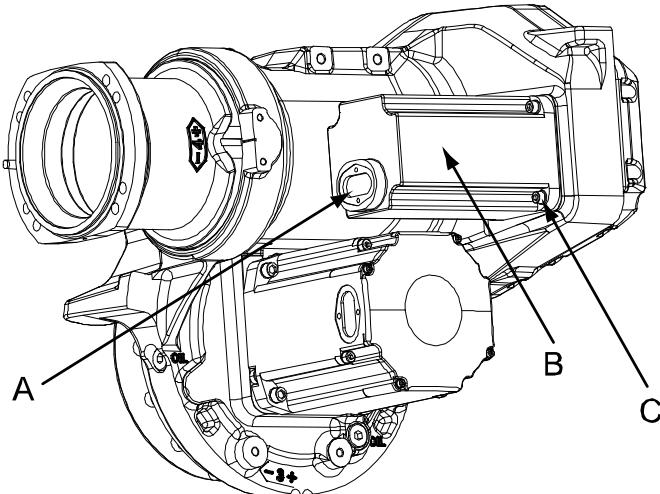
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	Action	Note
20	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage!</i> on page 48.	

4.6.4 Replacement of motor, axis 4

Location of motor

The motor axis 4 is located on the left-hand side of the upper arm as shown in the figure below.



xx0600003050

A	Cable gland cover, motor axis 4
B	Motor, axis 4
C	Motor attachment holes (4 pcs)

Required equipment

Equipment, etc.	Art. no.	Note
Motor including pinion	See spare part number in Spare part lists on page 353 .	Includes: <ul style="list-style-type: none">• motor• pinion• o-ring 21522012-430
O-ring	21522012-430	Must be replaced when reassembling motor!
Grease	3HAB3537-1	Used to lubricate the o-ring.
Loctite 574, Flange sealant	12340011-116	Option Foundry Plus
Guide pins M8 x 100	3HAC15520-1	For guiding the motor.
Guide pins M8 x 150	3HAC15520-2	For guiding the motor.
Rotation tool	3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with 24 VDC power supply.
Power supply	-	24 VDC, max. 1,5 A For releasing the brakes.
Standard toolkit	-	Content is defined in section Standard tools on page 350 .

Continues on next page

4 Repair

4.6.4 Replacement of motor, axis 4

Continued

Equipment, etc.	Art. no.	Note
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
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	3HAC024090-001	See chapter <i>Circuit diagram on page 355</i> .

Deciding calibration routine

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

Action	Note
1 Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in <i>Reference calibration routine on page 327</i> . Read more about reference calibration for Pendulum Calibration in <i>Operating manual - Calibration Pendulum</i> .
If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, motor axis 4

The procedure below details how to remove the motor, axis 4.

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

Continues on next page

	Action	Note
2	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	Remove the <i>cable gland cover</i> at the cable exit of the motor by unscrewing its two attachment screws.	Shown in the figure Location of motor on page 263 . Make sure the gasket is not damaged!
4	Remove the cover on top of the motor by unscrewing its four attachment screws.	
5	Disconnect all connectors beneath the motor cover.	
6	In order to release the brake, connect the 24 VDC power supply.	Connect to connector R2.MP4 <ul style="list-style-type: none"> • +: pin 2 • -: pin 5
7	Unscrew the motors four attachment screws and plain washers.	Shown in the figure Location of motor on page 263 .
8	Fit the two <i>guide pins</i> in two of the motor attachment screw holes.	
9	If required, press the motor out of position by fitting <i>removal tool, motor</i> to the motor attachment screw holes.	Art. no. is specified in Required equipment on page 263 . Always use the removal tools in pairs!
10	Lift the motor to get the pinion away from the gear and disconnect the brake release voltage.	
11	Remove the motor by gently lifting it straight out.	Make sure the motor pinion is not damaged!

Refitting, motor axis 4

The procedure below details how to refit motor, axis 4.

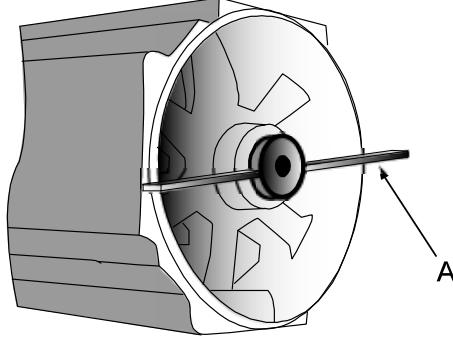
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the o-ring with <i>grease</i> .	Art. no. is specified in Required equipment on page 263 .
3	In order to release the brakes, connect the 24 VDC power supply.	Connect to connector R2.MP4: <ul style="list-style-type: none"> • +: pin 2 • -: pin 5

Continues on next page

4 Repair

4.6.4 Replacement of motor, axis 4

Continued

Action	Note
4 Fit the two <i>guide pins</i> in two of the <i>motor attachment holes</i> .	Art. no. is specified in Required equipment on page 263 . Shown in the figure Location of motor on page 263 .
5 Fit the motor with guidance of the pins, making sure the motor pinion is properly mated to the gear of gearbox 4.	Make sure the motor pinion does not get damaged!
6 Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear! Fit the motor, making sure the motor pinion is properly mated to the gear, axis 4.	Art. no. is specified in Required equipment on page 263 . Make sure the motor pinion does not get damaged! Make sure the motor is turned the right direction, that is the cables facing forwards.  xx0200000165 The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in figure above. <ul style="list-style-type: none">• A: Rotation tool.
7 Remove the guide pins.	
8 Secure the motor with four attachment screws and plain washers.	
9 Disconnect the brake release voltage.	
10 Reconnect all connectors beneath the motor cover.	
11 Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
12 Refit the <i>cable gland cover</i> at the cable exit with its two attachment screws.	Shown in the figure Location of motor on page 263 .
13 Perform a leak-down test if the gearbox has been drained.	Detailed in the section Performing a leak-down test on page 190 .
14 Refill the gearbox with oil if drained.	
15 Recalibrate the robot!	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .

Continues on next page

	Action	Note
16	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48.	

4 Repair

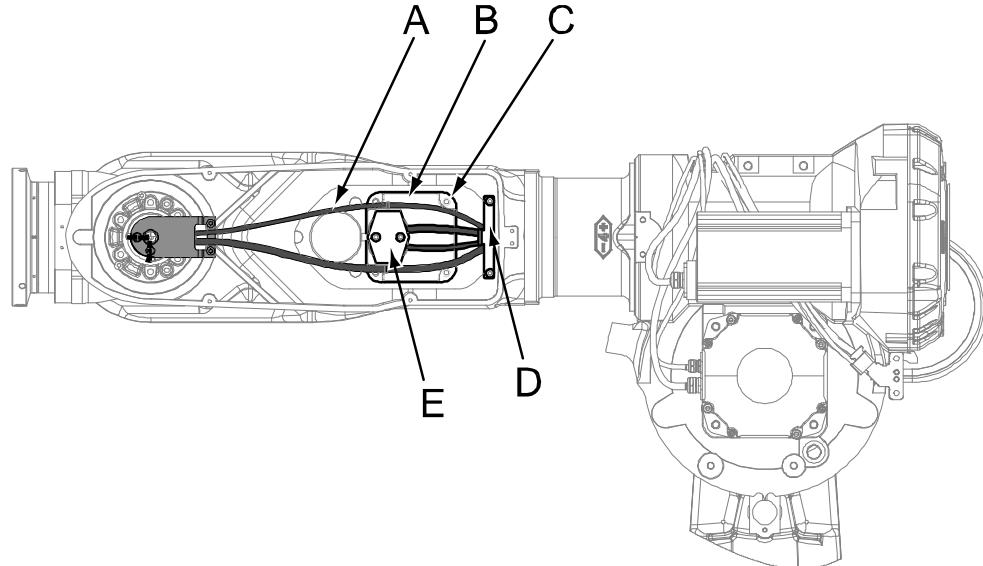
4.6.5 Replacement of motor, axis 5 , IRB 6620/6620LX

4.6.5 Replacement of motor, axis 5 , IRB 6620/6620LX

Location of motor

The motor axis 5 is located inside the upper arm tube, but attached to the wrist unit, as shown in the figure below.

A more detailed view of the component and its position may be found in [Spare part lists on page 353](#).



xx0600003049

A	Cable harness
B	Motor, axis 5
C	Attachment screws (4 pcs)
D	Metal clamp
E	Cover, cable gland

Required equipment

Equipment, etc.	Art. no.	Note
Motor	For spare part number, see Spare part lists on page 353 .	
Retrofit set Foundry Plus, wrist	For spare part number, see Spare part lists on page 353 .	
Retrofit set Foundry Plus, upper arm axis 4	For spare part number, see Spare part lists on page 353 .	
O-ring	21522012-430	Must be replaced when reassembling motor!
Grease	3HAB3537-1	For lubricating the o-ring.
Loctite 574, Flange sealant	12340011-116	Option Foundry Plus

Continues on next page

Equipment, etc.	Art. no.	Note
Removal tool, motor M10x	3HAC14972-1	Always use the removal tools in pairs!
Extension bar 300 mm for bits 1/2"	3HAC12342-1	
Guide pins M8 x 100	3HAC15520-1	For guiding the motor.
Guide pins M8 x 150	3HAC15520-2	For guiding the motor.
Power supply	-	24 VDC, 1.5 A For releasing the brakes.
Standard toolkit	-	Content is defined in section Standard tools on page 350 .
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 chapter Circuit diagram on page 355 .

Deciding calibration routine

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

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	<p>If the robot is to be calibrated with reference calibration:</p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327.</p> <p>Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum.</p>
	<p>If the robot is to be calibrated with fine calibration:</p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

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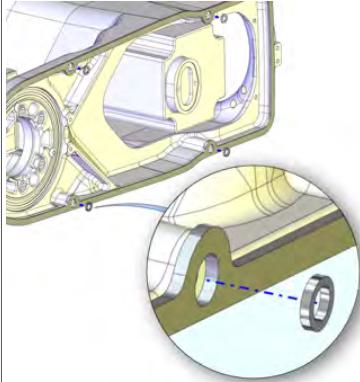
4 Repair

4.6.5 Replacement of motor, axis 5 , IRB 6620/6620LX

Continued

Removal, motor, axis 5

The procedure below details how to remove motor, axis 5.

Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2 Move the robot to a position where the upper arm is parallel to the floor and the side of the wrist unit, where motor axis 5 is placed, is facing up.	
3  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4 Remove the cover on the wrist unit by removing its attachment screws.  Note Make sure not to lose the washers placed in the holes of the foundry gasket.	 xx1400002580
5 Remove the <i>metal clamp</i> securing the cable harness.	Shown in the figure in section Location of motor on page 268 .
6 Remove the <i>cable gland cover</i> at the cable exit by unscrewing its two attachment screws.	Shown in the figure in section Location of motor on page 268 .
7 Remove the cover on top of the motor by unscrewing its four attachment screws.	
8 Disconnect all connectors beneath the motor cover and remove the cable of the axis-5 motor.	
9 Pull the <i>cable harness</i> out of the upper arm a little, far enough to make room for removal of the motor.	Shown in the figure in the section Location of motor on page 268 .
10 In order to release the brake, connect the 24 VDC power supply.	Connect to: - connector R2.MP5 (in the motor): <ul style="list-style-type: none"> • + : pin 2 • - : pin 5
11 Remove the motor by unscrewing its four attachment screws and plain washers.	
12 Fit the two <i>guide pins</i> in two of the motor attachment screw holes.	Art. no. is specified in Required equipment on page 268 .

Continues on next page

Action	Note
13 If required, press the motor out of position by fitting <i>removal tool, motor, M10</i> to the motor attachment screw holes.	Art. no. is specified in Required equipment on page 268 . Always use the removal tools in pairs and diagonally!
14 Lift the motor to get the pinion away from the gear and disconnect the brake release voltage.	Make sure the motor pinion is not damaged!
15 Remove the motor by gently lifting it straight out.	Keep track of the shims between the motor flange and the wrist housing.

Refitting, motor, axis 5

The procedure below details how to refit motor, axis 5.

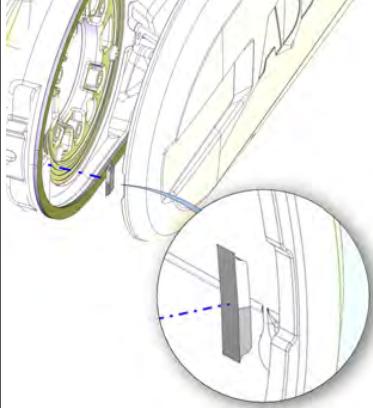
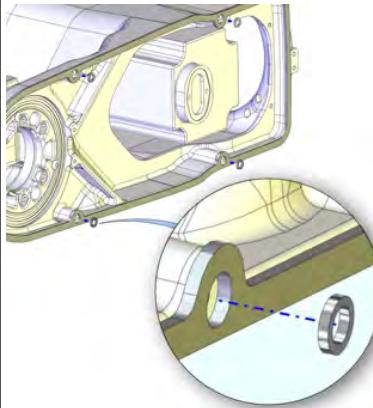
Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
2 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the <i>o-ring</i> with <i>grease</i> .	Art. no. is specified in Required equipment on page 268 .
3 In order to release the brake, connect the 24 VDC power supply.	Connect to: - connector R2.MP5 (in the motor): <ul style="list-style-type: none">• + : pin 2• - : pin 5
4 Fit the two <i>guide pins</i> in two of the motor attachment holes.	Art. no. is specified in Required equipment on page 268 .
5 Fit the motor, with guidance from the pins, making sure the motor pinion is properly mated to the gear of axis 5.	Make sure the motor pinion does not get damaged!
6 Secure the motor with four attachment screws and plain washers.	4 pcs: M8 x 25; tightening torque: 24 Nm.
7 Disconnect the brake release voltage.	
8 Refit the cable of the axis-5 motor and reconnect all connectors beneath the motor cover.	
9 Refit the cover on top of the motor with its four attachment screws.	
10 Refit the cable gland cover at the cable exit with its two attachment screws.	Make sure the cover is tightly sealed!
11 Refit the <i>metal clamp</i> securing the cable harness.	Shown in the figure in the section Location of motor on page 268 .
12 Perform a leak-down test.	Detailed in the section Performing a leak-down test on page 190 .
13 Standard Refit the cover of the wrist unit with its attachment screws.	

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4 Repair

4.6.5 Replacement of motor, axis 5 , IRB 6620/6620LX

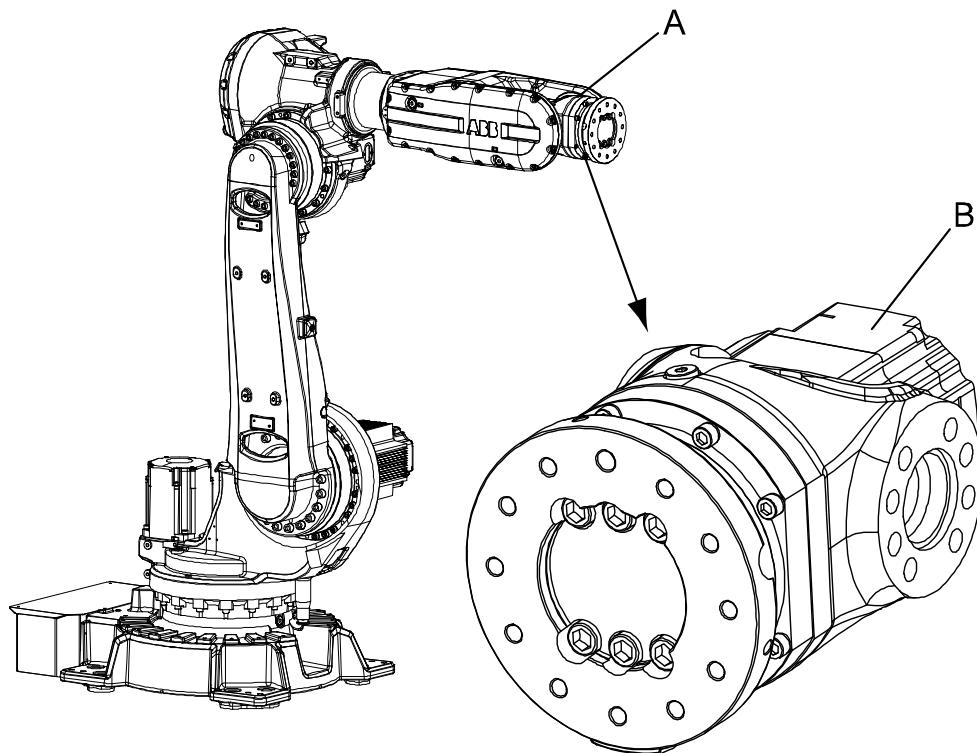
Continued

	Action	Note
14	<p>Foundry Plus Make sure that the gasket is undamaged. Also the small gasket fitted in the cover recess. Replace if damaged.</p>	 xx1400002579
15	<p>Foundry Plus Make sure the washers are fitted in the gasket holes. Refit the cover, <i>wrist unit Foundry Plus</i>.</p>	 xx1400002580
16	Refill the gear with oil.	Detailed in the section Changing oil, axis-5 gearbox on page 167 .
17	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .
18	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

4.6.6 Replacement of motor, axis 6

Location of motor

The motor axis 6 is located in the center of the wrist unit as shown in the figure below.



xx0600003039

A	Wrist unit
B	Motor, axis 6

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor including pinion Motor including pinion (Foundry Plus)	See spare part number in Spare part lists on page 353.		
Motor including pinion (insulated)	See spare part number in Spare part lists on page 353.		Includes: • motor • pinion • o-ring 21522012-430
O-ring	21522012-430		Must be replaced when reassembling motor!
Gasket	3HAC12877-1		Protection Standard. Must be replaced when replacing motor

Continues on next page

4 Repair

4.6.6 Replacement of motor, axis 6

Continued

Equipment, etc.	Spare part no.	Art. no.	Note
Gasket	3HAC033206-001		Protection Foundry Plus Must be replaced when replacing motor
Gasket, cover	3HAC033489-001		Must be replaced when opening cover.
Removal tool, motor M10x		3HAC14972-1	Always use the removal tools in pairs!
Extension bar 300 mm for bits 1/2"		3HAC12342-1	
Guide pins M8 x 100		3HAC15520-1	For guiding the motor.
Guide pins M8 x 150		3HAC15520-2	For guiding the motor.
Power supply		-	24 VDC, 1.5 A For releasing the brakes.
Grease		3HAB3537-1	For lubricating the o-ring.
Loctite 574, Flange sealant		12340011-116	Option Foundry Plus
Standard toolkit		-	Content is defined in section Standard tools on page 350 .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
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 chapter Circuit diagram on page 355 .

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	

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Action	Note
<p>If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327. Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum.</p>
<p>If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removal, motor

The procedure below details how to remove the motor, axis 6.

 Note
Robots with protection type Foundry Plus or Foundry Prime require special repair routines to maintain the tightness level, in addition to the procedure below, described in Replacement of the motor axis 6 (Foundry Plus) on page 278 .

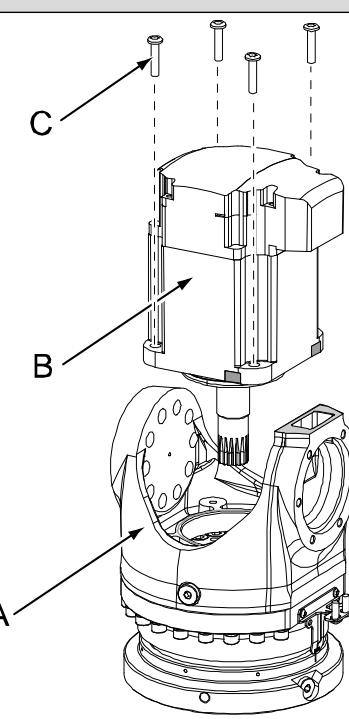
Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2 Move the robot to a position where the motor in axis 6 is pointed straight up. This position enables the motor to be replaced without draining the gear oil, which in turn saves time.	
3  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
4 Remove the rear motor cover by unscrewing the five attachment screws.	
5 Disconnect all connectors beneath the cover.	
6 In order to release the brake, connect the 24 VDC power supply.	Connect to connector R3.MP6 <ul style="list-style-type: none">• +: pin 2• -: pin 5

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4 Repair

4.6.6 Replacement of motor, axis 6

Continued

Action	Note
7 Remove the motor by unscrewing its four attachment screws and plain washers.	 xx0600003038 <ul style="list-style-type: none"> • A: Tilthouse • B: Motor, axis 6 • C: Attachment screws (4 pcs)
8 If required, press the motor out of position by fitting <i>removal tool, motor</i> to the motor attachment screw holes.	Art. no. is specified in Required equipment on page 273 . Always use the removal tools in pairs!
9 Lift the motor carefully to get the pinion away from the gear and disconnect the brake release voltage.	Make sure the motor pinion is not damaged!
10 Remove the motor by gently lifting it straight out.	

Refitting, motor

The procedure below details how to refit motor, axis 6.



Note

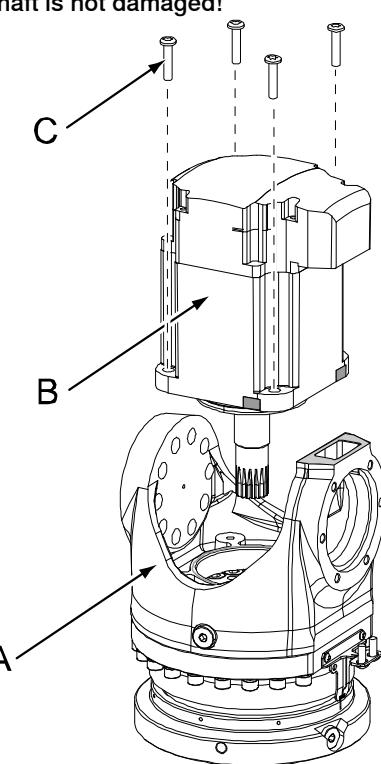
Robots with protection type Foundry Plus or Foundry Prime require special repair routines to maintain the tightness level, in addition to the procedure below, described in [Replacement of the motor axis 6 \(Foundry Plus\) on page 278](#).

Action	Note
1 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the <i>o-ring</i> with <i>grease</i> .	Art. no. is specified in Required equipment on page 273 .
2 In order to release the brake, connect the 24 VDC power supply.	Connect to connector R3.MP6 <ul style="list-style-type: none"> • +: pin 2 • -: pin 5

Continues on next page

4.6.6 Replacement of motor, axis 6

Continued

Action	Note
3 Fit the two <i>guide pins</i> in two of the motor attachment holes.	Art. no. is specified in Required equipment on page 273 .
4 Fit the motor, with guidance from the pins, making sure the motor pinion is properly mated to the gear of gearbox, axis 6.	Make sure the pinion on the motor shaft is not damaged!
	 <p>xx0600003038</p> <ul style="list-style-type: none"> • A: Tilthouse • B: Motor, axis 6 • C: Attachment screws
5 Remove the guide pins.	
6 Secure the motor with its four attachment screws and plain washers.	4 pcs: M8 x 25, tightening torque: 24 Nm.
7 Disconnect the brake release voltage.	
8 Reconnect all connectors beneath the motor cover.	
9 Refit the cover on top of the motor with its five attachment screws.	Make sure the cover is tightly sealed!
10 Recalibrate the robot.	<p>Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i>, enclosed with the calibration tools.</p> <p>Axis Calibration is described in Calibrating with Axis Calibration method on page 326.</p> <p>General calibration information is included in section Calibration on page 305.</p>

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4 Repair

4.6.6 Replacement of motor, axis 6

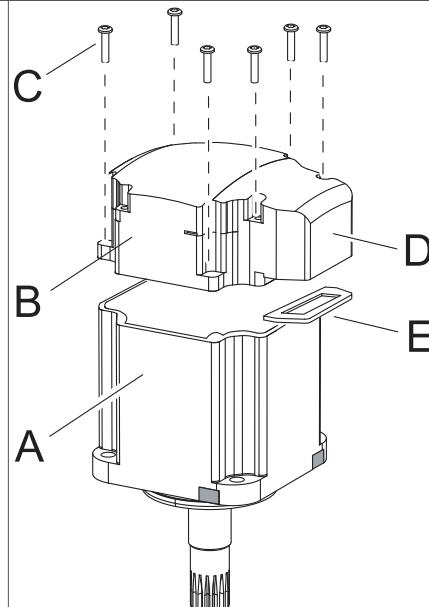
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Action	Note
<p>11  DANGER</p> <p>Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48.</p>	

Replacement of the motor axis 6 (Foundry Plus)

Robots with protection type Foundry Plus require special repair routines to maintain the tightness level.

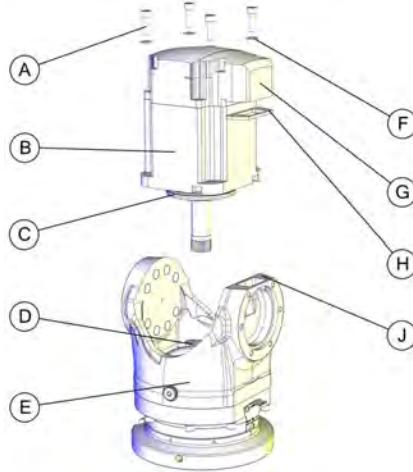
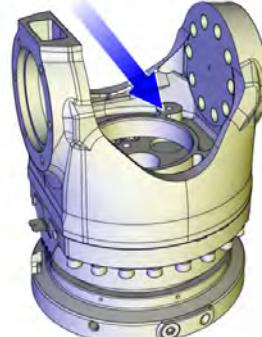
The repair must be done according to the previous repair procedure with the following additions.

Action	Note
<p>1  DANGER</p> <p>Turn off all:</p> <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot <p>Before entering the robot working area.</p>	
<p>2 Remove the rear motor cover by unscrewing the five attachment screws.</p>	 <p>xx1500002524</p> <ul style="list-style-type: none"> • A: Motor unit • B: Connection box • C: Attachment screw (5 pcs) • D: Rear motor cover • E: Gasket
<p>3 Continue to remove the motor unit, according to step 6 and forwards in Removal, motor on page 275.</p>	

Continues on next page

4.6.6 Replacement of motor, axis 6

Continued

Action	Note
4  Note Keep the old <i>rear motor cover</i> with the air nipple.	
5 Remove the protection strip on the <i>gasket</i> and mount it on the <i>motor</i> .	 xx1500002425 <ul style="list-style-type: none"> • A: Attachment screw (4pcs) Mercasol 3106 • B: Motor unit • C: O-ring • D: Sikaflex in screw recesses • E: Tilt house • F: Washer • G: Rear motor cover • H: Sealing • J: Loctite 574
6 Apply Mercasol 3106 on the <i>motor end cover</i> .	
7 Apply Loctite 574 flange sealant on the contact surface.	 xx1400000992
8 Apply grease on the <i>o-ring</i> on the <i>motor</i> .	
9 Continue to refit the new motor according to section, Refitting, motor on page 276 .	

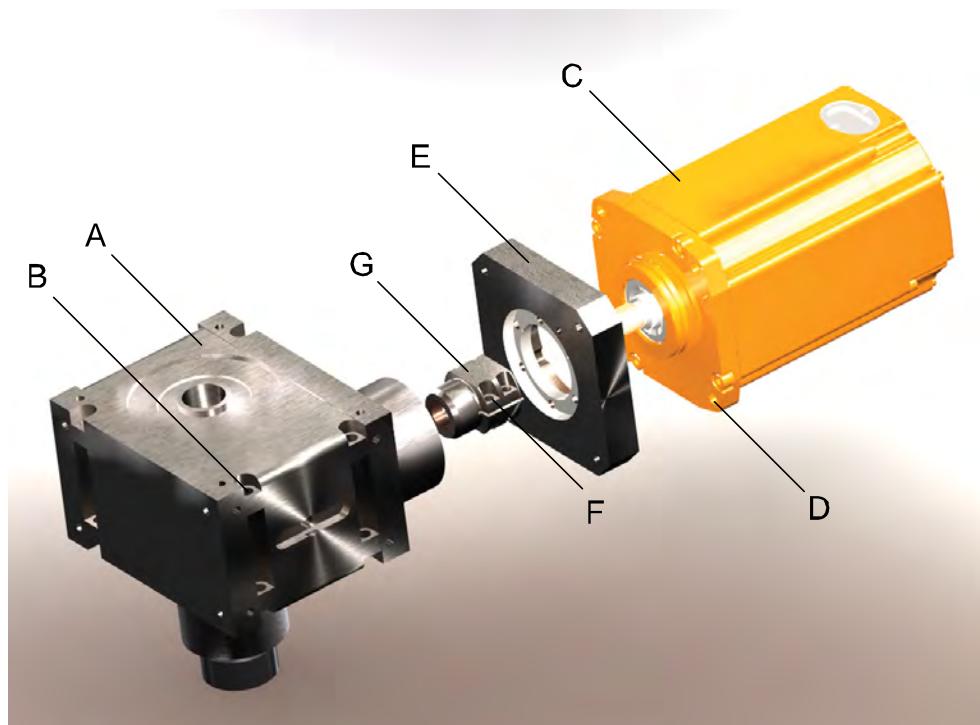
4 Repair

4.7.1 Replacement of gearbox 1

4.7 Gearboxes

4.7.1 Replacement of gearbox 1

Location of gearbox 1



xx0900000210

A	Gearbox axis 1
B	Attachment screws gearbox
C	AC motor
D	Attachment screws motor
E	Flank
F	Clutch locking screw
G	Clutch

Required equipment

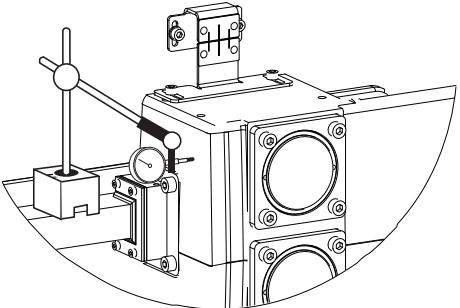
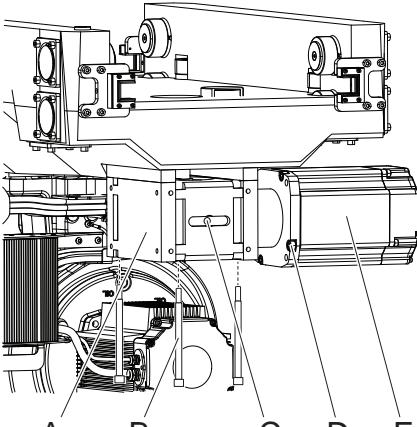
Equipment, etc.	Art. no.	Note
Dial indicator	-	
Brush	-	
Mobilux EP 2	-	Used to lubricate the motor clutch.
Standard tools	-	

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4.7.1 Replacement of gearbox 1

Continued

Removing the gearbox

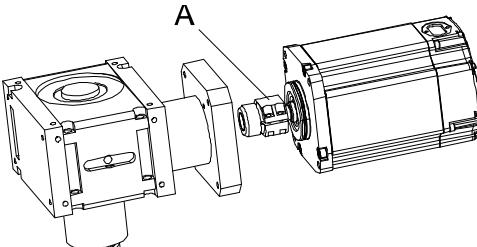
	Action	Note
1	Move carriage to the zero position, and use a dial indicator to make sure that the carriage remains in position when refitting the gearbox.	 xx1400000773
2	 DANGER Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
3	Remove R2.MP1 and R2.FB1 from the motor.	Described in the section Replacement of motor, axis 1 on page 242
4	 DANGER The motor weighs 30 kg.  Tip Use a forklift and a loading pallet to secure the motor from falling down.	
5	 DANGER The gearbox weighs 30 kg.  Tip Use a forklift and a loading pallet to secure the gearbox from falling down.	 xx1400000772 <ul style="list-style-type: none"> • A: Gearbox axis 1 • B: 4x screws M12x180 • C: Oil plug, draining • D: 4x motor attachment screws • E: AC Motor

Continues on next page

4 Repair

4.7.1 Replacement of gearbox 1

Continued

Action	Note
6 Loosen the four motor attachment screws (D) and remove the motor together with the clutch.	
 CAUTION Do not alter the clutch position on the motor shaft.	 xx0900000212 <ul style="list-style-type: none"> • A: Gearbox clutch

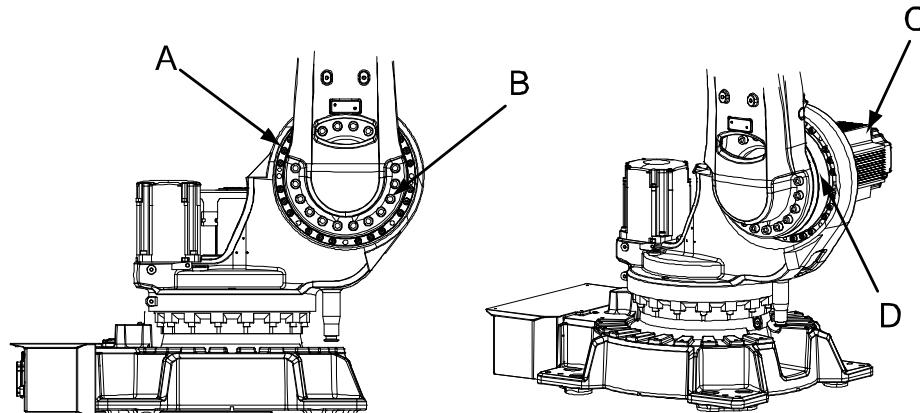
Refitting the gearbox

Action	Note
 DANGER Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2 Attach the motor onto the gearbox using the four attachment screws M8x30. Fasten the screws cross-wise according to the torque.	Tightening torque: 26 Nm
3 Refit the gearbox and motor unit to the carriage using the four attachment screws M12x180.	Tightening torque: 83 Nm
4 Refit R2.MP1 and R2.FB1 to the motor.	Described in the section Replacement of motor, axis 1 on page 242
5 Recalibrate the robot.	Described in the section Updating revolution counters on page 320

4.7.2 Replacement gearbox axis 2

Location of gearbox axis 2

The gearbox axis 2 is located in the lower arm rotational center.



xx0600003056

A	Attachment screws, M12x60 quality 12.9 Gleitmo (24 pcs)
B	Attachment screws, M16x50 quality 12.9 Gleitmo (16 pcs)
C	Motor, axis 2
D	Gearbox, axis 2

Required equipment

Equipment, etc	Spare part no.	Art. no.	Note
Gearbox, axis 2	See Spare parts		Includes: <ul style="list-style-type: none">• gearbox• o-ring
O-ring (339.3x5.7)	3HAB3772-91		
Grease		3HAB3537-1	For lubricating o-rings.
Lifting tool		3HAC026597-001	Instruction 3HAC026600-002 is enclosed.
Lifting tool		3HAC025214-001	For lifting gearbox
Roundsling		-	
Guide pins (M12x250)		3HAC13056-4	Always use in pairs.
Guide pins (M12x200)		3HAC13056-3	Always use in pairs.
Crank		3HAC020999-001	Used to turn the gear in correct position.
Standard toolkit		-	Content is defined in section Standard tools on page 350 .

Continues on next page

4 Repair

4.7.2 Replacement gearbox axis 2

Continued

Equipment, etc	Spare part no.	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.

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal

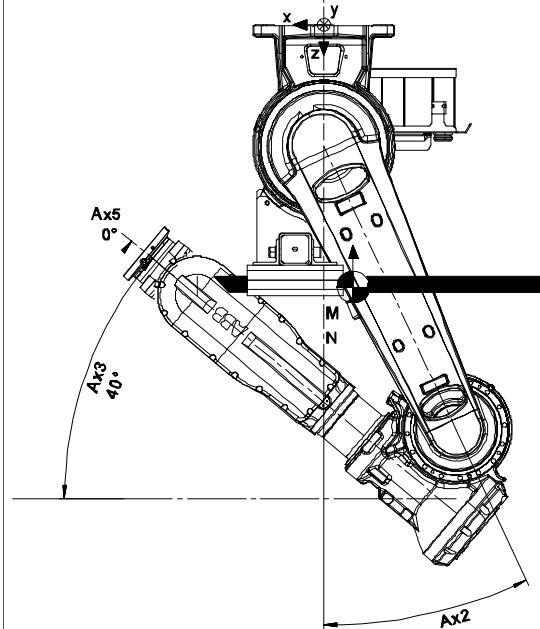
The procedure below details how to remove gearbox axis 2.

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

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4.7.2 Replacement gearbox axis 2

Continued

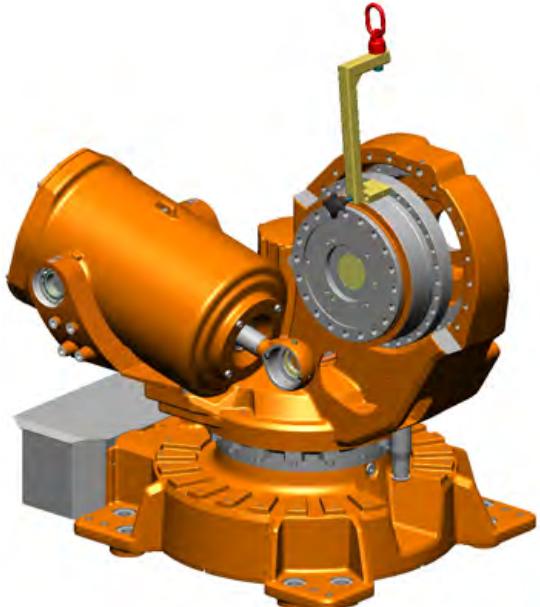
Action	Note
2 Jog the robot to the position shown in the figure to the right.	 xx0900000178
3  CAUTION The upper and lower arms (incl. gearboxes axes 2 and 3) weighs 455 kg. All lifting equipment used must be sized accordingly!	
4 Remove the robot from the carriage.	Described in the section Lifting and turning tool on page 84 .
5 Drain the oil from gearbox axis 2.	Detailed in the section Changing oil, axis-2 gearbox on page 158 .
6  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
7 Remove the cable harness, axes 1-3.	Detailed in the section Replacement of cable harness, lower end (axes 1-2) on page 195 .
8 Let the removed part of the cable harness hang loose and take care not to damage it during the removal process.	

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4 Repair

4.7.2 Replacement gearbox axis 2

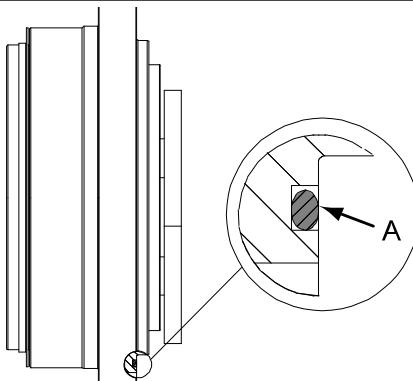
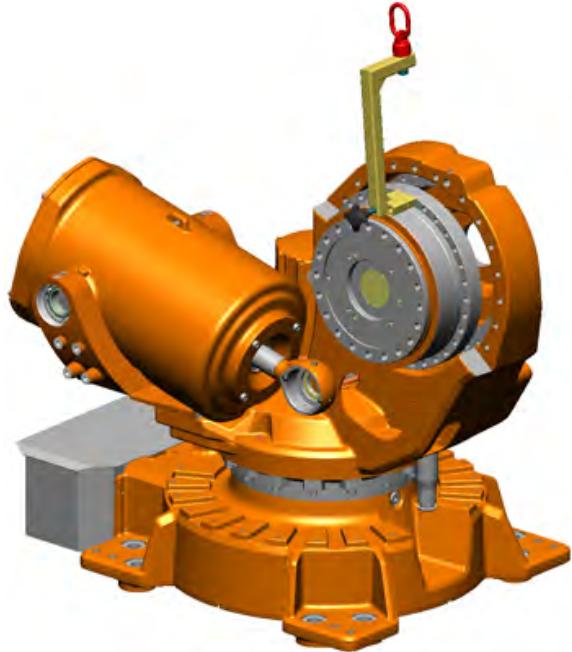
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	Action	Note
9	Remove the attachment screws M16x50 (16 pcs) that secure the lower arm to gearbox axis 2.	Shown in the figure Location of gearbox axis 2 on page 283 .
10	Remove the upper and lower arms and put them down on the floor.	
11	Remove motor axis 2.	Detailed in the section Replacement of motor axis 2 on page 249 .
12	Remove two attachment screws (M12x60) parallel to each other.	
13	Fit two guide pins in the holes, parallel to each other.	
14	 CAUTION The gearbox weighs 98 kg! All lifting equipment used must be sized accordingly!	
15	Fit the <i>lifting tool</i> for lifting the gearbox in the uppermost hole and secure it with a roundsling.	Art. no. is specified in Required equipment on page 283 .  xx0900000114
		The figure shows IRB6640.
16	Remove the attachment screws M12x60 (24 pcs) securing the gearbox to the frame.	Shown in the figure Location of gearbox axis 2 on page 283 .
17	Remove the gearbox and put it in a place where it will not/cannot be damaged.	
18	Wipe away residual oil and paint.	

Continues on next page

Refitting

The procedure below details how to refit gearbox axis 2.

	Action	Note
1	Make sure the o-ring is fitted to the gearbox. Lightly lubricate it with grease.	 xx0600003128 <ul style="list-style-type: none"> • A : O-ring 3HAB3772-91
2	 CAUTION The gearbox weighs 98 kg! All lifting equipment used must be sized accordingly!	
3	Fit the <i>lifting tool</i> for lifting the gearbox in the uppermost hole of the gearbox and secure it with a roundsling.	Art. no. is specified in Required equipment on page 283 .  xx0900000114 <p>The figure shows IRB6640.</p>
4	Fit two guide pins in two of the attachment holes, parallel to each other.	

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4 Repair

4.7.2 Replacement gearbox axis 2

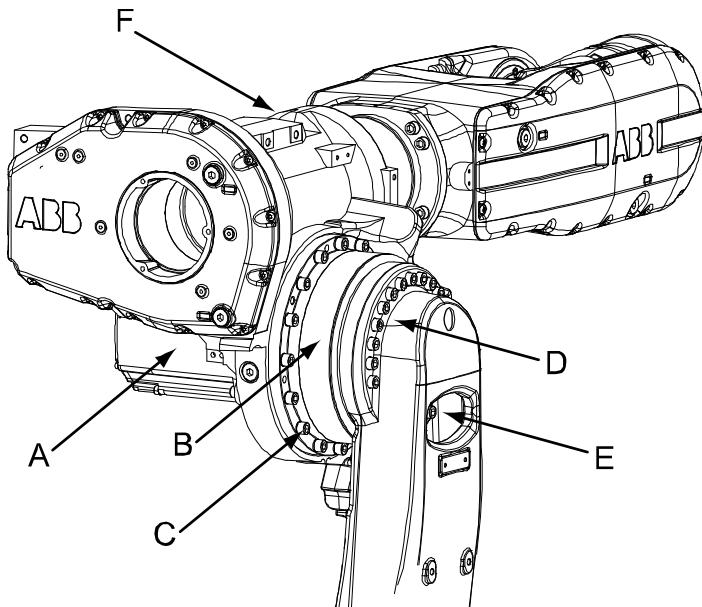
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	Action	Note
5	Lift the gearbox on to the guide pins and push it in mounting position.	
6	Refit the gearbox with its attachment screws.	M12x60 (24 pcs) Tightening torque: 120 Nm.
7	 CAUTION The upper and lower arms (incl. gearboxes axes 2 and 3) weighs 455 kg. All lifting equipment used must be sized accordingly!	
8	Use a crank in the gearbox in order to find the holes for the attachment screws.	
9	Refit the lower arm to the gearbox axis 2 with its attachment screws.	M16x50 (16 pcs) Tightening torque: 300 Nm.
10	Refit motor axis 2.	Detailed in the section Replacement of motor axis 2 on page 249 .
11	Refit the cable harness, axes 1-3.	Detailed in the section Replacement of cable harness, lower end (axes 1-2) on page 195 .
12	Fill the gearbox axis 2 with oil.	Detailed in the section Changing oil, axis-2 gearbox on page 158 .
13	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .
14	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

4.7.3 Replacement of gearbox axis 3

Location of gearbox axis 3

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



xx0600003057

A	Motor, axis 3
B	Gearbox, axis 3
C	Attachment screws, M12x50 quality 12.9 gleitmo (20 pcs)
D	Attachment screws, M16x50 quality 12.9 gleitmo (16 pcs)
E	Hole in lower arm

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Gearbox, axis 3	See Spare part lists on page 353 .		Includes: • gearbox • o-ring
O-ring		3HAB3772-92	Replace only if damaged.
Grease		3HAB3537-1	Used to lubricate the o-ring.
Lifting tool		3HAC026597-001	Instructions 3HAC 026600-002 is enclosed.
Lifting tool		3HAC025214-001	For lifting gearbox.
Standard toolkit		-	Content is defined in section Standard tools on page 350 .

Continues on next page

4 Repair

4.7.3 Replacement of gearbox axis 3

Continued

Equipment, etc.	Spare part no.	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.

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal

The procedure below details how to remove gearbox axis 3.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	

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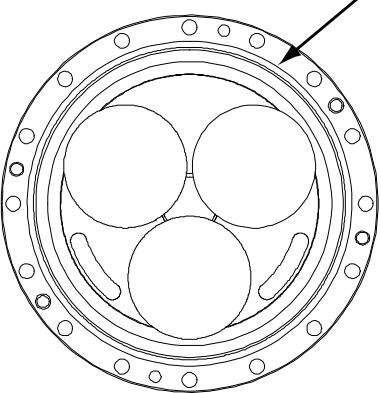
4.7.3 Replacement of gearbox axis 3

Continued

Action	Note
3 Drain the oil from gearbox axis 3.	Detailed in the section Changing oil, axis-3 gearbox on page 161 .
4 Remove the upper arm.	Detailed in the section Replacement of the upper arm on page 220 .
5 While the upper arm is resting on its side on the floor, fit the <i>lifting tool</i> in the uppermost hole of the gearbox.	Art. no. is specified in Required equipment on page 289 .
6  CAUTION The gearbox weighs 51 kg! All lifting equipment used must be sized accordingly!	
7 Secure the gearbox with a roundsling in an overhead crane.	
8 Remove the <i>attachment screws</i> securing the gearbox to the upper arm.	Shown in the figure Location of gearbox axis 3 on page 289 .
9 Remove the gearbox and put it in a safe place.	

Refitting

The procedure below details how to refit gearbox axis 3.

Action	Note
1 Make sure the o-ring is fitted to the gearbox. Lightly lubricate the o-ring with grease.	 xx0600003127 • A : O-ring 3HAB 3772-92
2  CAUTION The gearbox weighs 51 kg! All lifting equipment used must be sized accordingly!	
3 Fit a <i>lifting tool</i> in the uppermost hole of the gearbox and secure it with a roundsling.	Art. no. is specified in Required equipment on page 289 .
4 Fit two guide pins in two of the attachment holes, parallel to each other.	
5 Lift the gearbox on to the guide pins and push it to its mounting position.	

Continues on next page

4 Repair

4.7.3 Replacement of gearbox axis 3

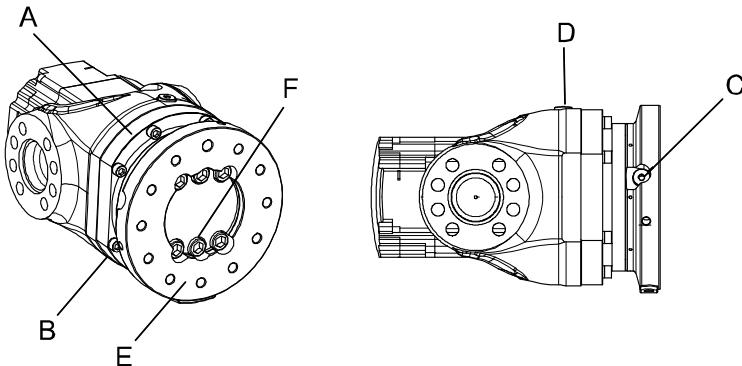
Continued

	Action	Note
6	Refit the gearbox, while the upper arm is resting on its side on the floor.	
7	Refit the <i>upper arm</i> .	Detailed in the section Replacement of the upper arm on page 220 .
8	Fill the <i>gearbox axis 3</i> with oil.	Detailed in the section Changing oil, axis-3 gearbox on page 161 .
9	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .
10	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

4.7.4 Replacement of gearbox, axis 6

Location of gearbox

The axis 6 gearbox is located in the center of the wrist unit as shown in the figure below.



xx0600003085

A	Gearbox, axis 6 (IRB 6620)
B	Attachment screws, gearbox
C	Oil plug, draining
D	Oil plug, filling
E	Turning disk
F	Attachment screws, turning disk

Required equipment

Equipment, etc.		Art. no.	Note
Gearbox		For spare part number, see Spare part lists on page 353 .	Includes o-ring.
O-ring		3HAB3772-58	Must be replaced when reassembling gearbox!
O-ring		3HAB3772-57	For type 2 of the gearbox. 164.7x3.53 Must be replaced when reassembling gearbox.
O-ring		3HAB3772-64	For type 2 of the gearbox. 150.0x2.0 Must be replaced when reassembling gearbox.
O-ring		3HAB3772-61	For type 2 of the gearbox. 12 pcs, 13.1x1.6 Must be replaced when reassembling gearbox.
Grease		3HAB3537-1	For lubricating the o-ring.
Flange sealant		12340011-116	Loctite 574

Continues on next page

4 Repair

4.7.4 Replacement of gearbox, axis 6

Continued

Equipment, etc.		Art. no.	Note
Standard toolkit		-	Content is defined in section Standard tools on page 350 .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
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.

Deciding calibration routine

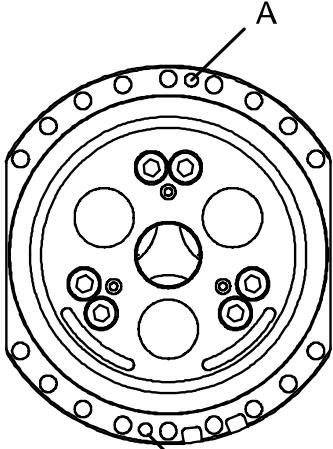
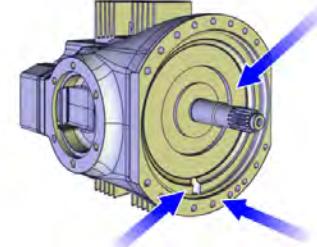
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 327 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removal, gearbox

The procedure below details how to remove gearbox, axis 6.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	Drain the oil from gearbox, axis 6.	Detailed in the section Changing oil, axis-6 gearbox on page 170 .
4	Remove the <i>turning disk</i> .	Detailed in the section Removing, turning disk on page 212 .
5	Remove the gearbox by unscrewing its 8 attachment screws.	Shown in the figure Location of gearbox on page 293 .
6	If required, apply M8 screws to the holes shown in the figure beside to press the gearbox out.	 xx0200000220 <ul style="list-style-type: none"> • A: M8 holes for pressing out the gearbox
	Foundry Plus: Remove old Loctite 574 flange sealant residues and other contamination from the contact surfaces.	 xx1400001123

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4 Repair

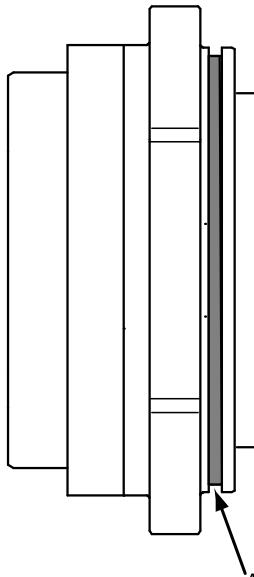
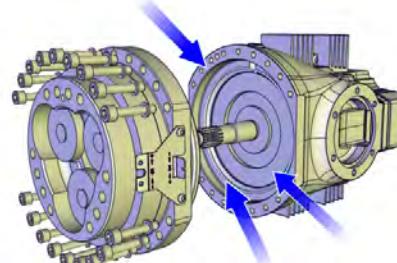
4.7.4 Replacement of gearbox, axis 6

Continued

Action	Note
7 Remove the gearbox axis 6 by lifting it out carefully.	Be careful not to damage the motor pinion!

Refitting, gearbox

The procedure below details how to refit gearbox, axis 6.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2 Make sure the <i>o-ring</i> is fitted to the rear of the gearbox. Lubricate the <i>o-ring</i> with <i>grease</i> .	Art. no. is specified in <i>Required equipment on page 293</i> .  xx0200000221 • A: O-ring, gearbox axis 6
3 Release the holding brake of motor axis 6.	Detailed in the section <i>Manually releasing the brakes on page 105</i> .
4 Foundry Plus: Apply Loctite 574 flange sealant on the contact surface.	 xx1400001122

Continues on next page

	Action	Note
5	Insert the <i>gearbox, axis 6</i> into the wrist unit.	Art. no. is specified in Required equipment on page 293 . Shown in the figure Location of gearbox on page 293 . Make sure the gears of the gearbox mate with the gears of the motor!
6	Secure the gearbox with the <i>attachment screws and washers</i> .	Shown in the figure Location of gearbox on page 293 . 8 pcs or 18 pcs (depending on wrist version): M8 x 40, 12.9 quality Gleitmo, Tightening torque: 30 Nm. Reused screws may be used, providing they are lubricated as detailed in section Screw joints on page 346 before fitting.
7	Refit the <i>turning disk</i> .	Detailed in the section Refitting, turning disk on page 213 .
8	Perform a <i>leak-down test</i> .	Detailed in the section Performing a leak-down test on page 190 .
9	Refill the gearbox with oil.	Detailed in the section Changing oil, axis-6 gearbox on page 170 .
10	Recalibrate the robot.	Pendulum Calibration is described in Operating manual - Calibration Pendulum , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 326 . General calibration information is included in section Calibration on page 305 .
11	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

4 Repair

4.8.1 Replacing the energy chain

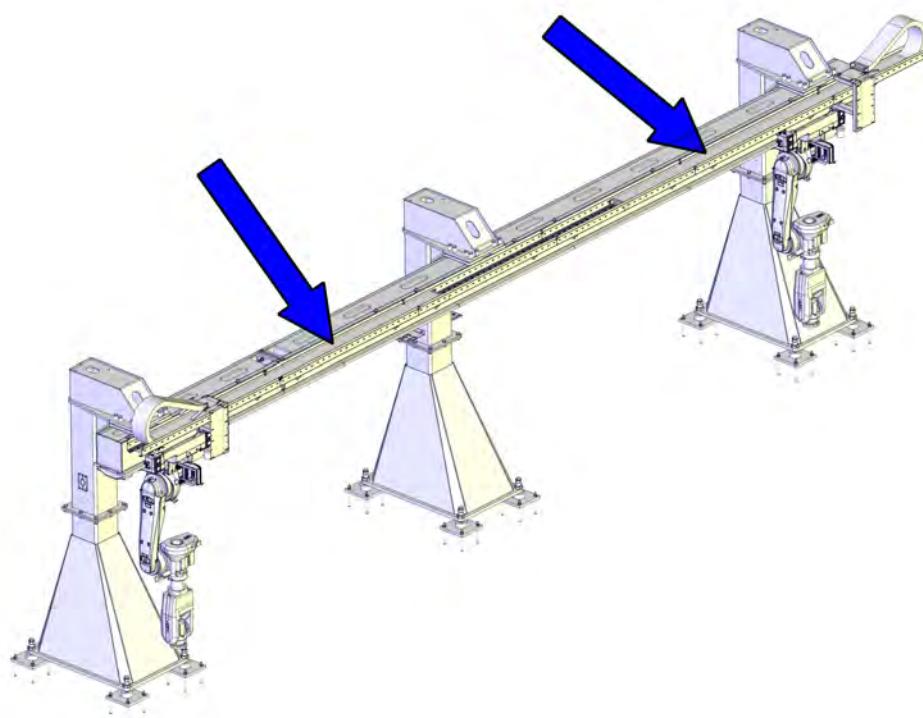
4.8 Energy chain

4.8.1 Replacing the energy chain

Location of energy chain

The energy chain is located in the guide trough.

The figure shows an installation with two robots and two energy chains.



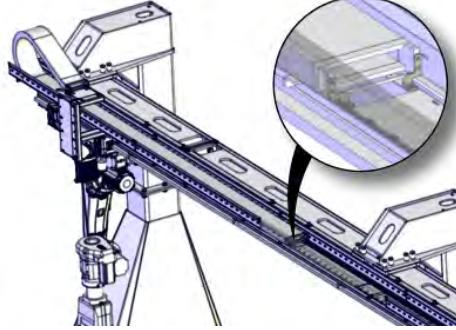
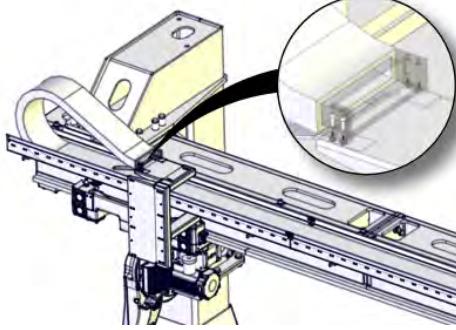
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Required equipment

Equipment	Article number	Note
Energy chain		
Lifting accessories	-	
Cable straps	-	
Standard toolkit	-	Content is defined in section Standard tools on page 350 .
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 energy chain

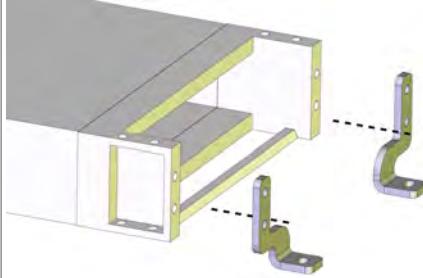
	Action	Note
1	 Tip Remove all cover plates before turning off all electric power. Without 24V DC the carriage can not be moved. If the cables to the release brakes are damaged, follow instructions in xx..	
2	 DANGER Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot and for the linear axis.	
3	Disconnect all cables from the robot base cable interface.	
4	Disconnect all cables from the linear axis motor.	
5	Cut all cable straps using standard tools.	
6	Loosen the fixed end of the energy chain.	Screws: 4 pcs.  xx1500000840
7	Loosen the drivers end of the energy chain.	Screws: 4 pcs.  xx1500000838

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4 Repair

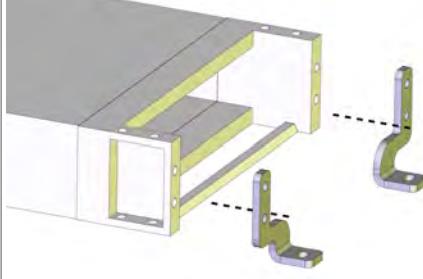
4.8.1 Replacing the energy chain

Continued

Action	Note
8 Attach lifting accessories to the energy chain. If it is not possible to slide out the cable chain beneath the moving end bracket, the bracket needs to be removed from the cable trough.	See Lifting and fitting the cable chain IGUS on page 116 .
9 Lift up the energy chain and remove it from the cable trough.	See Lifting and fitting the cable chain IGUS on page 116 .
10 Remove the mounting angle from the fixed end connection element.	 xx1500000841

Refitting the energy chain

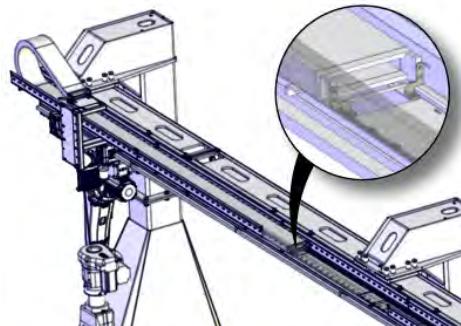
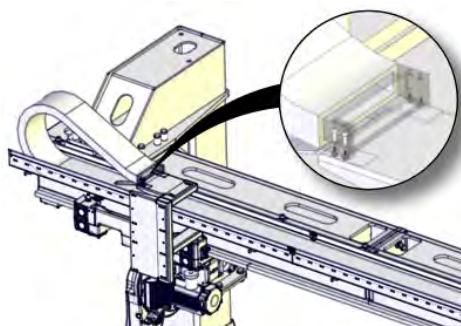
Also see additional installation information in documentation from IGUS: *Installation guide - Gliding applications (IGUS)*.

Action	Note
1 Clean the energy chain and look for wear on the energy chain. Wear on the energy chain can cause damage to the cables.	
2 Fit the mounting angle on the fixed end connection element using screws and nuts.	Screws and nuts: 4 pcs.  xx1500000841
3 Lift and place the energy chain in the cable trough.	See Lifting and fitting the cable chain IGUS on page 116 .

Continues on next page

4.8.1 Replacing the energy chain

Continued

Action	Note
4 Secure the fixed end of the energy chain with screws.	Screws: 2 pcs. Make sure to tighten the two screws in equal position in the elongated attachment holes.  xx1500000840
5 Secure the driver end of the energy chain with screws.	Screws: 4 pcs.  xx1500000838
6 Strap all the cables (A). The cables exiting the chain, on both the driver and fixed end, need to be strapped individually at least twice in order to strain relief correctly. If there are not enough holes available in the connection plates for individual strapping, the cables should be secured in such a way that they can not move.	
7 Connect all cables to the linear axis motor.	
8 Connect all cables to the robot base cable interface.	
9  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	
10 Perform a test run before powering up the linear axis to full speed and duty cycle.	See Test run on page 302 .

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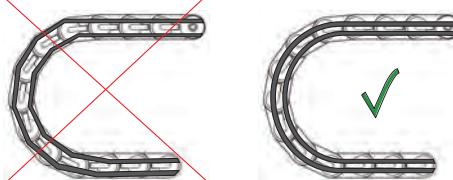
4 Repair

4.8.1 Replacing the energy chain

Continued

Test run

Use this procedure to check the installation of the cabling.

Action	Note
1 Run the system at low speed and insure that everything runs freely and smoothly without the carrier, cables and/or hoses binding.	
2 After 50 cycles, check that the cables and hoses are not installed too tight (stretched between carrier bars) or too loose (hanging on the carrier bars). Optimally, aim for the center line of the link of the carrier system, as shown in the figure.	 xx1200000518
3 Adjust the carrier position or alignment, if needed.	
4 Adjust the position and length of cables and/or hoses, if needed.	
5 If adjustments are made, repeat steps 1 to 4.	
6 Tighten all screws.	
7 The track is now ready to be powered up to full speed and duty cycle. Check the tightening torque on fastening screws after 500 cycles. Adjust, if needed. Periodically check to see if the cable strain relief is still in place.	

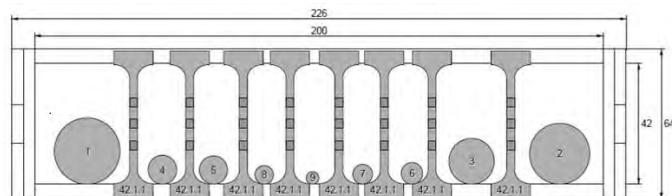
4.8.2 Replacing cables in the energy chain

Reference

Information about installing cables in the energy chain is found in *Installation guide - Gliding applications (IGUS)*.

Layout of cables inside the energy chain

Cable layout, material handling - with hydraulic hose



xx1500000843

1	Power 2
2	Power 1
3	Air
4	Signal SMB
5	Profinet Power
6	Earth Güdel
7	Earth Leoni
8	Profinet
9	Lubrication

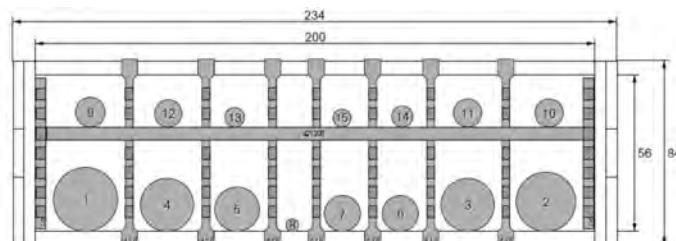
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4 Repair

4.8.2 Replacing cables in the energy chain

Continued

Cable layout, spot welding



xx1500000844

1	Power 1
2	Power 2
3	Water To
4	Water From
5	Air
6	Weld 2
7	Weld 3
8	Lubrication
9	Weld 1
10	KSR
11	Signal SMB
12	Profinet Power
13	Earth Leoni
14	Earth Güdel
15	Profinet

5 Calibration

5.1 Introduction to calibration

5.1.1 Introduction and calibration terminology

Calibration information

This chapter includes general information about the recommended calibration methods and also the detailed procedures for updating the revolution counters, checking the calibration position etc.

Detailed instructions of how to perform Axis Calibration are given on the FlexPendant during the calibration procedure. To prepare calibration with Axis Calibration method, see [Calibrating with Axis Calibration method on page 326](#).

Detailed instructions of how to perform Pendulum Calibration are given in the documentation enclosed with the calibration tools.

Calibration terminology

Term	Definition
Calibration method	A collective term for several methods that might be available for calibrating the ABB robot. Each method contains calibration routines.
Synchronization position	Known position of the complete robot where the angle of each axis can be checked against visual synchronization marks.
Calibration position	Known position of the complete robot that is used for calibration of the robot.
Standard calibration	A generic term for all calibration methods that aim to move the robot to calibration position.
Fine calibration	A calibration routine that generates a new zero position of the robot.
Reference calibration	A calibration routine that generates a new zero position of the robot. This routine is more flexible compared to fine calibration and is used when tools and process equipment are installed. Requires that a reference is created before being used for recalibrating the robot.
Update revolution counter	A calibration routine to make a rough calibration of each manipulator axis.
Synchronization mark	Visual marks on the robot axes. When marks are aligned, the robot is in synchronization position.

5 Calibration

5.1.2 Calibration methods

5.1.2 Calibration methods

Overview

This section specifies the different types of calibration and the calibration methods that are supplied by ABB.

Types of calibration

Type of calibration	Description	Calibration method
Standard calibration	The calibrated robot is positioned at calibration position. Standard calibration data is found on the SMB (serial measurement board) or EIB in the robot. For robots with RobotWare 5.04 or older, the calibration data is delivered in a file, calib.cfg, supplied with the robot at delivery. The file identifies the correct resolver/motor position corresponding to the robot home position.	Axis Calibration or Calibration Pendulum ⁱ Levelmeter calibration (alternative method)

- ⁱ The robot is calibrated by either Calibration Pendulum or Axis Calibration at factory. Always use the same calibration method as used at the factory.
Information about valid calibration method is found on the calibration label or in the calibration menu on the FlexPendant.
If no data is found related to standard calibration, Calibration Pendulum is used as default.

Brief description of calibration methods

Calibration Pendulum method

Calibration Pendulum is a standard calibration method for calibration of all ABB robots (except IRB 6400R, IRB 640, IRB 1400H, and IRB 4400S).

Two different routines are available for the Calibration Pendulum method:

- Calibration Pendulum II
- Reference calibration

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.

Axis Calibration method

Axis Calibration is a standard calibration method for calibration of IRB 6620LX and is the most accurate method for the standard calibration. It is the recommended method in order to achieve proper performance.

The following routines are available for the Axis Calibration method:

- Fine calibration
- Update revolution counters
- Reference calibration

The calibration equipment for Axis Calibration is delivered as a toolkit.

An introduction to the calibration method is given in this manual, see [Calibrating with Axis Calibration method on page 326](#).

Continues on next page

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

Levelmeter calibration - alternative method

Levelmeter calibration is referred to as the alternative method for calibration of ABB robots because of the less accurate values obtained during calibration. The method uses the same principles as Calibration Pendulum, but does not have as good of mechanical tolerances to the toolkit parts as the standard method with Calibration Pendulum.

This method may, after calibration, require modifications in the robot program and is therefore not recommended.

The calibration equipment (Levelmeter 2000) for levelmeter calibration is ordered as separate parts for each robot, and includes the *Operating manual - Levelmeter Calibration*, which describes the method and the different routines further.

References

Article numbers for the calibration tools are listed in the section [Special tools on page 351](#).

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.

5 Calibration

5.1.3 When to calibrate

5.1.3 When to calibrate

When to calibrate

The system must be calibrated if any of the following situations occur.

The resolver values are changed

If resolver values are changed, the robot must be recalibrated using the calibration methods supplied by ABB. Calibrate the robot carefully with standard calibration, according to information in this manual.

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 320](#). 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 reach ability of a robot is changed, it needs to be recalibrated for new resolver values.

Axis 1 calibration

Axis 1 calibration needs to be performed at installation of the robot (axes 2-6) on the linear axis (axis 1) when commissioning the complete robot system. See [Calibration and configuration of Joint Bound, axis 1 on page 311](#).

5.2 Synchronization marks and axis movement directions

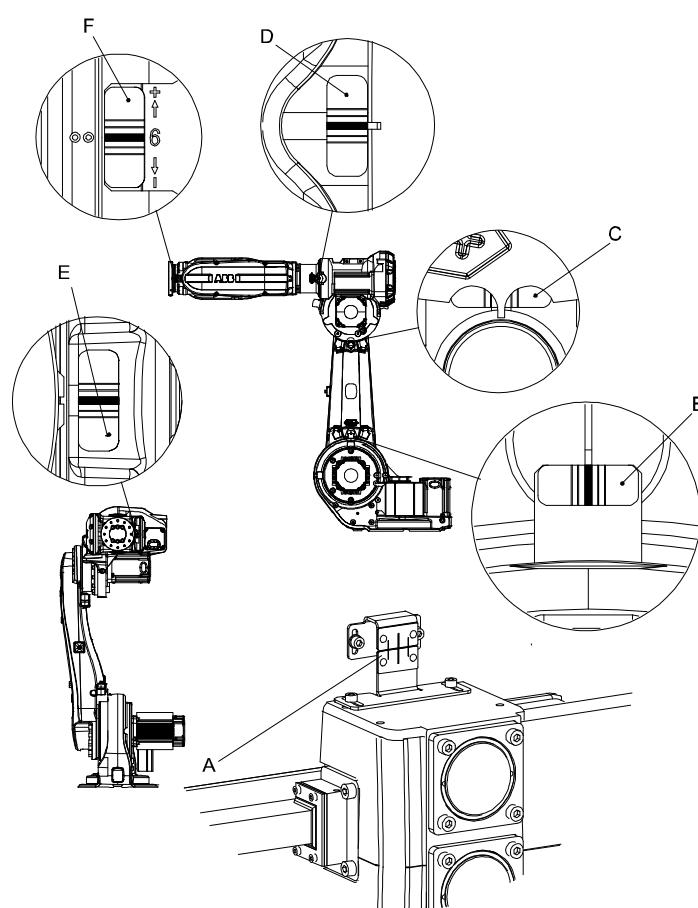
5.2.1 Synchronization marks and synchronization position for axes

Introduction

This section shows the position of the synchronization marks and the synchronization position for each axis.

Synchronization marks, IRB 6620LX

The illustration below shows the positions of the synchronization marks on all axes of the robot.



xx0900000223

A	Synchronization mark, axis 1 (optional location) ⁱ
B	Synchronization mark, axis 2
C	Synchronization mark, axis 3
D	Synchronization mark, axis 4
E	Synchronization mark, axis 5
F	Synchronization mark, axis 6

ⁱ The location of the synchronization mark for axis 1 is optional and can be placed at a suitable position for the installation.

5 Calibration

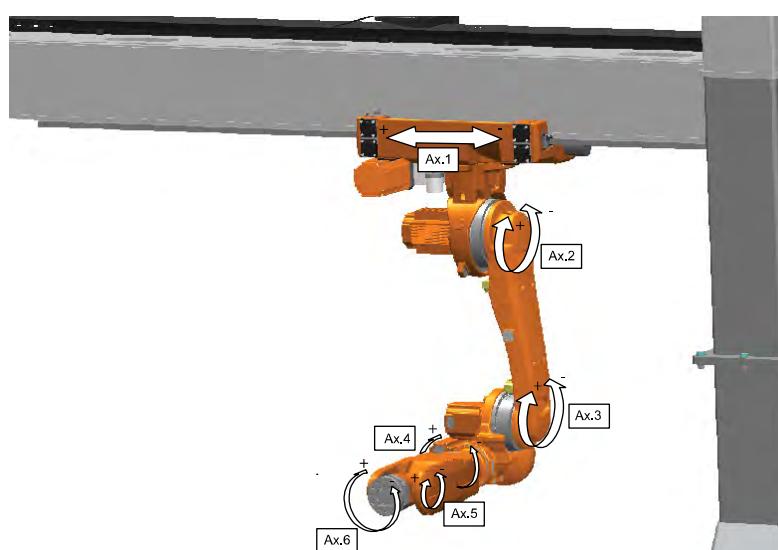
5.2.2 Calibration movement directions for all axes

Overview

When calibrating, the axis must consistently be run towards the calibration position in the same direction in order to avoid position errors caused by backlash in gears and so on. Positive directions are shown in the graphic below.

Calibration service routines will handle the calibration movements automatically and these might be different from the positive directions shown below.

Manual movement directions IRB6620 LX



xx0900000140

5.3 Calibration and configuration of Joint Bound, axis 1

General

This section describes how to fine calibrate axis 1 of IRB 6620LX.

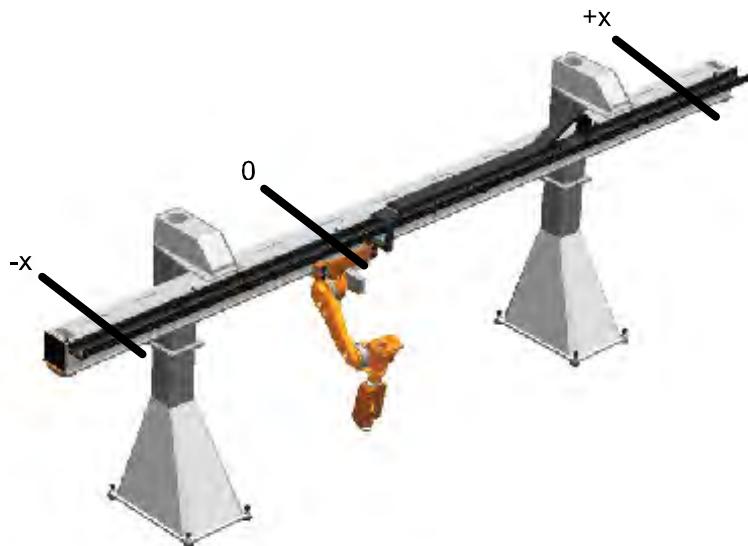
The calibration procedure differs depending on if the Axis Calibration method is available or not. This section describes both procedures.

Required equipment

Use the equipment specified if the Axis Calibration method is used for calibration of axis 1.

Equipment	Article number	Note
Drill gauge	-	From Güdel
Axis Calibration support block	-	From Güdel
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.

Travel directions for axis 1



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5 Calibration

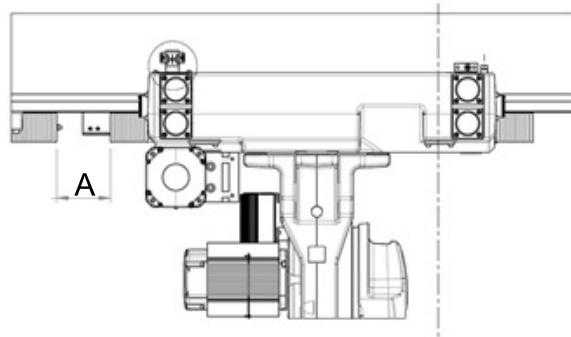
5.3 Calibration and configuration of Joint Bound, axis 1

Continued

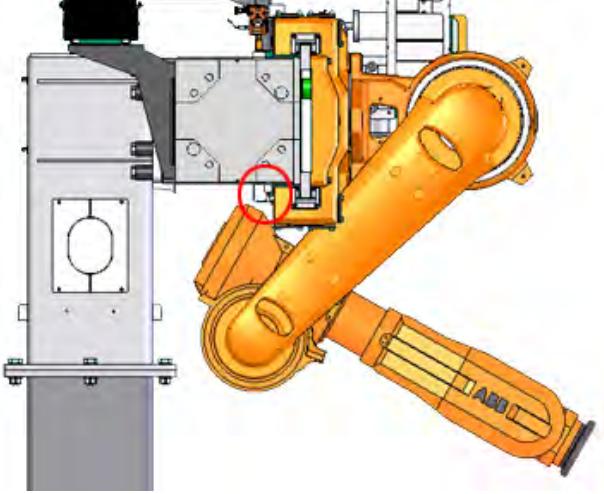
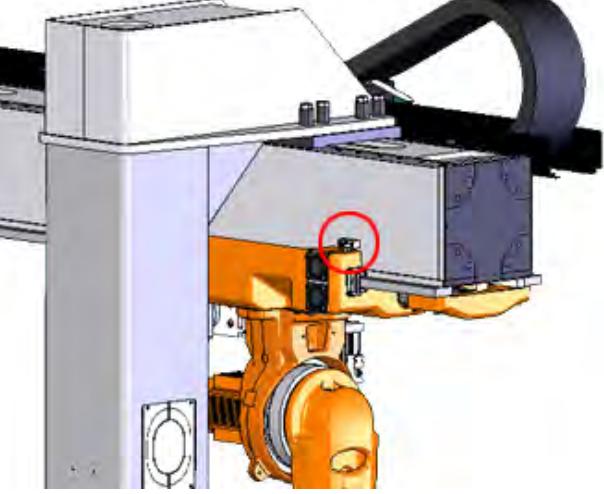
Calibrating axis 1 with Axis Calibration method

Installation of the Axis Calibration support block

If the Axis Calibration support block is not already installed on the beam, use this procedure to install it.

Action	Note
1 Manually run the robot axis 1 to an optional calibration position.	<p>The calibration position has to be close to an end point with minimum 100 mm clearance between the dampers of the carriage and the end stop.</p>  <p>xx1600001123</p> <p>A Minimum clearance 100 mm (also other end of beam)</p>

Continues on next page

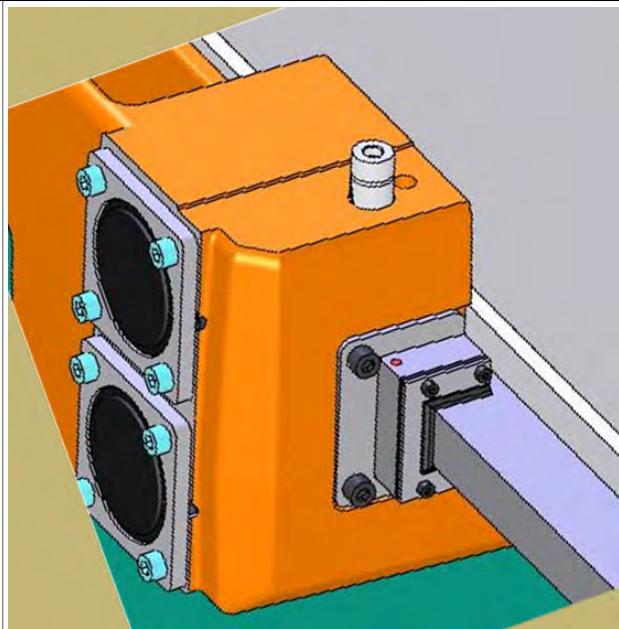
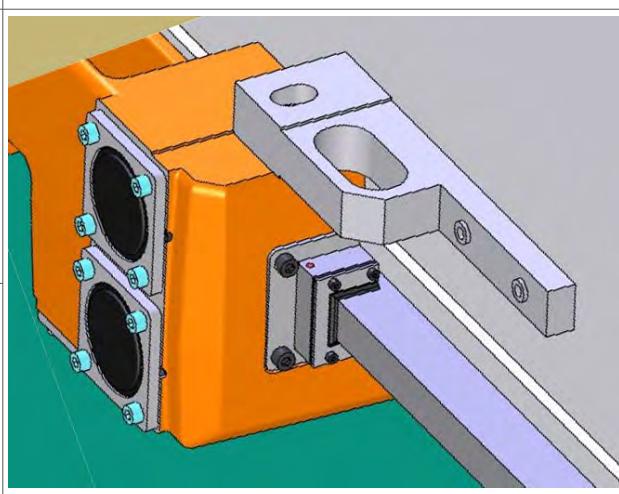
Action	Note
2 Locate the fixed calibration pin on the carriage.	Wall mounted:  xx1600001130 Suspended:  xx1600001131

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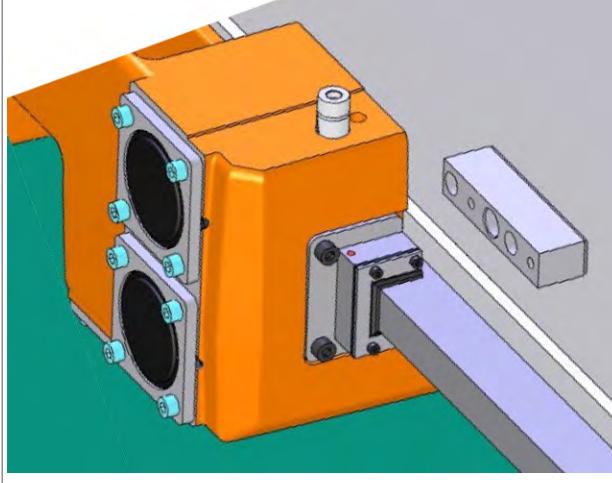
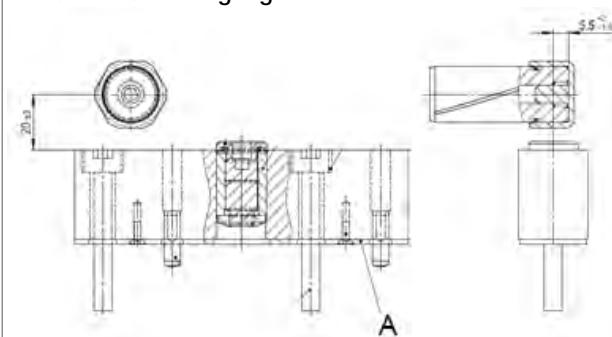
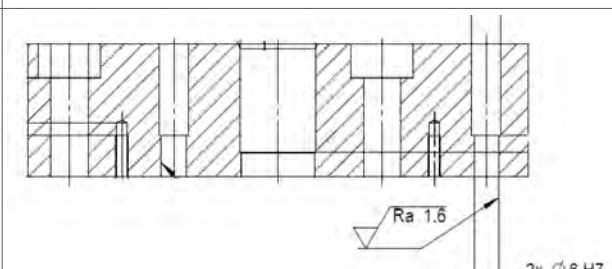
5 Calibration

5.3 Calibration and configuration of Joint Bound, axis 1

Continued

Action	Note
3 Move the carriage to contact with the end stop in order to make space for the drill gauge.	 xx1600001132
4 Place the drill gauge over the fixed calibration pin and against the surface of the beam. The drill gauge fixes itself with magnets. Place the gauge so that it points away from the end stop.	 xx1600001133
5 Drill the fastening threads for the Axis Calibration support block screws (2 x M8) by using the drilling gauge.	

Continues on next page

	Action	Note
6	Fit the Axis Calibration support block to the beam with screws. Orient it according to the figure. Do not tighten yet.	Screws: M8x50 8.8 (2 pcs).  xx1600001134
7	Adjust the height of the support block (measurement 20 mm) by adding or removing shims.	Measurement 20 +/- 2 mm is defined by the number of shims (A). Add or remove shims. There are two 2 mm shims supplied with the delivery.
8	Check the measurement 5.5 mm and adjust within the tolerance of the M8 screws. Tighten the M8 screws.	Measurement 5.5 +2/-1.5 mm is defined by the correct location of the drill gauge.  xx1600001136
9	Drill two holes for dowel pins (2 x Ø6 H7) using the Axis Calibration support block for guidance.	 xx1600001137
10	Insert the supplied dowel pins.	Dowel pins: 2 x Ø6 M6x20

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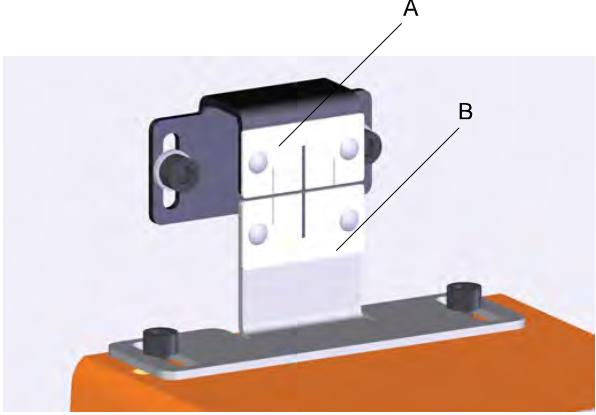
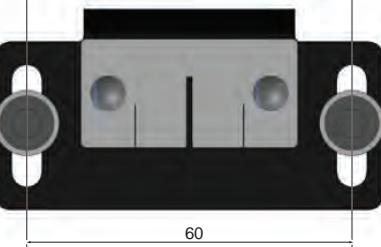
5 Calibration

5.3 Calibration and configuration of Joint Bound, axis 1

Continued

Calibrating axis 1

Use this procedure to calibrate axis 1 with the Axis Calibration method.

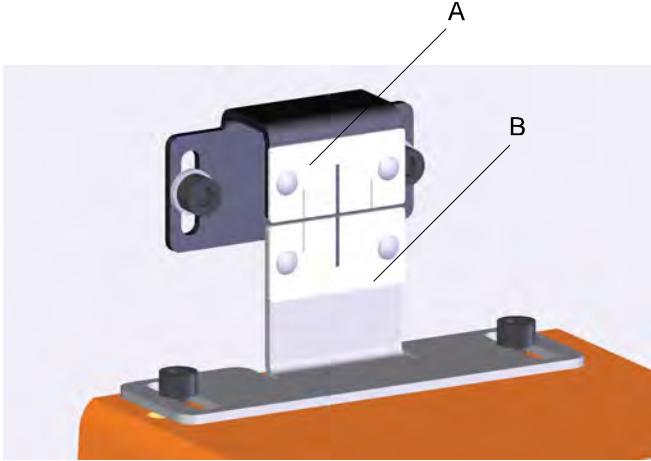
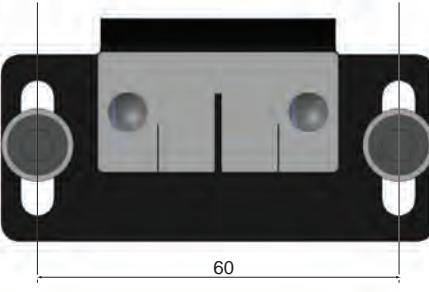
	Action	Note
1	Configure Gravity Beta for the robot.	See Setting the system parameters for a suspended or tilted robot on page 110 .
2	Put the carriage in position to align the fixed pin on the carriage with the bushing in the Axis Calibration support block. Manually update the revolution counters.	See Updating revolution counters on page 320 .
3	Run the fine calibration routine for Axis Calibration to calibrate axis 1.	See Axis Calibration - Running the calibration procedure on page 332 .
4	Fit the synchronization mark plate on the carriage (B).	
5	Find the position of the synchronization mark plate for the frame (A) by lining it up against the plate on the carriage.	 <p>xx0900000387</p> <p>A Synchronization mark plate on the frame, axis 1 B Synchronization mark plate on the carriage, axis 1</p>
6	Fit the synchronization mark plate to the frame, using a drill for M5 screw hole distance 60 mm.	 <p>xx0900000388</p>

Continues on next page

Calibrating axis 1 without Axis Calibration method

Calibrating axis 1

Use this procedure to calibrate axis 1 when the Axis Calibration method is not available. See [Calibration methods on page 306](#).

	Action	Note
1	Configure <i>Gravity Beta</i> for the robot.	See Setting the system parameters for a suspended or tilted robot on page 110 .
2	Manually run the robot axis 1 to an optional calibration position.	
3	Fit the synchronization mark plate on the carriage (B).	 xx0900000387
4	Find the position of the synchronization mark plate for the frame (A) by lining it up against the plate on the carriage.	 xx0900000388
5	Fit the synchronization mark plate to the frame, using a drill for M5 screw hole distance 60 mm.	
6	Calibrate robot axis 1 using the FlexPendant.	<p>See Fine calibration procedure on FlexPendant on page 318</p> <p> CAUTION</p> <p>This calibration method is only valid for axis 1. For all other axes the calibration methods described in section Calibration methods on page 306 must be used.</p>

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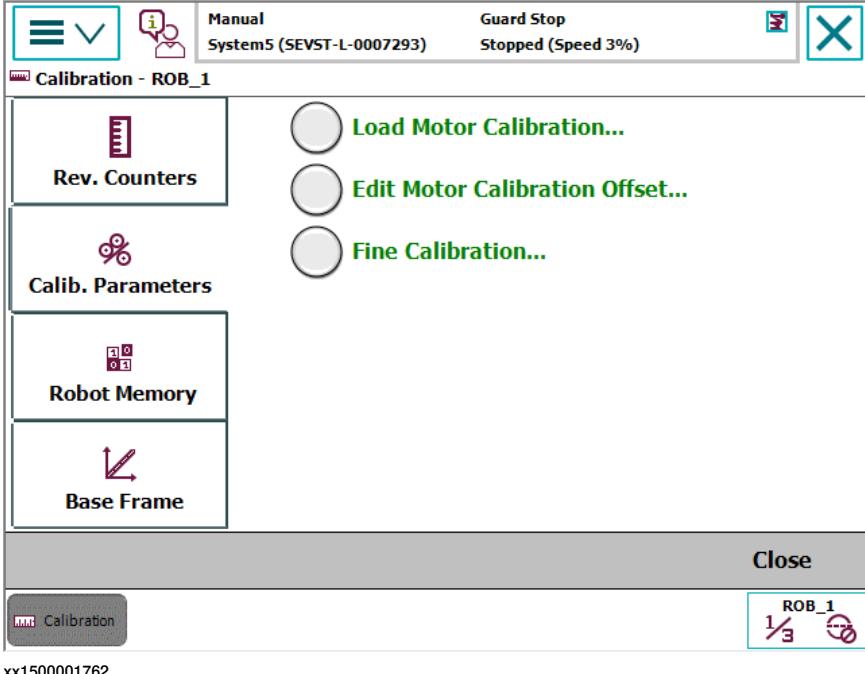
5 Calibration

5.3 Calibration and configuration of Joint Bound, axis 1

Continued

Fine calibration procedure on FlexPendant

Use this procedure to fine calibrate using the FlexPendant.

Action
<p>1  WARNING Do not fine calibrate the robot without special equipment used for axis calibration! It would cause an unsatisfactory accuracy in the robot movement.</p>
<p>2 On the ABB menu, tap Calibration. All mechanical units connected to the system are shown along with their calibration status.</p>
<p>3 Tap to select the mechanical unit and then tap Calib. Parameters.</p> 
<p>4 Tap Fine Calibration.... A dialog box is displayed, urging you to use external equipment to performing the actual calibration. Make sure all necessary calibration equipment is fitted, as detailed in the calibration instruction, for the axis to be calibrated. A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions:</p> <ul style="list-style-type: none">• Tap Yes to proceed.• Tap No to cancel.
<p>5 Select the check-box for the axis to calibrate.</p>
<p>6 Tap Calibrate. A dialog box is displayed, warning that calibration of the selected axes will be changed, which cannot be undone:</p> <ul style="list-style-type: none">• Tap Calibrate to proceed.• Tap Cancel to cancel. <p>Tapping Calibrate results in briefly displaying a dialog box, announcing that the calibration process has started.</p> <p>The axis is calibrated and the system returns to the list of available mechanical units.</p>

Continues on next page

Configuration of Joint Bound axis 1

Use this procedure to configure the *Joint Bound* system parameters on the FlexPendant.

Action	Note
1 Switch to manual mode.	
2 On the FlexPendant, tap the ABB menu and then tap Control Panel .	
3 Tap Configuration .	This opens the system parameters configuration editor.
4 Tap the menu Topics and then tap Motion .	
5 Select the type Arm and tap Show All .	
6 Select rob 1_1 and tap Edit .	
7 Both <i>Upper Joint Bound</i> and <i>Lower Joint Bound</i> are initially set to 0.	This results in impossible motion of axis 1.
8 Tap Upper Joint Bound twice to change the value.	Use a large value, for example 50 meters.
9 Tap Lower Joint Bound twice to change the value.	Use a large negative value, for example -50 meters.
10 Tap OK .	
11 Tap YES to restart the controller.	
12 When the controller is restarted, it is possible to jog the robot to a suitable position for configuration of <i>Upper Joint Bound</i> and <i>Lower Joint Bound</i> .	
13 Jog the robot to a suitable positive position.	
14 Read the position from the Jogging window.	
15 Open the system parameters configuration editor again from the Control Panel .	
16 Change <i>Upper Joint Bound</i> to the present position.	
17 Jog the robot to a suitable negative position.	
18 Read the position from the Jogging window.	
19 Change <i>Lower Joint Bound</i> to the present position.	
20 Close the configuration editor and restart the controller.	
21 The system is now ok.	

5 Calibration

5.4 Updating revolution counters

5.4 Updating revolution counters

Introduction

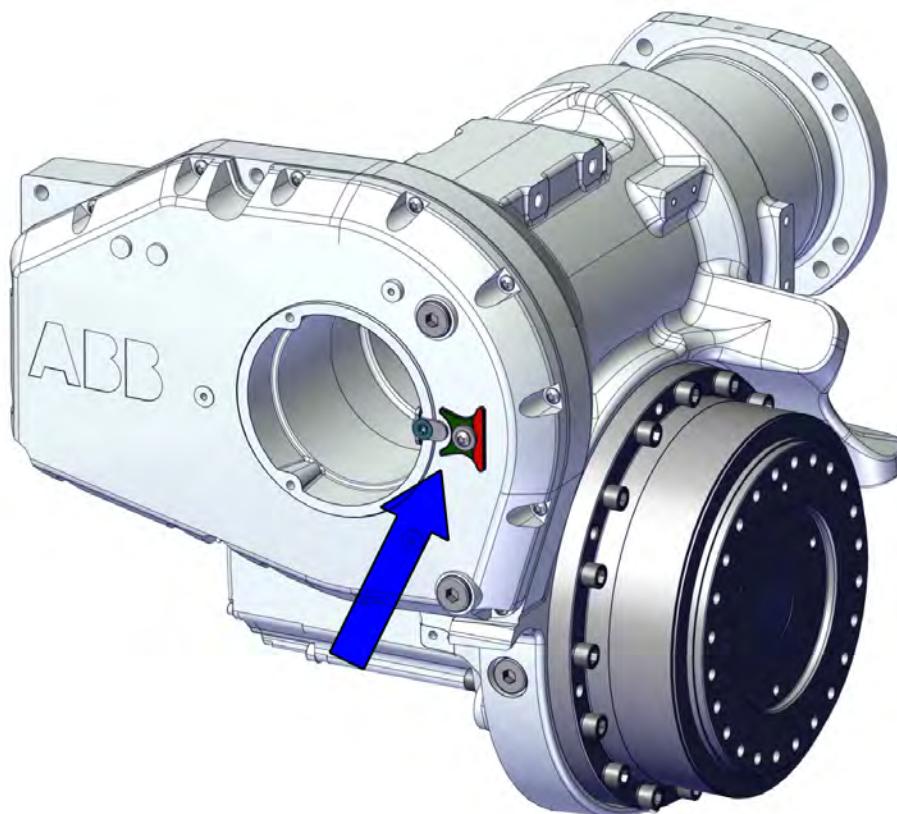
This section describes how to do a rough calibration of each manipulator axis by updating the revolution counter for each axis, using the FlexPendant.

Revolution indicator

The IRB 6620/IRB 6620 LX (not Foundry version) is equipped with a revolution indicator on axis 4.

Location

The revolution indicator is located as shown in figure.



xx1500002405

Function

Before doing an update of the revolution counter, the revolution indicator must be checked.

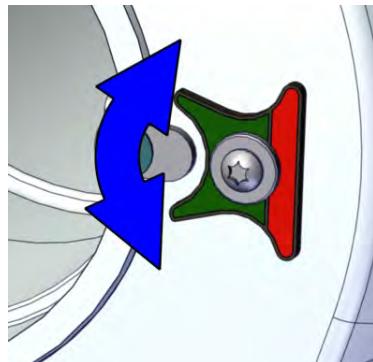
The green side of the indicator shall point towards axis centre.

The indicator shows if axis 4 is turned correctly or has been rotated more than $\pm 360^\circ$. If the indicator has been turned, the robot has to be jogged manually in the

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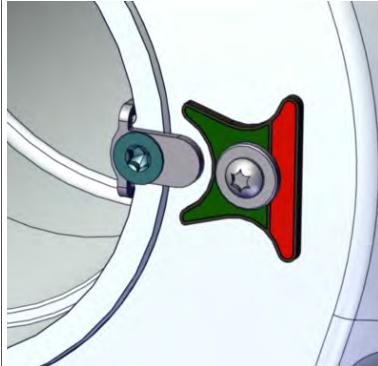
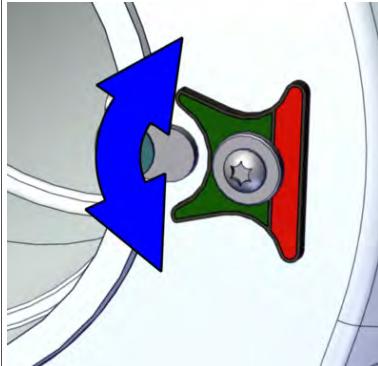
opposite direction to reach the correct position before aligning synchronization marks. If not there is a risk of twisting the cabling.

- When turning axis 4, the indicator will move accordingly, up or down.



xx1500002449

Check indicator before synchronization

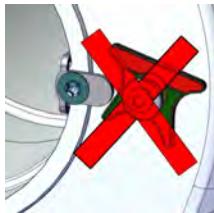
	Action	Note
1	Make sure that the green side of the indicator is turned towards the axis 4 center.	 xx1500002404
2	If not: Jog the robot manually in the opposite direction to reach the correct position.	 xx1500002449

Continues on next page

5 Calibration

5.4 Updating revolution counters

Continued

Action	Note
3 If the indicator moves towards red when jogging, switch to the opposite direction to reach green side.  CAUTION If axis 4 is turned too much, the red side of the indicator will turn towards axis 4 and the cabling may be damaged. Jog the robot in the opposite direction.  xx1500002450	
4 If the red side of the indicator points towards axis 4 centre, make a check that the motor cabling and motor connectors are not damaged. Replace if damaged.	

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 309 .
3 When all axes are positioned, update the revolution counter.	Step 2 - Updating the revolution counter with the FlexPendant on page 323 .

Correct calibration position of axis 4 and 6

When jogging the manipulator to synchronization position, it is extremely important to make sure that axes 4 and 6 of the following mentioned manipulators are positioned correctly. The axes can be calibrated at the wrong turn, resulting in an incorrect manipulator calibration.

Make sure the axes are positioned according to the correct calibration values, not only according to the synchronization marks. The correct values are found on a label, located either on the lower arm, underneath the flange plate on the base or on the frame.

At delivery the manipulator is in the correct position, do NOT rotate axis 4 or 6 at power up before the revolution counters are updated.

If one of the following mentioned axes are rotated one or more turns from its calibration position before updating the revolution counter, the correct calibration

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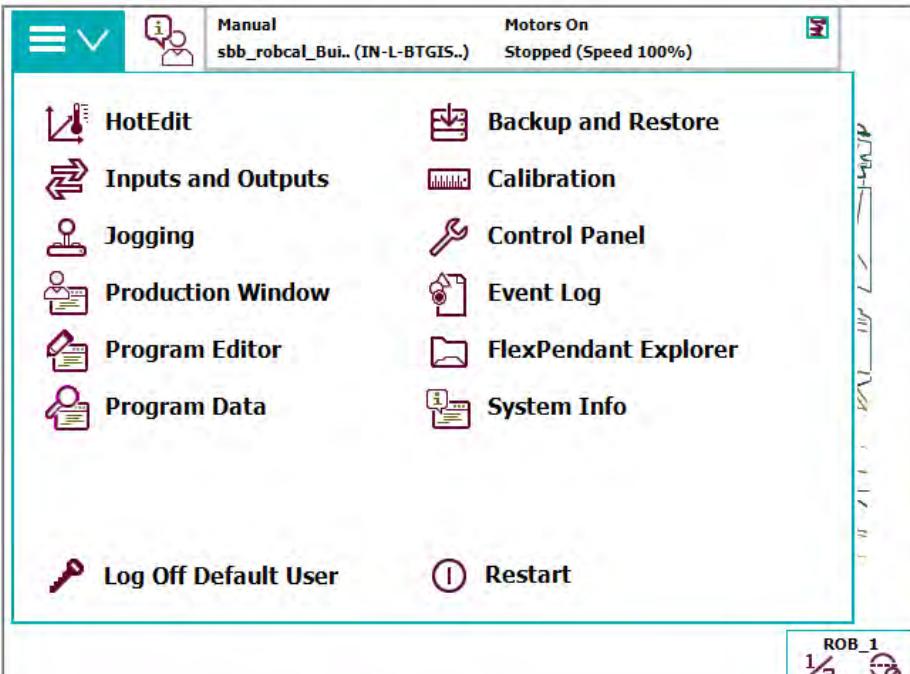
position will be lost due to non-integer gear ratio. This affects the following manipulators:

Manipulator variant	Axis 4	Axis 6
IRB 6620LX	Yes	No

If the synchronization marks seem to be wrong (even if the motor calibration data is correct), try to rotate the axis one turn, update the revolution counter and check the synchronization marks again (try both directions, if needed).

Step 2 - Updating the revolution counter with the FlexPendant

Use this procedure to update the revolution counter with the FlexPendant (IRC5).

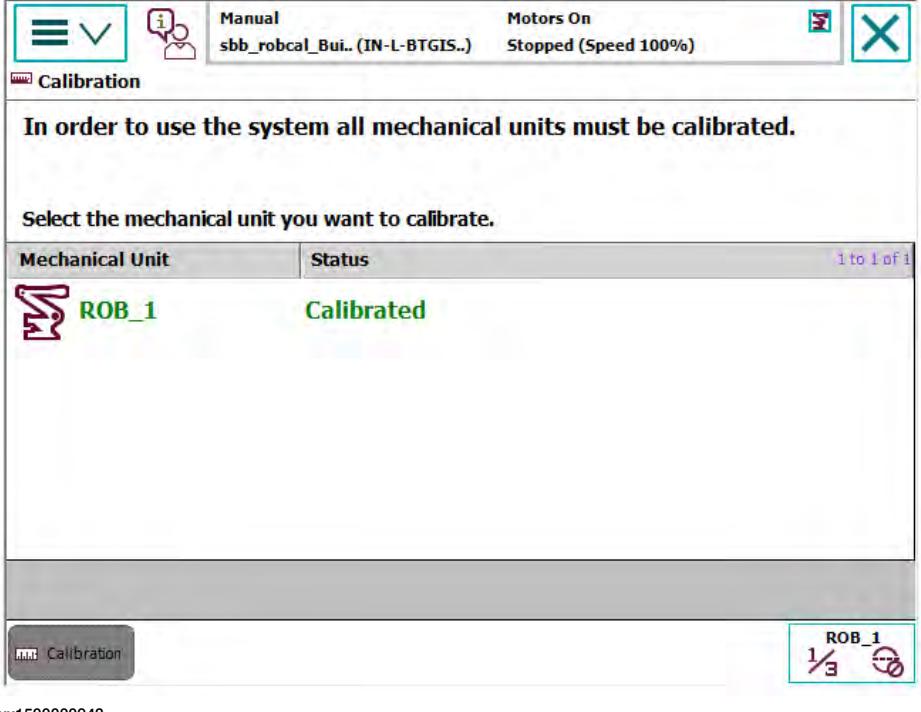
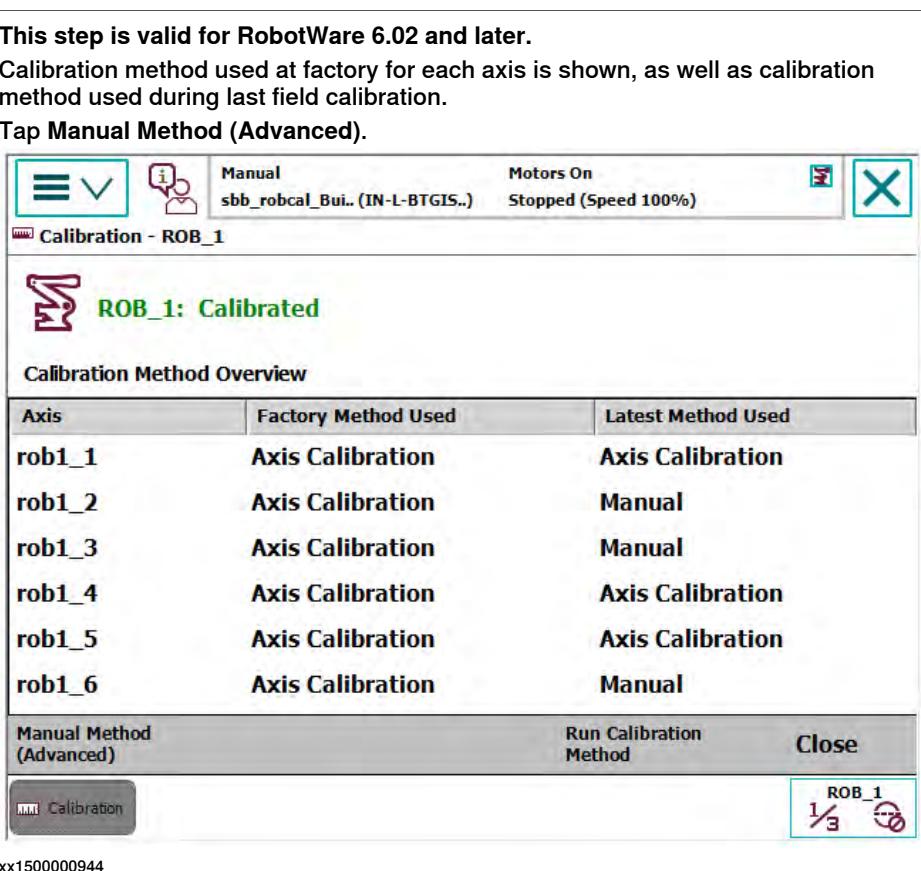
Action
1 On the ABB menu, tap Calibration. 

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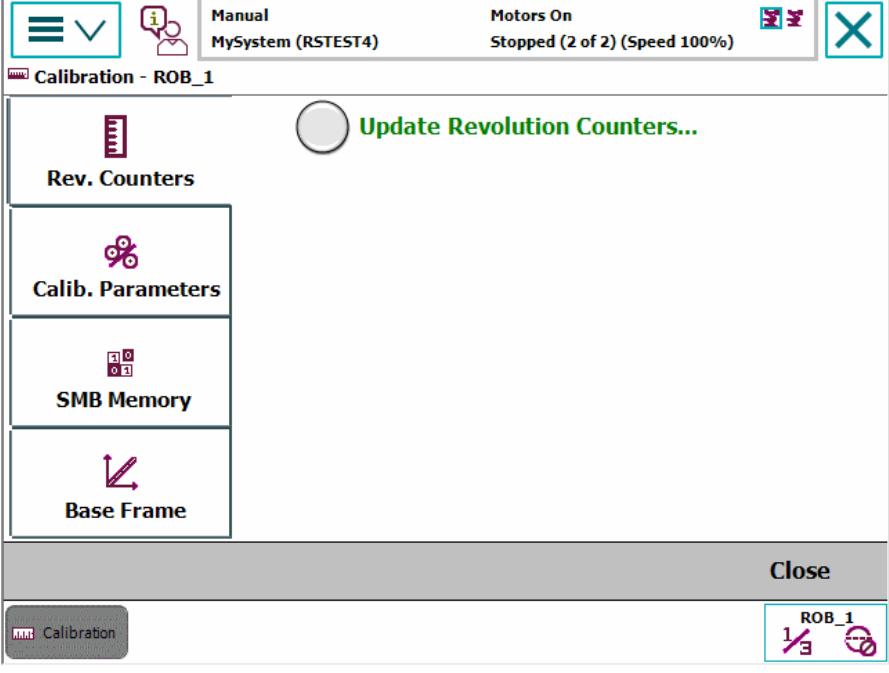
5 Calibration

5.4 Updating revolution counters

Continued

	Action
2	<p>All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.</p>  <p>The screenshot shows the 'Calibration' screen for a single mechanical unit, 'ROB_1'. The top bar displays 'Manual', 'sbb_robcal_Bui.. (IN-L-BTGIS..)', 'Motors On', and 'Stopped (Speed 100%)'. Below this is a message: 'In order to use the system all mechanical units must be calibrated.' A table lists the 'Mechanical Unit' as 'ROB_1' and its 'Status' as 'Calibrated'. At the bottom right is a progress indicator showing '1/3' and a circular icon with a checkmark.</p>
3	<p>This step is valid for RobotWare 6.02 and later. Calibration method used at factory for each axis is shown, as well as calibration method used during last field calibration. Tap Manual Method (Advanced).</p>  <p>The screenshot shows the 'Calibration - ROB_1' screen. It displays a 'Calibration Method Overview' table for six axes: rob1_1 through rob1_6. The table columns are 'Axis', 'Factory Method Used', and 'Latest Method Used'. All axes show 'Axis Calibration' as both the factory and latest method. At the bottom is a table with 'Manual Method (Advanced)' and 'Run Calibration Method' buttons, along with a 'Close' button. A progress indicator at the bottom right shows '1/3' and a circular icon with a checkmark.</p>

Continues on next page

Action
4 A screen is displayed, tap Rev. Counters. 
5 Tap Update Revolution Counters.... A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions: <ul style="list-style-type: none">• Tap Yes to update the revolution counters.• Tap No to cancel updating the revolution counters. Tapping Yes displays the axis selection window.
6 Select the axis to have its revolution counter updated by: <ul style="list-style-type: none">• Ticking in the box to the left• Tapping Select all to update all axes. Then tap Update.
7 A dialog box is displayed, warning that the updating operation cannot be undone: <ul style="list-style-type: none">• Tap Update to proceed with updating the revolution counters.• Tap Cancel to cancel updating the revolution counters. Tapping Update updates the selected revolution counters and removes the tick from the list of axes.
8  CAUTION If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury! Check the synchronization position very carefully after each update. See Checking the synchronization position on page 340 .

5 Calibration

5.5.1 Description of Axis Calibration

5.5 Calibrating with Axis Calibration method

5.5.1 Description of Axis Calibration

Instructions for Axis Calibration procedure given on the FlexPendant

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

This manual contains a brief description of the method, additional information to the information given on the FlexPendant, article number for the tools and images of where to fit the calibration tools on the robot.

Overview of the Axis Calibration procedure

The Axis Calibration procedure applies to all axes, and is performed on one axis at the time. The robot axes are both manually and automatically moved into position, as instructed on the FlexPendant.

A fixed calibration pin/bushing is installed on each robot axis at delivery.

The Axis Calibration procedure described roughly:

- A removable calibration tool is inserted by the operator into a calibration bushing on the axis chosen for calibration, according to instructions on the FlexPendant.



WARNING

Calibrating the robot with Axis Calibration requires special calibration tools from ABB. Using other pins in the calibration bushings may cause severe damage to the robot and/or personnel.



WARNING

The calibration tool must be fully inserted into the calibration bushing, until the steel spring ring snaps into place.

- During the calibration procedure, RobotWare moves the robot axis chosen for calibration so that the calibration tools get into contact. RobotWare records values of the axis position and repeats the coming-in-contact procedure several times to get an exact value of the axis position.



WARNING

Risk of pinching! The contact force for large robots can be up to 150 kg. Keep a safe distance to the robot.

- The axis position is stored in RobotWare with an active choice from the operator.

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Routines in the calibration procedure

The following routines are available in the Axis Calibration procedure, given at the beginning of the procedure on the FlexPendant.

Fine calibration routine

Choose this routine to calibrate the robot when there are no tools, process cabling or equipment fitted to the robot.

Reference calibration routine

Choose this routine to create reference values and to calibrate the robot when the robot is dressed with tools, process cabling or other equipment.

Also choose this routine if the robot is wall mounted or suspended.

If calibrating the robot with reference calibration there must be reference values created before repair is made to the robot, if values are not already available.

Creating new values requires possibility to move the robot. The reference values contain positions of all axes, torque of axes and technical data about the tool installed. The reference value is unique for the current setup of the robot and will be named according to tool name, date etc.

Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.

When reference calibration is performed, the robot is restored to the status given by the reference values.

Update revolution counters

Choose this routine to make a rough calibration of each manipulator axis by updating the revolution counter for each axis, using the FlexPendant.

Validation

In the mentioned routines, it is also possible to validate the calibration data.

Position of robot axes

The axis chosen for calibration is automatically run by the calibration program to its calibration position during the calibration procedure.

In order for the axis to be able to be moved to calibration position, or in order for getting proper access to the calibration bushing, other axes might need to be jogged to positions different from 0 degrees. Information about which axes are allowed to be jogged will be given on the FlexPendant. These axes are marked with **Unrestricted** in the FlexPendant window.

How to calibrate a suspended or wall mounted robot

The IRB 6620LX is calibrated floor standing in factory, prior to shipping.

To calibrate a suspended or wall mounted robot, reference calibration must be used. Reference values for a suspended or a wall mounted robot must be created with the robot mounted at its working position, not standing on a floor.

To calibrate a suspended or wall mounted robot with the fine calibration routine, the robot must first be taken down and mounted standing on the floor.

5 Calibration

5.5.2 Calibration tools for Axis Calibration

5.5.2 Calibration tools for Axis Calibration

Calibration tool set

The calibration tools used for Axis Calibration are designed to meet requirements for calibration performance, durability and safety in case of accidental damage.



WARNING

Calibrating the robot with Axis Calibration requires special calibration tools from ABB. Using other pins in the calibration bushings may cause severe damage to the robot and/or personnel.

Equipment, etc.	Article number	Note
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.

Examining the calibration tool

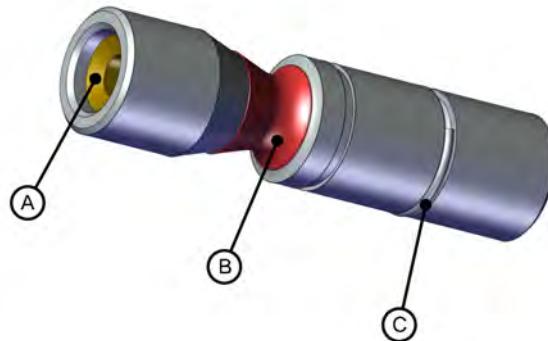
Check prior to usage

Before using the calibration tool, make sure that the tube insert, the plastic protection and the steel spring ring are present.



WARNING

If any part is missing or damaged, the tool must be replaced immediately.



xx1500001914

A	Tube insert
B	Plastic protection
C	Steel spring ring

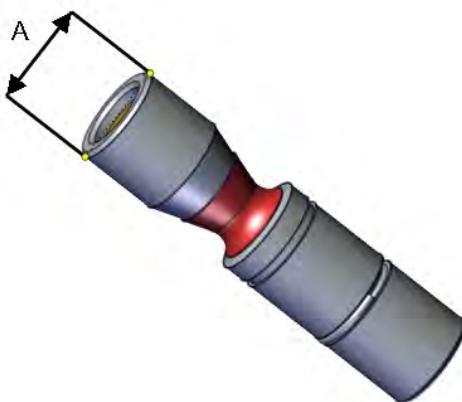
Periodic check of the calibration tool

If including the calibration tool in a local periodic check system, the following measures should be checked.

- Outer diameter within Ø12g4 mm, Ø8g4 mm or Ø6g5 mm (depending on calibration tool size).

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- Straightness within 0.005 mm.



xx1500000951

A	Outer diameter
---	----------------

Identifying the calibrating tools

It is possible to make the calibration tool identifiable with, for example, an RFID chip. The procedure of how to install an RFID chip is described below.



Note

The tool identifier is NOT delivered from ABB, it is a customized solution.

	Action	Note
1	<p>It is possible to use any RFID solution, with the correct dimensions. ABB has verified function on some suppliers fulfilling the requirements of NFC compatible devices (13.56 Mhz) according to ISO 14443 or ISO 15693.</p> <p> Note</p> <p>The maximum dimensions on the RFID chip must not exceed Ø7.9 mm x 8.0 mm, Ø5.9 mm x 8.0 mm or Ø3.9 mm x 8.0 mm (depending on calibration tool size).</p>	
2	<p>There is a cavity on one end of the calibration tool in which the RFID chip can be installed.</p> <p>Install the RFID chip according to supplier instructions.</p> <p>Install the chip in flush with the tool end.</p>	

5 Calibration

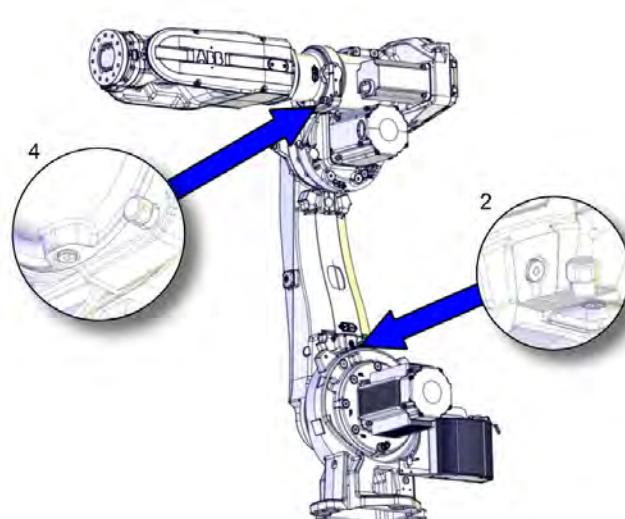
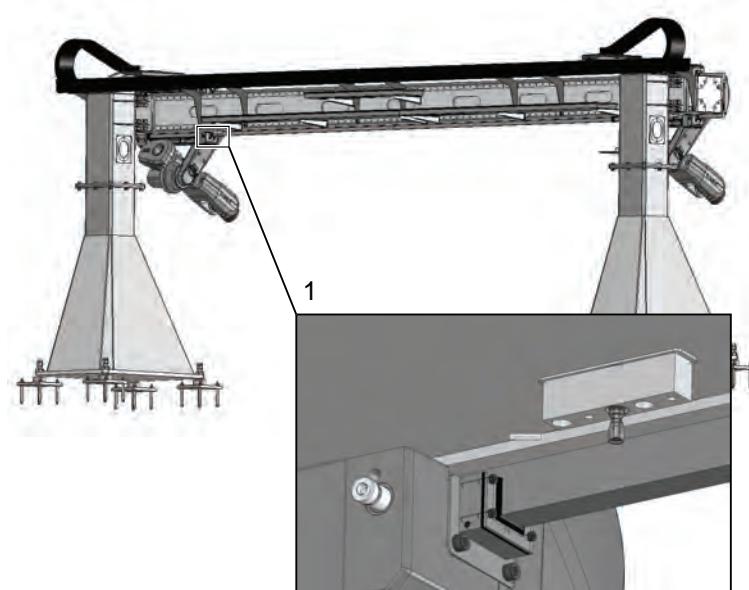
5.5.3 Installation locations for the calibration tools

5.5.3 Installation locations for the calibration tools

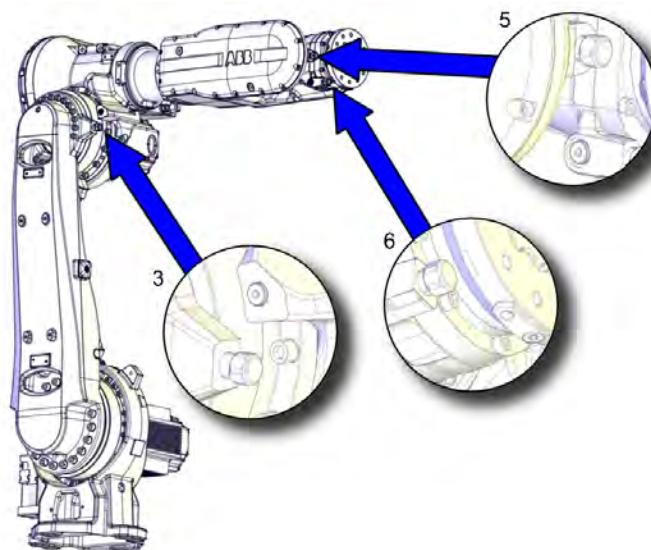
Location of fixed calibration items

The figure shows how the robot is equipped with items for installation of calibration tools for Axis Calibration (fixed calibration pins and/or bushings). The figure does not show installed calibration tools.

A fixed calibration pin and a bushing for the movable calibration tool are located on each axis as follows.



Continues on next page



xx1600000003

Spare parts

When calibration is not being performed, a protective cover and an o-ring should always be installed on the fixed calibration pin as well as a protective plug, included a sealing, in the bushing. Replace damaged parts with new, if needed.

Spare part	Article number	Note
Protection cover and plug set	3HAC056806-001	Contains replacement calibration pin covers and protective plugs for the bushing.

5 Calibration

5.5.4 Axis Calibration - Running the calibration procedure

5.5.4 Axis Calibration - Running the calibration procedure

Required tools

The calibration tools used for Axis Calibration are designed to meet requirements for calibration performance, durability and safety in case of accidental damage.



WARNING

Calibrating the robot with Axis Calibration requires special calibration tools from ABB. Using other pins in the calibration holes may cause severe damage to the robot and/or personnel.

Equipment, etc.	Article number	Note
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.

Required consumables

Consumable	Article number	Note
Clean cloth	-	

Spare parts

Spare part	Article number	Note
Protection cover and plug set	3HAC056806-001	Contains replacement calibration pin covers and protective plugs for the bushing.

Overview of the calibration procedure on the FlexPendant

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

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

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

- 1 Choose calibration routine. The routines are described in [Routines in the calibration procedure on page 327](#).
- 2 Choose which axis/axes to calibrate.
- 3 The robot moves to synchronization position.
- 4 Validate the synchronization marks.
- 5 The robot moves to preparation position.
- 6 Remove the protective cover from the fixed pin and the protection plug from the bushing, if any, and install the calibration tool.

Continues on next page

5.5.4 Axis Calibration - Running the calibration procedure

Continued

- 7 The robot performs a measurement sequence by rotating the axis back and forth.
- 8 Remove the calibration tool and reinstall the protective cover on the fixed pin and the protection plug in the bushing, if any.
- 9 The robot moves to verify that the calibration tool is removed.
- 10 Choose whether to save the calibration data or not.

Calibration of the robot is not finished until the calibration data is saved, as last step of the calibration procedure.

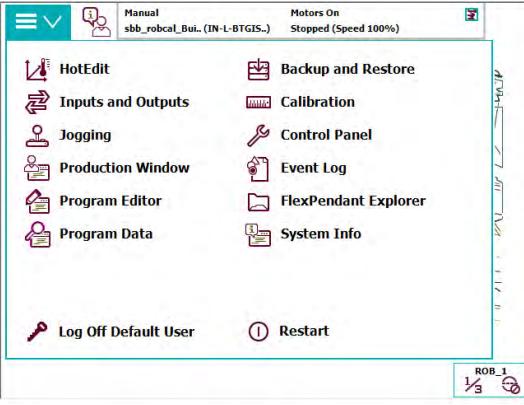
Preparation prior to calibration

The calibration procedure is described in the FlexPendant while conducting it.

Action	Note
1  DANGER While conducting the calibration, the robot needs to be connected to power. Make sure that the robots working area is empty, as the robot can make unpredictable movements.	
2  Note The calibration method is exact. Dust, dirt or color flakes will affect the calibration value.	Use a clean cloth.

Starting the calibration procedure

Use this procedure to call for the Axis Calibration method on the FlexPendant.

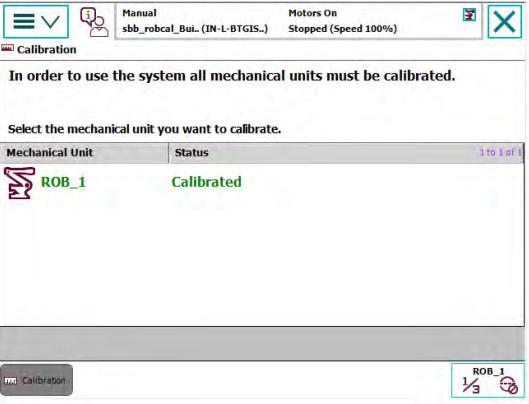
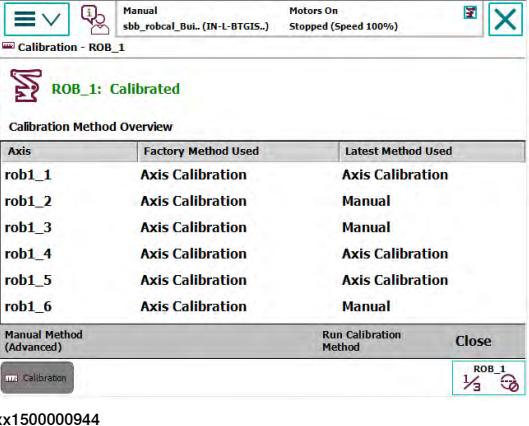
Action	Note
1 On the ABB menu, tap Calibration. 	

Continues on next page

5 Calibration

5.5.4 Axis Calibration - Running the calibration procedure

Continued

Action	Note
<p>2 All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.</p> 	
<p>3 Calibration method used at factory for each axis is shown, as well as calibration method used for the robot during last field calibration. Tap Run Calibration Method. The software will automatically call for the procedure for the valid calibration method.</p> 	The FlexPendant will give all information needed to proceed with Axis Calibration.
<p>4 Follow the instructions given on the FlexPendant.</p>	A brief overview of the sequence that will be run on the FlexPendant is given in Overview of the calibration procedure on the FlexPendant on page 332 .

Restarting an interrupted calibration procedure

If the Axis Calibration procedure is interrupted before the calibration is finished, the RobotWare program needs to be started again. Use this procedure to take required action.

Situation	Action
The three-position enabling device on the FlexPendant has been released during robot movement.	Press and hold the three-position enabling device and press Play.

Continues on next page

Situation	Action
The RobotWare program is terminated with PP to Main.	<p>Remove the calibration tool, if it is installed, and restart the calibration procedure from the beginning. See Starting the calibration procedure on page 333.</p> <p>If the calibration tool is in contact the robot axis needs to be jogged in order to release the calibration tool. Jogging the axis in wrong direction will cause the calibration tool to break. Directions of axis movement is shown in Calibration movement directions for all axes on page 310</p>

Axis Calibration with SafeMove option

To be able to run Axis Calibration SafeMove needs to be unsynchronized. The Axis Calibration routine recognizes if the robot is equipped with SafeMove and will force SafeMove to unsynchronize automatically.

However, SafeMove may generate other warning messages anytime during the Axis Calibration routine.

Safety controller not synchronized - SafeMove message

	Action	Note
1	<p>SafeMove generates the message "Safety controller not synchronized".</p>  <p>The screenshot shows the 'Event Log - Event Message' window. It displays a single event message: 'Event Message 20451' at '2015-11-04 08:27:49'. The message is titled 'SC 1 Not synchronized' and includes a description: 'Safety Controller (SC) 1 is not synchronized with supervised Mechanical units.' There are 'Show Log' and 'Acknowledge' buttons at the bottom. The 'Acknowledge' button is highlighted with a green border.</p>	
2	Confirm unsynchronized state by pressing Acknowledge to continue Axis Calibration procedure.	
3	Restart Axis Calibration procedure by pressing Play.	

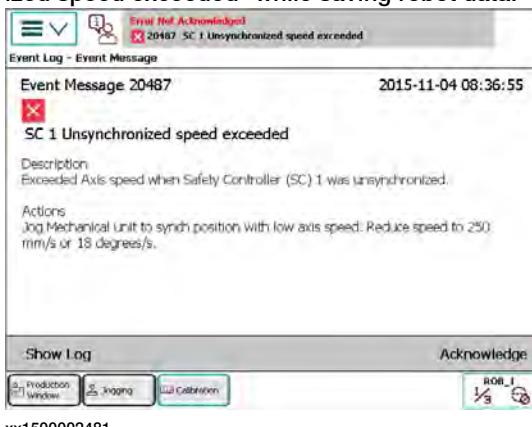
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5 Calibration

5.5.4 Axis Calibration - Running the calibration procedure

Continued

Unsynchronized speed exceeded - SafeMove message while saving robot data

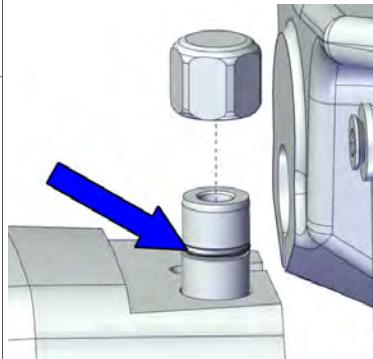
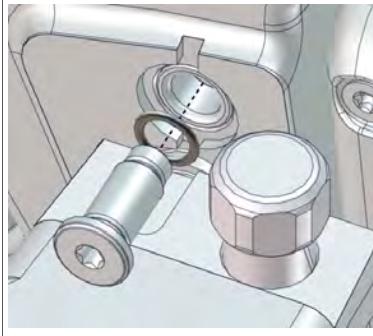
Action	Note
<p>1 SafeMove generates the message "Unsynchronized speed exceeded" while saving robot data.</p>  <p>The screenshot shows the 'Event Log - Event Message' window. It displays an event message for 'SC 1 Unsynchronized speed exceeded' with the timestamp '2015-11-04 08:36:55'. The message details that the exceeded axis speed was when Safety Controller (SC) 1 was unsynchronized. Actions listed include jogging the mechanical unit at low axis speed and reducing speed to 250 mm/s or 18 degrees/s. Buttons for 'Show Log' and 'Acknowledge' are visible, along with tabs for 'Production Window', 'Jogging', and 'Axis Calibration'. The status bar shows 'xx1500002481'.</p>	
<p>2 Press Acknowledge to continue Axis Calibration procedure.</p>	
<p>3 Restart Axis Calibration procedure by pressing Play.</p>	

Unsynchronized time limit expired - SafeMove message anytime during Axis Calibration routine

Action	Note
<p>1 SafeMove generates the message "Unsynchronized time limit expired" (anytime).</p>  <p>The screenshot shows the 'Event Log - Event Message' window. It displays an event message for 'SC 1 Unsynchronized time limit expired' with the timestamp '2015-11-03 16:45:03'. The message details that available time to move the robot when unsynchronized has expired for Safety Controller (SC) 1. Actions listed include confirming a stop and synchronizing SC 1. Buttons for 'Next', 'Previous', and 'OK' are visible, along with tabs for 'Production Window', 'Axis Calibration', 'JOG', and 'SafeMove Visualizer'. The status bar shows 'xx1500002482'.</p>	
<p>2 Press OK to continue Axis Calibration procedure.</p>	
<p>3 Restart Axis Calibration procedure by pressing Play.</p>	

Continues on next page

After calibration

	Action	Note
1	Check the o-ring on the fixed calibration pin. Replace if damaged or missing.	 xx1600002102 Protection cover and plug set: 3HAC056806-001.
2	Reinstall the protective cover on the fixed calibration pin on each axis, directly after the axis has been calibrated. Replace the cover with new spare part, if missing or damaged.	 xx1500000952 Protection cover and plug set: 3HAC056806-001.
3	Reinstall the protective plug and sealing in the bushing on each axis, directly after the axis has been calibrated. Ensure that the sealing is not damaged. Replace the plug and the sealing with new spare part, if missing or damaged.	

5 Calibration

5.6 Calibrating with Calibration Pendulum method

5.6 Calibrating with Calibration Pendulum method

Where to find information for Calibration Pendulum

Detailed instructions of how to perform Pendulum Calibration are given in the documentation enclosed with the calibration tools.

5.7 Verifying the calibration

Introduction

Always verify the results after calibrating *any* robot axis to verify that all calibration positions are correct.

Verifying the calibration

Use this procedure to verify the calibration result.

Action	Note
1 Run the calibration home position program twice. Do not change the position of the robot axes after running the program!	See Checking the synchronization position on page 340 .
2 Adjust the <i>synchronization marks</i> when the calibration is done, if necessary.	This is detailed in section Synchronization marks and synchronization position for axes on page 309 .
3 Write down the values on a new label and stick it on top of the calibration label. The label is located on the lower arm.	
4 Remove any calibration equipment from the robot.	

5 Calibration

5.8 Checking the synchronization position

5.8 Checking the synchronization position

Introduction

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

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

Using 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: <pre>MoveAbsJ [[0,0,0,0,0,0], [9E9,9E9,9E9,9E9,9E9,9E9]] \NoEOffs, v1000, fine, tool0</pre>	
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 309 and Updating revolution counters on page 320 .

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 309 and Updating revolution counters on page 320 .

6 Decommissioning

6.1 Environmental information

Hazardous material

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

Dispose components properly to prevent health or environmental hazards.

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

Oil and grease

Where possible, arrange for oil and grease to be recycled. Dispose of via an authorized person/contractor in accordance with local regulations. Do not dispose of oil and grease near lakes, ponds, ditches, down drains, or onto soil. Incineration must be carried out under controlled conditions in accordance with local regulations.

Also note that:

- Spills can form a film on water surfaces causing damage to organisms. Oxygen transfer could also be impaired.
- Spillage can penetrate the soil causing ground water contamination.

6 Decommissioning

6.2 Scrapping of robot

6.2 Scrapping of robot

Important when scrapping the robot



DANGER

When a robot is disassembled while being scrapped, it is very important to remember the following before disassembling starts, in order to prevent injuries:

- Always remove all batteries from the robot. 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.

7 Reference information

7.1 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.

Standards, EN ISO

The product is designed in accordance with the requirements of:

Standard	Description
EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN ISO 13849-1	Safety of machinery, safety related parts of control systems - Part 1: General principles for design
EN ISO 13850	Safety of machinery - Emergency stop - Principles for design
EN ISO 10218-1	Robots for industrial environments - Safety requirements -Part 1 Robot
EN ISO 9787	Robots and robotic devices -- Coordinate systems and motion nomenclatures
EN ISO 9283	Manipulating industrial robots, performance criteria, and related test methods
EN ISO 14644-1 ⁱ	Classification of air cleanliness
EN ISO 13732-1	Ergonomics of the thermal environment - Part 1
EN IEC 61000-6-4 (option 129-1)	EMC, Generic emission
EN IEC 61000-6-2	EMC, Generic immunity
EN IEC 60974-1 ⁱⁱ	Arc welding equipment - Part 1: Welding power sources
EN IEC 60974-10 ⁱⁱ	Arc welding equipment - Part 10: EMC requirements
EN IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1 General requirements
IEC 60529	Degrees of protection provided by enclosures (IP code)

ⁱ Only robots with protection Clean Room.

ⁱⁱ Only valid for arc welding robots. Replaces EN IEC 61000-6-4 for arc welding robots.

European standards

Standard	Description
EN 614-1	Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles
EN 574	Safety of machinery - Two-hand control devices - Functional aspects - Principles for design

Continues on next page

7 Reference information

7.1 Applicable standards

Continued

Other standards

Standard	Description
ANSI/RIA R15.06	Safety requirements for industrial robots and robot systems
ANSI/UL 1740	Safety standard for robots and robotic equipment
CAN/CSA Z 434-14	Industrial robots and robot Systems - General safety requirements

7.2 Unit conversion

Converter table

Use the following table to convert units used in this manual.

Quantity	Units		
Length	1 m	3.28 ft.	39.37 in
Weight	1 kg	2.21 lb.	
Weight	1 g	0.035 ounces	
Pressure	1 bar	100 kPa	14.5 psi
Force	1 N	0.225 lbf	
Moment	1 Nm	0.738 lbf-ft	
Volume	1 L	0.264 US gal	

7 Reference information

7.3 Screw joints

7.3 Screw joints

General

This section describes how to tighten the various types of screw joints on the IRB 6620LX.

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. 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.

Screws lubricated in other ways

Screws lubricated with Molycote 1000 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.

Lubricant	Article number
Molycote 1000 (molybdenum disulphide grease)	11712016-618

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.

Continues on next page

- 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%!

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*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Oil-lubricated screws with allen head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws with allen head screws*. Any 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
M24	680	960	1150

Lubricated screws (Molycote, 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*. Any 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
M8	28	35
M10	55	70
M12	96	120
M16	235	280
M20	460	550
M24	790	950

ⁱ Lubricated with Molycote 1000, Gleitmo 603 or equivalent

Continues on next page

7 Reference information

7.3 Screw joints

Continued

Water and air connectors

The following table specifies the recommended standard tightening torque for *water and air connectors* when *one or both* connectors are made of *brass*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Dimension	Tightening torque Nm - Nominal	Tightening torque Nm - Min.	Tightening torque Nm - Max.
1/8	12	8	15
1/4	15	10	20
3/8	20	15	25
1/2	40	30	50
3/4	70	55	90

7.4 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 robot weighs 610 kg. All lifting accessories used must be sized accordingly!	

7 Reference information

7.5 Standard tools

7.5 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	Rem.
1	Ring-open-end spanner 8-19 mm	
1	Socket head cap 5-17 mm	
1	Torx socket no: 20-60	
1	Box spanner set	
1	Torque wrench 10-100 Nm	
1	Torque wrench 75-400 Nm	
1	Ratchet head for torque wrench 1/2	
2	Hexagon-headed screw M10x100	
1	Hex bit socket head cap no. 14 socket 40 mm L=100 mm	
1	Hex bit socket head cap no. 14 socket 40 mm L=20 mm	To be shortened to 12 mm
1	Hex bit socket head cap no. 6 socket 40 mm L=145 mm	
1	Hex bit socket head cap no. 6 socket 40mm bit L=220 mm	

7.6 Special tools

General

All service instructions contain lists of tools required to perform the specified activity. The required tools are a sum of standard tools, defined in the section [Standard tools on page 350](#), and of special tools, listed directly in the instructions and also gathered in this section.

Calibration equipment, Calibration Pendulum

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

The robot is calibrated by either Calibration Pendulum or Axis Calibration at factory. Always use the same calibration method as used at the factory.

Information about valid calibration method is found on the calibration label or in the calibration menu on the FlexPendant.

If no data is found related to standard calibration, Calibration Pendulum is used as default.

Description	Art. no.	Note
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual.

Calibration equipment, Axis Calibration

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

The robot is calibrated by either Calibration Pendulum or Axis Calibration at factory. Always use the same calibration method as used at the factory.

Information about valid calibration method is found on the calibration label or in the calibration menu on the FlexPendant.

If no data is found related to standard calibration, Calibration Pendulum is used as default.

Description	Art. no.	Note
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.

7 Reference information

7.7 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.

This implies that the instructions delivered with the lifting accessories should be stored for later reference.

8 Spare part lists

8.1 Spare part lists and illustrations

Location

Spare parts and exploded views are not included in the manual but delivered as a separate document on the documentation DVD.

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9 Circuit diagram

9.1 Circuit diagrams

Overview

The circuit diagrams are not included in this manual, but delivered as separate documents on the documentation DVD. See the article numbers in the tables below.

Controllers

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRC5</i>	<i>3HAC024480-011</i>
<i>Circuit diagram - IRC5 Compact</i>	<i>3HAC049406-003</i>
<i>Circuit diagram - IRC5 Panel Mounted Controller</i>	<i>3HAC026871-020</i>
<i>Circuit diagram - Euromap</i>	<i>3HAC024120-004</i>
<i>Circuit diagram - Spot welding cabinet</i>	<i>3HAC057185-001</i>

Robots

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRB 120</i>	<i>3HAC031408-003</i>
<i>Circuit diagram - IRB 140 type C</i>	<i>3HAC6816-3</i>
<i>Circuit diagram - IRB 260</i>	<i>3HAC025611-001</i>
<i>Circuit diagram - IRB 360</i>	<i>3HAC028647-009</i>
<i>Circuit diagram - IRB 460</i>	<i>3HAC036446-005</i>
<i>Circuit diagram - IRB 660</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 760</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 1200</i>	<i>3HAC046307-003</i>
<i>Circuit diagram - IRB 1410</i>	<i>3HAC2800-3</i>
<i>Circuit diagram - IRB 1600/1660</i>	<i>3HAC021351-003</i>
<i>Circuit diagram - IRB 1520</i>	<i>3HAC039498-007</i>
<i>Circuit diagram - IRB 2400</i>	<i>3HAC6670-3</i>
<i>Circuit diagram - IRB 2600</i>	<i>3HAC029570-007</i>
<i>Circuit diagram - IRB 4400/4450S</i>	<i>3HAC9821-1</i>
<i>Circuit diagram - IRB 4600</i>	<i>3HAC029038-003</i>
<i>Circuit diagram - IRB 6400RF</i>	<i>3HAC8935-1</i>
<i>Circuit diagram - IRB 6600 type A</i>	<i>3HAC13347-1 3HAC025744-001</i>
<i>Circuit diagram - IRB 6600 type B</i>	<i>3HAC13347-1 3HAC025744-001</i>
<i>Circuit diagram - IRB 6620</i>	<i>3HAC025090-001</i>

Continues on next page

9 Circuit diagram

9.1 Circuit diagrams

Continued

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRB 6620 / IRB 6620LX</i>	<i>3HAC025090-001</i>
<i>Circuit diagram - IRB 6640</i>	<i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6650S</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6660</i>	<i>3HAC025744-001</i> <i>3HAC029940-001</i>
<i>Circuit diagram - IRB 6700</i>	<i>3HAC043446-005</i>
<i>Circuit diagram - IRB 7600</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 14000</i>	<i>3HAC050778-003</i>
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